RALPH LAINSON
21 February 1927 — 5 May 2015
Ralph Lainson was a distinguished protozoologist and a parasitologist of many abilities. Above all, he was a naturalist, as reflected both by his approach to work and by his two principal hobbies, fishing and collecting butterflies. Besides this, he had a strong artistic streak, expressed by his love of playing the trombone and painting. Many of his published works are exquisitely illustrated with his own watercolour and pen and ink drawings. These talents are present throughout his scientific career. He was a ‘traditional protozoologist’, who wanted to find out how parasites were transmitted and related to each other. Although many of the organisms he discovered were associated with a disease, Ralph openly admitted that his ultimate interest would always be the parasite. His research methods were simple, but he would readily embrace a technology if it solved his problem. He admitted to not being good with equipment. As an example, he mentioned an aptitude test used by the British Army: to put together a dismantled bicycle tyre pump—for him this was an impossible task! This shows his ability to use such tales to get others to do tasks he preferred not to, as they distracted him. His self-control was remarkable; in the 30 years that we worked together, I cannot remember a single instance of him raising his voice to anybody. He was extremely dedicated to whatever he did, be it work, hobbies or play. His stories at the dinner table or around a campfire, when out in the field, were a source of joy that reflected his good nature.
Biographical Memoirs

EARLY LIFE

What leads you to take up a profession? From our conversations, I feel strongly that Ralph’s childhood roots in the English countryside were important in him choosing a career in biology. He was born on 21 February 1927 in Upper Beeding, a small village in West Sussex situated on the headwaters of the river Ouse, not far from its source. His father was Charles Henry Lainson and his mother was Ann, née Denyer. He went to the village’s primary school and at the age of 11 moved to Steyning Grammar School, established in 1614; it was close to his home, more or less a 35-minute walk or 10 minutes by bus—even less by bicycle.

Ralph was lucky not being evacuated during World War II, as many were, and so spent those important formative years at home. His father took him fishing in the rivers close to where they lived and at Shoreham-by-Sea. They prepared their catches for eating, and gutting them revealed some strange worm-like creatures that were obviously not part of the fish. These were the first parasites that Ralph saw (Watts 2015), but he never worked on helminths—I suspect he may not have found them attractive enough. I say this because, while being interviewed at an event for the seventy-fifth anniversary of the death of Sir Henry Wellcome FRS, he said, referring, of course, to protozoa: ‘What I love about my work is the opportunity to discover and enjoy the extraordinary beauty of structure and complicated life cycles of these little organisms. It’s not work, more of a very interesting hobby, and these parasites are rather beautiful little creatures’ (Looi 2011). During field trips in the Amazon we sometimes came across myriads of butterflies feeding in damp patches along the edges of streams or at river crossings. He said they reminded him of the flocks of Chalkhill blue he used to see on the South Downs, of which he spoke fondly.

Ralph never mentioned his mother, who passed away in 1980. On the other hand, he always spoke warmly of his father, to whom he was very attached; Charles died in 1977. Ralph’s son, Stephen, an electrical engineer, told me that Ralph referred to Charles as Pop and that he was Pops to the grandchildren. Charles Lainson was a chemist who worked in Hove for Associated Portland Cement, known today by the brand name Blue Circle Cement. He was involved in developments of fast-setting concrete that proved to be extremely important during the war. Ralph believed his father never received the recognition he deserved. He told me this story on more than one occasion, especially after a few whiskies or caipirinhas. I wonder if this led him to subconsciously choose a career where he would be master of his own destiny and discoveries.

After gaining his school certificate in 1945, at the age of 18, Ralph enlisted in the British Army (Whitworth 2015). As a teenager, an accident with a pair of scissors had resulted in him losing the sight of his right eye. He implied that is why he became a physical training instructor in the army. Most people love to tell stories about their escapades in the armed forces, but Ralph never spoke to me about those years, which was strange as we talked and confided on almost every subject. This period of his life endowed him with an enviable level of physical fitness, well suited for strenuous field work and making it difficult to keep up with him on long treks. He was also much disciplined in his activities, especially those related to work. This may have reflected a natural characteristic, but I also sensed a military influence behind it.

After leaving the army in 1947, he returned to his childhood surroundings and enrolled for a biology degree at the Brighton School of Technology, which subsequently merged with other institutions to become the University of Brighton. The school did not have its own
degrees, so Ralph was registered as an external student for a Bachelor of Science degree of London University, his special subject being entomology. He mentioned that one of the reasons he gained his BSc was because of the amazing enthusiasm of the course’s teacher; I was surprised that he never named a parasite after her. John Robin Baker (Molyneux 2013) took the same course, and they graduated together in 1951, when—I assume—their friendship began. They both became doctoral students of Percy Cyril Claude Garnham (FRS 1964) at the London School of Hygiene and Tropical Medicine (LSHTM) in 1952 (9)*. For me it was an amazing coincidence that they ended up doing their PhDs together. John became a highly respected parasitologist famous for his studies on bird and bat trypanosomes and for his brilliant editorial skills. He worked in Africa but returned to the school, where he played a pivotal role in the electron microscope studies of the malaria parasite’s sexual stages. Ralph continued at the LSHTM until 1959, when he left for Central America. This was where his long-lasting fascination and passion for neotropical parasitic protozoa began.

