Nevertheless, his manner in controversy was restrained, and at times tinged with humour, often so applied as to soften the otherwise keen point of an argument. He leaves behind the memory of a gracious personality, to whom the Science of Botany owes a supreme debt, not only as a great observer but also as a safe guide to correct channels of thought. He made frequent visits to Great Britain, the last occasion being the International Botanical Congress at Cambridge in 1930. He was specially a persona grata among British botanists. Latterly his letters reflected some sense of disappointment that enthusiasm for Morphology was not more widely spread at the present time. "Nowadays small attention is bestowed on anything but Genetics and Experimental Physiology." True these not only touch the foundations of Morphology; they are themselves essential parts of that basis on which the building must rest. But they are not the building itself. He adds, however, in this letter written within a month of his accident, the hopeful words: "Aber die Zeit wird kommen." Surely the time should not be long, if a book such as von Goebel's "Organographie" runs into three editions.

F. O. B.


Ronald Ross was born at Almora in the Kumaon Hills, North-West Nepal, on May 13, 1857, three days after the outbreak of the great Indian Mutiny, when his father held the rank of Captain. His forebears for three generations had been linked with India.

His grandfather, Lieut.-Col. Hugh Ross, served in the Indian Army and died at Cawnpore in 1838, having married Eliza, a daughter of Major William Watson of the 35th Regiment by his wife Catherine Claye. Hugh and Eliza had six children: (1) Hugh, who died young, and is described as having been a brilliant student at Edinburgh; (2) Campbell, of whom more presently; (3) William Alexander, who became Lieut.-Col. in the Bengal Artillery; (4) Charles Edward, a physician; (5) Eliza Jane, who married Captain Barwell; (6) Adelaide Anne, married General John Tytler, V.C., who also served in India.

His father, General Sir Campbell Claye Ross, K.C.B., Bengal Staff Corps, joined the 68th Bengal Native Infantry (Gurkhas) as Ensign in 1841 at the age of eighteen. In 1856 he married Matilda Charlotte, daughter of Edward Merrick Elderton, a London lawyer, by his wife Matilda, daughter of Joseph Halford of Charlement Hall, Staffordshire. Sir Campbell died in 1892 and his wife in 1906, having had ten children of whom the eldest was Ronald.
At the age of eight, Ronald was sent back to England for his education. He records that a fondness for painting and music prevailed among members of both sides of his family, starting with his four grandparents, which accounts for his wish to be an artist when he was seventeen. However, following his father’s wish, he became a medical student, entering St. Bartholomew’s Hospital Medical School. He passed his M.R.C.S. and L.S.A. examinations in 1881, and in April entered the Madras Medical Service as Surgeon, sailing for Bombay after taking a course at Netley. Practically his whole time was spent in military work in the Indian Medical Service. He served in the Burma War (frontier medal and clasp) and the Andamans. In 1888 he returned for a year on his first leave and took the Diploma of Public Health then newly established, having studied bacteriology under Klein in London. Until fourteen years had elapsed after he had qualified there was no indication that he would distinguish himself one day in the field of medicine.

In 1892–93 he became interested in malaria, but not having seen the malaria parasite discovered by Laveran in 1880 was led astray, as evidenced by his earlier papers.

In 1894, he returned on his second leave to England and saw Kanthack who directed him to Manson. The latter showed him stained blood-films containing malaria parasites—the first Ross had seen—and Kanthack (he told this to the writer in May, 1898) showed Ross how to stain the parasites. Manson fired Ross’s ambition to solve the problem of the etiology of malaria on his return to India, having greatly impressed him with the probable truth of the “mosquito theory” of which Manson was an outstanding exponent.

Ross arrived in Bombay on April 21, 1895, and on the 24th, at Secunderabad, fell to work on the malaria problem whenever regimental duties permitted. In the second of many letters to Manson, he wrote: “The heat is awful and like the blast of an engine furnace.” Although Laveran had described the parasites fifteen years before (in 1880), their significance was not as yet appreciated in India and microscopic examination of the blood was not employed for diagnosis. Malaria patients were frightened, some thinking he was practising witchcraft, when he sought to prick their fingers with a needle to obtain drops of blood for examination. Owing to the dry heat prevailing (90°–100° F.), he had to work rapidly in spreading blood-films under coverglasses and sealing them on slides, and in dissecting mosquitoes in salt solution. He liberated the mosquitoes in a net covering the recumbent patient and captured them singly after they had sucked blood, so that he might dissect them. He found that the insects only fed when the net and bed were moistened. He did not use stains, but worked throughout on living parasites and freshly dissected insects. He had to discover how to handle, raise, and differentiate mosquitoes, how to dissect and study their internal organs, to determine if and how the malaria parasites developed in them. Working with malignant malaria parasites, he discovered
that at most 60% of the crescents (gametes) readily underwent what was called exflagellation in the midgut of particular mosquitoes. These insects had boat-shaped eggs, their larvae floated flat ("like sticks") beneath the surface film of water and the adults were dappled winged—they were unquestionably Anopheles. Exflagellation took place in ten to twenty minutes after the insects had imbibed malarial blood. (Ross then lost time on a fruitless attempt to determine if malaria in man might be waterborne through infected mosquitoes contaminating the water—one of several hypotheses that had been advanced.)

Early in September, 1895, Ross was ordered to Bangalore on special sanitary duty of importance which occupied him for eighteen months. This checked his malaria work. On May 27, 1896, he wrote to Manson: "the belief is growing on me that the disease is communicated by the mosquito (through its bite)." In July he noted that the "flagella" disappear from the mosquito's gut soon after they had been liberated.