**Career**

*Great Britain: the London School of Hygiene and Tropical Medicine 1952–1959*

Ralph’s research career began in the Parasitology Department studying the life cycle of *Toxoplasma gondii*. At the time the school’s major animal facilities were at the Winches Farm field station in St Albans, which is where he did his experimental work. He commented that there was a very relaxed and happy community spirit among the working staff and students.

His first publication on a microsporidian he discovered in the brain of a laboratory rat, known as *Encephalitazoon*, came out in 1954 (1). It is a common parasite of rabbits, and has been associated with clinical symptoms in immunodepressed people. Between 1952 and 1960 he authored and co-authored 33 papers, eight of which were on *Toxoplasma*. *Toxoplasma* is a parasite that causes serious health problems. At the time, the challenge was to determine its life cycle, an extremely difficult task since nobody had any idea of its taxonomic position. This only became known at the end of the 1960s, long after Ralph had finished his thesis. He studied its cystic stages, found in mouse brains, and its oral transmission. Subsequently, such infections have been shown to alter the behaviour of infected hosts.

During these student days Ralph forged a lasting friendship with Robert (Bob) Killick-Kendrick (10). Bob had joined the school as a junior technician in 1949 and helped Ralph collect material from dogs that were put down at the Battersea Dogs’ home. The idea was to verify their importance as sources of toxoplasmosis, but disappointingly it turned out they were not. Ralph was awarded his PhD in 1955, at which time he became a junior lecturer at LSHTM.

These formative years moulded his career. He gained experience working with practically every major parasitic protozoan group, from microsporidians, to trypanosomatids, to apicomplexans, such as malaria and coccidia. At the same time, he was introduced to a whole range of natural hosts, ranging from birds to monkeys. His collaboration in Garnham’s study (2), to find *Plasmodium ovale*’s pre-erythrocytic stage, involved risks. What was needed was an infection, in a volunteer, with large numbers of gametocytes, which are the female and

* References in this form refer to the bibliography at the end of the text.
male sexual stages equivalent to the eggs and sperm in higher animals. In mosquitoes this would result in heavy infections with large numbers of sporozoites (the infective offspring of the sexual stages), which are inoculated when the mosquito feeds. This strategy greatly increases the chances of finding the asexual reproductive stages known as pre-erythrocytic schizonts that occur in the liver prior to the typical forms found in the blood. The downside was that this volunteer would suffer a liver biopsy. Ralph received Garnham’s infected blood and had a persistent fever for three weeks but few gametocytes. His blood was passed on to another volunteer, and so on until an infection with large numbers of gametocytes was obtained. The whole experiment began in June and ended in October 1953, when William Cooper, Garnham’s chief technician, who had been bitten by heavily infected mosquitoes, was submitted to a liver biopsy. Mr Cooper, as he was known (Garnham 1964), processed his own biopsy and found pre-erythrocytic schizonts. Ralph had now added Homo sapiens to his list of experimental animals!

His first adventures into avian parasitology took place at Winches Farm in the 1950s when he attempted to untangle the life cycle of a haemosporidian of the English sparrow (Passer domesticus domesticus). Initially he thought that it belonged to the genus Atoxoplasma. However, because of endogenous gametogony (the production of the sexual stages in internal tissues) and vectorial transmission, he regarded it as being a Lankesterella species. These findings also led him to consider Atoxoplasma as a junior synonym of Lankesterella. Subsequently he named the sparrow parasite Lankesterella garnhami, one from the English rook as Lankesterella corvi and one from a canary as Lankesterella serini. Unwittingly he had entered into a taxonomic minefield.

In 1970 Edith Box failed to repeat Ralph’s transmission (3) of the sparrow parasite to canaries (Box 1970). She showed that the blood forms belonged to an intestinal Isospora species. Unfortunately, nobody paid attention to a note Ralph had added in the proof: ‘a number of naturally infected canaries have been found. Superficially this would appear to invalidate the experimental transmission.’ Recent molecular studies (Schrenzel et al. 2005) showed that parasites from passerine birds classified as belonging to the genus Atoxoplasma fell within a group of avian Isospora; however, this genus is artificial. Extraintestinal stages of these parasites can result in morbidity and death in young or stressed birds, a condition known as atoxoplasmosis. Extraintestinal merogony (asexual reproduction of merozoites) is common, but gamogeny (production of sexual forms) is rare, and has only been reported on three occasions. It is considered as an aberrant character. Both Lankesterella and Atoxoplasma parasitize blood cells, but the former are parasites of amphibians and reptiles, where gamogeny is endogenous, while the latter are parasites of birds and gamogeny is intestinal. So, either Ralph had observed a rare event when he saw extraintestinal gamogeny in sparrows and rooks or he had indeed found Lankesterella in birds. Support for the latter comes from a recent paper (Megía-Palma et al. 2016), which found that a parasite of birds was phylogenetically closest to Lankesterella minima from a frog. Today Lankesterella and Atoxoplasma are considered as valid genera. Life cycle details and host preferences have been used extensively in haemosporidian taxonomy. They have proved to be generally robust, but they fail where convergent evolution has occurred. This is perhaps the case with some Lankesterellidae, and their resolution requires molecular studies.

Ralph’s fascination with parasites of cold-blooded vertebrates also began at Winches Farm, when he rediscovered Eimeria raillieti in the faeces of slow worms (Anguis fragilis). The parasite was described by Leger in 1899 and the only other reference to a similar one was
Ralph describes the different stages of its life cycle in great detail, illustrating them with his own beautiful pen and ink drawings. The paper is a textbook on ‘how to describe a coccidian life cycle’.

Ralph’s time at LSHTM was drawing to an end. In 1957 Dr Raymond Lewthwaite CMG OBE, director of Colonial Medical Research, asked Garnham if he would be willing to go to British Honduras (now Belize) to investigate cutaneous leishmaniasis, known as bay-sore. Garnham accepted and asked Dr David Lewis, a world authority on sand flies, to accompany him. The two months that they spent there at the beginning of 1958 were extremely productive (Garnham & Lewis 1959). This opened the path to a better understanding of Chiclero’s ulcer, the other name by which the disease is known. Garnham concluded that in-depth studies were needed over a longer period. Based on this opinion, Lewthwaite agreed that a research unit should be set up in British Honduras to study the disease. The name chosen was the Dermal Leishmaniasis Unit. Garnham told Ralph ‘you can’t learn anything about tropical medicine in London, you’ve got to go to the tropics’. It was Hobson’s choice; the scene was set for the next chapter of Ralph’s life.

Central America: British Honduras (Belize) 1959–1962

In 1959 Ralph and his first wife Anne (née Russell) left for British Honduras (BH) to set up the Dermal Leishmaniasis Unit, which was located at the Central Farm agricultural research station located at Baking Pot, El Cayo District. Ralph became its director under the umbrella of the BH Medical Services, which took care of administering the unit’s local staff and supplies. John Strangways-Dixon, an entomologist, was allotted to the unit by the Department of Technical Cooperation. During the first year, besides setting up their home, Anne assisted with looking after the wild animals, establishing hamster, mice, rat, guinea pig and gerbil colonies and helping with the bay-sore patients, some of whom were staff members. Their eldest daughter, Karen, who inherited Ralph’s artistic abilities and is today a respected ceramics artist, was born in August 1961, just before Hurricane Hattie struck land on 31 October, destroying the city of Belize and much of the forest. Thankfully, inland Baking Pot did not experience the hurricane’s full fury.

Initial work focused on patients with bay-sore. Since they were being infected in the forest, it was obvious that the source must be wild animals. Characterizing samples from these cases in culture and in mice and hamsters was an essential step to be able to say if an isolate from a sylvatic mammal was the same. At the time, the taxonomy of American Leishmania was in its infancy and Ralph’s preliminary note published in the British Medical Journal refers to the parasite as Leishmania brasiliensis. Biagi considered the parasite to be a new subspecies of Leishmania tropica, naming it L. t. mexicana (Biagi 1953). Based on its very distinctive pathology in hamsters, Garnham gave it a specific rank that was followed in all subsequent publications. The clinical studies confirmed that lesions develop predominantly on the ear. In chronic infections the pinna may become partly or almost completely destroyed. It was generally considered that transmission took place at night, but two patients were definitely infected during the daytime during short visits to the forest.

Armed with the epidemiological information culled from the patients, Ralph began his search for the reservoir(s) and vector(s). He examined any wild animal he could get his hands on. Parallel to this he attempted to experimentally infect a range of them with cultures of L. mexicana strains originating from patients. The only species that was susceptible was the cotton rat (Sigmodon hispidus), but he never encountered it naturally infected, probably
because it is not a typical forest animal. Until October 1961 he had not seen a natural leishmanial infection in any sylvatic mammal. He reasoned that perhaps he was looking at the wrong animals and so concluded that he needed to look at forest rodents that trappers did not bring. The only solution was to catch them himself.

Sometimes there is a good side to something bad, and in Ralph’s case Hurricane Hattie was exactly that. Time was running out, as 1962 was the last year of his tour and the general devastation caused by the high winds meant that the small rodent trapping that had just begun stopped abruptly. It seemed that all was lost. Traps were recovered and set in November. To his surprise and delight, catches were far greater than before, perhaps because of a shortage of natural food. Disappointingly, all cultures from the internal organs and blood of the rodents were negative. Then, as the bodies of four vesper-rats (Nyctomys sumichrasti) were being disposed of, a tiny swelling was noted at the base of the tail of one of them. A smear from it contained numerous intracellular amastigotes, the rounded form also known as Leishman–Donovan bodies. After this, similar skin lesions were found in other forest rats, but the cultures from their viscera and blood were all negative. He later published a series of four papers on other parasites he had discovered entitled ‘Parasitological studies in British Honduras’ (see supplementary material).

The reservoirs of bay-sore had finally been found, and he proved this by inoculating the vesper-rat strain into a volunteer, who happened to be Anne, his wife. In all, six volunteers were inoculated with parasites from human cases and rodents, a crucial step in validating isolates from animals as being the same as the bay-sore pathogen: *L. mexicana*. Ralph also became infected when a syringe full of culture forms flew into the air while trying to inoculate an armadillo. It fell like a dart on his thigh, resulting in a lump, but no lesion appeared.

Unfortunately, finding the vector was not so successful. There was little doubt that it would be phlebotomine sand flies, the proven vectors elsewhere. A pool of locally caught sand flies inoculated into a hamster produced a leishmanial lesion. The question remained as to the identity of the fly; of the nine phlebotomine species collected, one was *Phlebotomus apicalis* (=*Bichromomyia olmeca olmeca*), later shown to be the vector (4). However, the team did accomplish the first experimental transmission of bay-sore to humans. A female *Phlebotomus pessoanus* (=*Psychodopygus carrerai*) that had fed four days before on an infected hamster was allowed to feed on a volunteer. Seventeen days later a small papule appeared at the bite that was positive for parasites.

It was time to leave BH. A good friend, Bill (Robert Stow) Bray, who was also a volunteer in Garnham’s *P. ovale* experiments, had returned to the LSHTM in the early 1960s (Ashford & Baker 2008). He decided to investigate the immunology of leishmaniasis, which at the time was a relatively neglected area. Bill was happy with the technical side, but realized that he needed somebody with experience in handling the parasite. Ralph fitted the slot perfectly.

**Back to Great Britain: the London School of Hygiene and Tropical Medicine 1962–1965**

The immunology project was funded by the National Institutes of Health and the Atlanta Foundation. Bill and Ralph travelled extensively to gather *Leishmania* strains, and in 1963 Ralph visited South America. I mention this trip as it was the door that opened up Brazil to him. The year coincided with the seventh International Congress for Tropical Medicine and Malaria in Rio de Janeiro. Before going to the meeting, Ralph visited different institutes, including the Instituto Evandro Chagas (IEC) in Belém, Pará. There he met Ottis Rembert
Causey, the director of Rockefeller’s Belém Virus Laboratory. Ralph showed him photos of the BH rodent tail lesions. Ottis was impressed by their similarity to ones he had seen on the same kind of animals that were being monitored in a recapture programme for arboviruses. He promised to make smears from them. Time was short and Ralph had to continue his travels, but they met again at the Rio congress. Ottis’s smears were teeming with amastigotes. This discovery was fundamental in Ralph’s determination to work in Belém.

The laboratory studies progressed and those under Ralph’s wing were related to vaccination and cross-immunity. Mice and hamsters immunized with killed amastigotes plus Freund’s adjuvant, or those that had received a prophylactic chemical, were not protected. The other line of research involved investigating the cross-immunity between \textit{L. braziliensis} and \textit{L. mexicana} in rhesus monkeys (\textit{Macaca mulatta}). Two \textit{L. braziliensis} and one of Ralph’s \textit{L. mexicana} strains were used. Professor Saul Adler FRS said of their \textit{L. braziliensis} strain (L15) that ‘this parasite is antigenically indistinguishable from undoubted strains of \textit{L. braziliensis} from typical cases of espundia’ and insisted the two \textit{L. braziliensis} strains were ‘antigenically identical’ (4). However, subsequently in Brazil we showed that L15 was definitely not \textit{L. braziliensis}, but a species related to \textit{L. mexicana}. My conclusion is that Adler’s \textit{L. braziliensis} standard belonged to the \textit{mexicana} complex and that the two \textit{braziliensis} strains in Ralph and Bill’s paper (4) were in fact \textit{mexicana} parasites. So, it would seem that \textit{L. mexicana} had not protected against \textit{L. braziliensis}.

During this period in England Ralph continued writing up his BH work and resumed his studies on \textit{Encephalitazoon}, the parasite he had found nine years earlier. Both parasites produce cysts in the brains of mice, rats, rabbits and humans and both were taxonomic orphans as their relationship to other taxa was uncertain. He had noticed the presence of a vacuole and remarked in his PhD thesis that it was ‘reminiscent of the polar capsule of the Cnidosporidia’ (microsporidian). Electron micrographs showed structures that left no doubt that \textit{Encephalitazoon} was a microsporidian and that the cysts were a stage in the life cycle of a parasite described from rabbits in 1923 as \textit{Nosema cuniculi}. Today it is accepted that members of the genus \textit{Nosema} are fungal parasites of invertebrates and those of the genus \textit{Encephalitazoon} parasites of vertebrates, so the correct name for the parasite that Ralph worked on is presently \textit{Encephalitazoon cuniculi}. The importance of his work is that knowing which group the parasite belonged to helped in managing infections.

By that time, I had just recovered from cutaneous leishmaniasis I contracted in Panama. Knowing this, Ralph asked me if I would be interested in participating in a cross-immunity experiment. I accepted. The plan was to first confirm that we were immune to our own parasites and then exchange parasites. We showed that the Panamanian parasite (\textit{Leishmania (Viannia) panamensis}) protected against the BH one (\textit{L. (Leishmania) mexicana}), but the inverse was not true (5). Although he never said anything, I imagine that this result was contrary to the one he expected, especially as it meant he had to spend some time in hospital. At this point we realized we had a common interest in this neglected disease and friendship followed.

Ralph admitted to me later that there was no doubt that more strains were needed for their immunological work, but for him the principal purpose of his 1963 South American trip was to find a place to work. His choice of the IEC in Belém, Brazil, came easily. I cannot say when he began to make his plans to go, but the first I knew about them was in February 1965 when he asked if I would like to join him. It was a very tempting and unexpected offer. There were many difficult personal and professional aspects to consider but finally I said ‘yes’. Garnham
suggested that the Wellcome Trust might be interested in the project. An appointment was
arranged with Peter Williams (Watts 2014), the Trust’s newly appointed director. He listened
attentively to our justification, asking just a few questions. At the end, he said: ‘It’s a very
interesting project so please send me a short 2-page outline of your ideas.’ We both sensed
that he was sympathetic to what had been said and the justification that Ralph wrote was soon
in the post.

The trustees approved a three-year grant and insisted that we took a Portuguese course.
This we did and the results were sometimes disconcerting and hilarious. Having home help in
Brazil was very normal, so, on our arrival, in our broken Portuguese we said we would need
two raparigas (young women) to do housework. Our trusted friend Dr Miguel Azevedo’s (the
IEC’s acting director) face lit up. Smiling, he said ‘Really?’ and burst out laughing. Obviously,
we had made a gaffe, but what was it? Well, in Brazilian Portuguese rapariga refers to a
prostitute!

Plans were made to leave for Brazil, and it was decided that the best way to go would be
by sea. It would allow Ralph’s family and my own to relax in preparation for the challenges
that lay ahead, it would be easier to adjust to the time differences, and Beaver, Ralph’s lovely
Great Dane, would certainly have a better journey! So, on 22 September 1965 we set sail
from Southampton to Kingston, Jamaica, on a Fyffe’s banana boat. From there we made our
separate ways to Belém.

Back to Tropical America: Belém, Pará, Brazil 1965–2015

Leishmaniasis is a worldwide neglected disease. It is endemic in 92 countries, but the actual
number of people infected is unknown, running into millions. It is estimated that a quarter of
the world’s population live in areas where there is a risk of contracting either the cutaneous
form, which can be extremely disfiguring, or the visceral form, which is fatal if untreated.

When Ralph began studying the disease in BH, you could count on one hand the number
of known or suspected reservoirs and vectors in the Americas. Towards the end of his life
this number ran into double figures. He and his team in Brazil discovered many, but of equal
importance was the incentive for other researchers to do the same. When he started work
in Brazil it was considered that three species were responsible for the cutaneous disease
in the Americas. Today at least 15 species are known to be involved. Some belong to
other genera of the Leishmaniinae subfamily and it is arguable that we should now use the
name leishmaniinaes instead of leishmaniases to reflect this hither to unsuspected pathogen
diversity. Understanding this is essential in developing drugs, diagnostic methods, vaccines
and especially control protocols. It is sometimes forgotten that, as animals are the source of
infection, these diseases can never be eliminated.

Ralph’s review (7) of the Wellcome Parasitology Unit’s 21 years contains many important
personal comments, and he admitted that to do it ‘in these few pages is no mean task’.
Compared with that, covering his 50 years in Belém is a truly daunting assignment. The focus
of the following text is to expand on previously published accounts ((8); Shaw 2016, 2019),
and it includes key historical events that moulded the Brazilian society and ended up affecting
Ralph’s daily life.

Ralph, Anne and their three children, Karen and the twins, Amanda and Stephen, who were
born in 1964, and of course Beaver arrived in Belém in October 1965. Dr Miguel Azevedo
helped them find a house and furnishings. Obtaining the latter was not easy because of a
limited budget and not knowing how long they would be in Brazil. Miguel suggested that
good quality furniture was much cheaper at local auctions. Besides acquiring the much-needed
furniture, Ralph rapidly learnt to count in Portuguese during the bidding process!

Whenever needed, Belém’s small British expatriate community immediately came to our
rescue, especially John (Jack) Payne Woodall (Burki 2017) and his wife Louise, who knew
everybody. Jack was the Rockefeller’s Belém Virus Laboratory’s director and generously lent
basic laboratory sundries on the understanding that they would be returned in kind in the
future.

In 1964 the Brazilian Armed Forces overthrew the civilian government. At this time Ralph
was so busy preparing to go to Brazil that he was completely unaware of the coup d'état.
Gradually he heard that there had been a ‘revolution’ and was told not to worry. His focus was
on science not politics, and he worked under the military regime with no difficulties, guided
carefully by Miguel, whose only interest was the well-being of his institute. The military
dictatorship ended in 1985, but its economic policies provoked periodic shortages of many
commodities accompanied by hyperinflation that only ended in 1994. In 30 years, Brazil had
six different currencies! The distinction between them was the removal of a few zeros. Day-
to-day life under these conditions was really challenging, some days being worse and more
difficult than others.

Most of the first year was devoted to setting up and equipping laboratories, finding staff,
building animal houses, establishing a hamster colony and purchasing field vehicles. But under
what name could the equipment and vehicles be purchased? The only legal solution was to
create a non-governmental organization, the Wellcome Parasitology Unit. The unit might not
have gained its name so quickly if it had not been for Brazilian bureaucratic requisites.

Anne was extremely busy coping with the family, so did not assist in setting up things
as she had in BH. Work began, in collaboration with the virus laboratory’s field team, on
the rodent leishmaniasis that Ottis Causey had found in the Utinga Forest, nowadays a State
Park. During the first two years, strains were isolated from patients, and the rodent parasite’s
enzootic cycle, including its vector, was uncovered. A request was made for an extension, and
the Trust approved a further two years.

It is important to emphasize that Ralph was a hands-on scientist. As a student he learnt
the art of fixing and staining tissues from Mr Cooper. If a routine slide was not up to his
high standard, he would either gather new material or attempt to re-stain it himself. Also, if
the samples were from an important experiment, he would not delegate their collection and
subsequent processing. His perception down the microscope was exceptional and it was a
joke, mixed with admiration, that he saw more with one eye than most of us did with two. To
which he would reply, ‘the other eye is a distraction’.

At the time, specialists asked: ‘Do American lizards have Leishmania?’ Many of these
animals were obtained and examined to try to answer this question. Ralph’s focus on all
parasites led him to discover new groups of apicomplexans in these cold-blooded vertebrates,
but no Leishmania infections were found. Ralph never made any excuses for studying protozoa
not directly related to leishmaniasis. However, I know that at times he was concerned how
the Trust would view his parasitological excursions, but this did not deter him. In a 2012
interview (Soares 2012), when asked about the difficulties of finding funds to study organisms
of no apparent medical or veterinarian importance, he said: ‘An applicant for a grant therefore
usually needs to entitle his or her project in a manner to overcome this problem, just as I did
with the official title of “Ecology and epidemiology of leishmaniasis in the Amazon region of
Brazil”. This is the “bread and butter” title, but usually it is possible to find some time to study
other parasites . . . ’ But for him it was all part of the same picture. Gradually, outside interest in his discoveries grew, as did the list of new species (see Appendix I of the supplementary material) and respected friends, many of whom collaborated with him and some made it to Belém.

The first discovery of a new apicomplexan took place in April 1967, when he saw gametocytes in blood cells of the teiid lizard *Tupinambus nigropunctatus*. There was no evidence of malaria pigment nor schizogonic stages that are the asexual reproductive forms found in the erythrocyte characterized by multiple division. Was it a new *Leucocytozoon* species? However, as these are all bird parasites, a new genus, *Saurocytozoon*, was created for this haemosporidian. Subsequently other workers found members of this genus in Asian saurians. The renowned French protozoologist Irène Landau, of the Muséum National d’Histoire Naturelle in Paris, shared Ralph’s fascination for the beauty and biological complexity of the apicomplexans. In the 1970s, together with Odile Bain (Martin 2013), she visited Belém. They experimentally transmitted the teiid *Saurocytozoon tupinambi* and later discovered another one in the skink, which they named *Saurocytozoon mabuyi*. There was a mutual respect and admiration between them that led to a special friendship. Subsequently Irène created the Lankesterellidae genus *Lainsonia* after Ralph. Together they then discovered a new species of this genus, which they named *Lainsonia legeri*. But this was just the beginning.

Ralph went on to discover a new apicomplexan family he named after Professor Garnham. The Garnidae are saurian haemosporidia whose life cycle follows that of the malaria parasites, but they do not have malarial pigment. Within this family he created two genera, *Garnia* and *Fallisia*. The former undergoes schizogony and gametogony in red cells, while in the latter these two processes occur in thrombocytes.

In 1968 we received an invitation from the Royal Society and the Royal Geographical Society to join their Xavantina–Cachimbo Expedition (Smith et al. 1971). Ralph immediately saw it as an opportunity to collect material in another region of Amazonia and readily accepted. We arrived at the base camp in June 1968. Neither of us had been so cold since leaving England. Temperatures at night dropped below 10°C and in hammocks we felt as if it was below zero. The only thing that helped was trying to line them with old newspapers, but it was still so cold that we had to sleep fully clothed.

Unhappily, the isolates from local rodents and cutaneous leishmaniasis patients were biologically quite different. Although it was extremely disappointing not to have found the reservoir of the human disease, it set the scene for major advances in the taxonomy of the *Leishmania*. Comparisons of isolates from other sources confirmed that very diverse parasites were infecting humans. This challenged the view held by Brazilian clinicians in 1965 that *Leishmania braziliensis* was the only form responsible for all cases of cutaneous leishmaniasis, the disease outcomes being attributable to particular immunological responses of the patient. In part this is true, but some clinical features are specific to the particular *Leishmania* species involved.

There were many other trips to indigenous tribes, mines and engineering projects to either gather material or offer advice on outbreaks of cutaneous leishmaniasis. One of the most memorable was the request from the United States Steel Company’s Brazilian subsidiary, Meridional de Mineração, to visit Serra das Carajás, the site they were prospecting, which turned out to be the world’s biggest deposit of high-grade iron ore. They were alarmed because practically all their workers were contracting leishmaniasis, including the cooks. The only way
to get there in 1968 was in a twin-engine cargo plane that landed on top of a cloud-covered mountain. The wreckage at the beginning of the runway acknowledged that not all of them landed safely.

Visiting their surveying teams’ field camps on one or two nights soon revealed the problem. While they ate their supper and prepared to sleep the men were being bitten by sand flies. The commonest one not only was a new species, but also proved to be the disease’s vector; it was named Psychodopygus wellcomei in honour of Sir Henry Wellcome. The company asked us to prepare a document outlining how to avoid some of the region’s commonest health problems that their work force would be subjected to. One of our recommendations was not to allow dogs in the mining area. This was because many workers came from Minas Gerais, where visceral leishmaniasis is endemic. Bringing their dogs posed the risk of introducing this disease into the mining area. To this day dogs are not allowed and no visceral leishmaniasis cases are reported there. However, the disease is now endemic in the surrounding countryside.

Identifying phlebotomine sand flies is a difficult task, especially when dealing with the large number of species found in Amazonia. However, understanding the biology of an individual species is a critical step in defining the disease’s epidemiology. Dr David Lewis, who had accompanied Garnham to BH, helped us enormously in the beginning, but he emphasized that the magnitude of the problem demanded full time biologists. The Institute’s Dr Habib Fraiha Neto took care of the sand fly identifications, but Ralph realized he needed a person to deal with their biology and establish sand fly colonies for experimental studies. So, he requested the Trust’s support for somebody to cover these two areas. In 1970 Richard (Douglas) Ward arrived in Belém together with his wife Mary. Richard was the first of our three expatriate entomologists, the others being Paul Ready and Lee Ryan. All were carefully chosen. Their contributions proved fundamental to Ralph’s research road map. For the first time we managed to experimentally transmit the parasite responsible for visceral leishmaniasis by the bite of its vector Lutzomyia longipalpis. His satisfaction at this accomplishment was enormous and it led to L. longipalpis becoming an internationally important research tool. New sand fly species were discovered, described and named, and some were important leishmaniasis vectors.

Leishmanial species’ names and groups were periodically revised in different publications. In 1979 the different patterns of development in the sand fly were given names hypopylaria, peripyarian and suprapyalaria (6). In 1980 our team was joined by a clinician, Fernando Tobias Silveira, who advanced clinical studies. Finally, in 1987 we published our major taxonomic revision of the genus Leishmania based principally on behaviour in sand flies, creating the subgenus Leishmania (Viannia) for a clade found exclusively in the Americas (7). In spite of it being based on nearly 20 years’ work, some at the time upsettingly said it was ‘precipitous’. However, it gained support and was subsequently confirmed by others in many publications. Work on leishmaniasis led to the naming and discovery of 10 new species, one of which is now classified in the relatively new genus Porcisia (Espinosa et al. 2018). Some species were found in wild mammals before humans, and I strongly believe this facilitated their subsequent identification in patients.

In collaboration with Ralph’s second wife, Zéa Constante Lins-Lainson (Pinheiro 2016), an infection of a visceral leishmanial parasite was found in a fox captured close to Belém. The immediate question for Ralph was how important were these animals in visceral leishmaniasis’ epidemiology? He realized the need for somebody who understood their biology and contacted Oxford’s zoologist David Whyte Macdonald, an expert in studying sylvatic mammal behaviour. The focus was to see how closely foxes interacted with dwellings
where the disease was endemic. Using tracking devices, along with Orin Courtenay they found these animals frequently visited houses at night. In collaboration with Christopher Dye (FRS 2012) the work expanded to canine visceral leishmaniasis (CVL). There was some disagreement as to the conclusions, but Ralph kept his view that the parasite circulating in foxes would maintain the infection even if CVL was eliminated.

Besides leishmaniasis, Ralph’s team made landmark contributions to Chagas disease. In 1968 *Trypanosoma (Schizotrypanum) cruzi* trypomastigotes were seen in the blood smears of a febrile young man suspected of having malaria. He died, but it was discovered that his mother and two sisters were also infected. These were the first parasitologically proven cases of Chagas disease in Amazonia. Epidemiological studies failed to find triatomine bugs in their home, so it was concluded that they must have become infected by eating or drinking some contaminated food. Today the most common method of Chagas disease transmission in Brazil is, again, *per os*.

Michael Miles was working on Chagas disease in Bahia funded by the Wellcome Trust. Ralph was consulted and agreed to him joining the Belém team on the condition that he set the enzyme electrophoresis identification method up; this gave Belém in-house biochemical methods to identify trypanosomatids. It led to the discovery that different clades of *T. (S.) cruzi* infect humans and display different epidemiologies, and, importantly, it facilitated the identification and naming of *Leishmania* species. Other animal trypanosomes also found were described. The finding of *Trypanosoma (Duttonella) vivax* in water buffaloes was of notable
economic importance; infected animals eat normally, but fail to put on weight. This was the first publication of the pathogen in Brazil. Subsequently it was found in cattle elsewhere.

During his life in Belém, Ralph hosted many friends, fellow scientists and illustrious visitors (Shaw 2016), but I felt that the very special one for him was Cyril Garnham’s visit in 1969. He stayed with Ralph, and during the first days he was unwell—perhaps it was the strain of the journey combined with the humid heat. Ralph was extremely worried and said to me he had nightmares of the headlines ‘World famous parasitologist dies in Belém’. Thankfully within a few days he was recovered and fit for the field trip (figure 1) to find a haemosporidian of bats. It was a success and Garnham returned home safely with the slides of a new parasite, *Polychromophilus deanei*, much to Ralph’s satisfaction and relief.

Ralph officially retired in 1992, but continued his studies on the apicomplexans funded by a Wellcome Trust veterinary grant. In 2008 the Parasitology Department’s leishmaniasis laboratory moved to the IEC’s Gilberta Bensabath campus in Ananindeua. Ralph decided not to move the coccidial laboratory with them, saying it was—indeed—too far away. The following year his trusted technician and friend, Constância Maia Franco, died. Ralph mentioned how devastated he was by her loss, and after that only published one apicomplexan paper. He was very supportive of the IEC’s *Revista Pan-Amazônica de Saúde* and was present at its inauguration in 2010 (figure 2). He dedicated his final years to writing his three-volume
Atlas of protozoan parasites of the Amazonian fauna of Brazil, which he said was aimed at students.

Ralph was a very stalwart character and spoke little of his private life during all the years that I knew him. Only by chance would I learn something special had happened, be it good or bad. Ralph introduced many to the joys and fascination of tropical biology and parasitology. I believe one of his great legacies is to never forget the importance of animals as sources of human disease—a message so eloquently expressed in the leishmaniasis studies and so pertinent today with the appearance of new pathogens. His vision changed lives and opened up broad areas of science for future generations. These gifts that he left us are a reflection of the pure enjoyment and satisfaction these little creatures magically endowed this very special discoverer’s world.

AWARDS AND HONOURS

1971 The Chalmers Medal, Royal Society of Tropical Medicine and Hygiene, London
1973 Oswaldo Cruz Medal, Conselho Estadual de Cultura do Pará, Brazil
1982 Fellow, Royal Society, London
Honorary Fellow, London School of Hygiene and Tropical Medicine
Doutor Honoris Causa, Federal University of Pará, Belém, Brazil
1983 Commemorative Medal, tenth Aniversário de Instalação do Conselho Estadual de Saúde do Pará, Brazil
The Manson Medal, Royal Society of Tropical Medicine and Hygiene, London
1984 Honorary Member, British Society for Parasitology, London
1987 Commemorative Medal, Trigésimo Aniversário de Criação da Universidade Federal do Pará, Brazil
1989 Associate Fellow, Third World Academy of Sciences (TWAS), Trieste, Italy
1996 Order of the British Empire (OBE), London
Honorary Fellow, Royal Society of Tropical Medicine and Hygiene, London
1997 Honorary Member, Society of Protozoologists, Chicago, USA
2009 Honorary International Fellow, American Society of Tropical Medicine and Hygiene, Arlington, USA

SUPPLEMENTARY MATERIAL

Appendix 1 provides a list of taxa described by Ralph Lainson and colleagues and can be found at http://dx.doi.org/10.1098/rsbm.2020.0032.

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The frontispiece photograph was taken in 2002 by Prudence Cuming Associates and is © The Royal Society.
Author Profile

Professor Jeffrey Jon Shaw

Professor Jeffrey Jon Shaw gained his PhD in 1964 at the London School of Hygiene and Tropical Medicine, the last PhD student of Professor Percy Cyril Claude Garnham FRS, and his DSc in 1977. His thesis was on the biology of the trypanosomatids of sloths, which involved field work in Central America. He went to Brazil in 1965 with Ralph Lainson and they worked together for 30 years at the Evandro Chagas Institute in Belém, Pará, Brazil. He retired from his Wellcome Trust Research Fellowship at Cambridge in 1994 to take up a senior professorship at São Paulo University Biomedical Sciences Institute’s Parasitology Department, where he continues to work. His research focuses on the crucial importance of parasite genetic diversity, especially in neglected diseases such as leishmaniasis, and he has 394 publications. In 1999 he became an Officer of the Order of the British Empire (OBE), and he is a Fellow of the Brazilian Academy of Science and the Linnean Society and an Honorary International Fellow of the American Society of Hygiene and Tropical Medicine.

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