On June 18, 1897, he arrived again at Secunderabad and resumed his malaria work. He hatched out various species of mosquitoes from larvae collected in the vicinity and allowed the adults to suck the blood of a patient with malignant malaria. As in his previous experiments, the replete female insects were each isolated in cotton-plugged tubes, but now he delayed their dissection until an interval of days had elapsed. On August 20, 1897 (commemorated afterwards by Ross as his "Mosquito Day"), he examined an Anopheles that had sucked blood containing crescents four days previously and found "pigmented cysts" (oöcysts of malaria parasites) in the insect's gut wall, the cysts containing the characteristic pigment. These cysts measured 12-16 microns in diameter. A second Anopheles, dissected on the fifth day, harboured larger cysts. Obviously the parasites had undergone further development in this mosquito. At last the goal was in sight. Working under trying conditions and at full pressure, without encouragement other than that derived from Manson's letters,* Ross now felt that in a short time he would certainly complete his study of the development of the human malaria parasite in the mosquito.

In the midst of further experiments, however, he was ordered away on September 26, 1897, to Kherwara in Rajputana on military service—a place over a thousand miles away, where there was no malaria and little of importance to do. The situation was exasperating.

It was not until February 17, 1898, that Ross was able to reach Calcutta and resume work on malaria. Manson had interceded with the Secretary of State for India on behalf of Ross and succeeded in having him set free for research during a limited period. In the meantime Ross had learnt from

* Manson's letters are referred to at length in Ross's "Memoirs," where he describes them as a "noble series such as few men have received." See also Manson's "Life and Work."
Manson of MacCallum’s investigations in Baltimore, Maryland (preliminary note of November 13, 1897), proving that the “flagella” (microgametes) of Halteridium of birds and the malignant parasites of man constitute the male elements and serve to impregnate the “pigmented spheres” or female elements. The impregnated element in Halteridium developed into a motile “vermicule” (oökinete) in blood removed from the infected bird to a microscopic slide. This discovery was of considerable help to Ross. Finding difficulty in obtaining human malaria cases, owing to the advent of the “healthy season,” Ross began to study malaria in caged sparrows and larks. The cages were covered with gauze to confine the mosquitoes which fed on the birds. Starting in March, he followed the development of Proteosoma (Plasmodium) in Culex fatigans that had fed on infected birds. He saw the “vermicules” develop in the lumen of the mosquito’s midgut and form cysts (oöcysts) in the gut wall, the cysts growing in size on successive days. When the cysts had attained a diameter of about 60 microns they burst, liberating their contained “germinal rods” (sporozoites) into the insect’s coelomic cavity, whence they entered the salivary gland cells and issued through the proboscis with the saliva when the infective mosquito bit. He made numerous positive infection experiments on birds by means of mosquitoes. These results constitute the classical demonstration of how malaria is conveyed.

The results of his work were announced by Manson on July 24, 1898, at the Edinburgh Meeting of the British Medical Association in the form of an abstract from Ross’s printed Report to the Director-General of the Indian Medical Service, bearing the date May 21, 1898, coupled with citations from letters and a telegram sent to Manson by Ross in time for the meeting. Owing to official difficulties in securing prompt publication of his work, Ross wrote a long series of letters to Manson (with accompanying diagrammatic figures and occasional specimens), keeping him constantly informed of the progress he was making. He did the same with Laveran and Nuttall, starting with the latter in August, 1898. By this means Ross’s work was made known as early as possible in Great Britain, France, Germany, and other countries.

Among the difficulties encountered by Ross at this period, was his having to go to Assam for the period September–October to report on kala-azar. Moreover, it being rumoured among the ignorant population that they were being inoculated with plague—actually anti-cholera and anti-plague inoculation was being practised—it was almost impossible to find malaria cases that would allow themselves to be pricked with a needle to obtain a blood drop or two for malaria work. Circumstances therefore compelled Ross to confine his work almost entirely to avian malaria. Another difficulty with which he had to contend was the attitude of others toward his work, “Mosquito Ross” was the subject of ridicule or indifference to some who deemed themselves wiser, and there was positive opposition to him at the hands of sundry medical men and
officials. Nevertheless, he persevered and conquered, but the responsibility for the delay in the progress of his work rests on those who scoffed and opposed. If Ross had been helped intelligently, he would have solved the problem sooner for the benefit of mankind. The form in which his work appeared was criticized by those familiar with the best technical methods employed in well-equipped laboratories, forgetting that the simplest methods combined by acute observation are frequently the best in solving the essentials of a problem. In this connection Wenyon may be quoted: “One is led to wonder whether Ross would have achieved so much had he been better trained in more orthodox methods of research. His want of special knowledge drove him to work out his own salvation and gave scope for that genius which he undoubtedly possessed.”

On February 22, 1899, Ross sailed from Calcutta and arrived in London about March 20. Early in April, he became Lecturer in Tropical Medicine at the Liverpool School of Tropical Medicine. On July 31, he retired from the Indian Medical Service as Major. In 1902–12 he was Professor of Tropical Medicine in the University of Liverpool, and in 1913 Professor of Tropical Sanitation. Whilst in Liverpool he organized and led expeditions to Sierra Leone (1899–1900), West Africa (1901–02), Mauritius (1907–08), Spain, Cyprus and Greece (1912), his chief concern being the prevention of malaria. He was Editor of the “Annals of Tropical Medicine” whilst in Liverpool. In 1912, he moved to London and became physician for tropical diseases at King’s College Hospital, whilst continuing to give an annual course of lectures at Liverpool and retaining his Chair for a period. He established himself but for a few years in Cavendish Square as a consultant in tropical diseases. He became a member of numerous medical committees and was Editor of “Science Progress.”

In 1908, he received a Commission as Major in the R.A.M.C., Territorial Force, became Lieut.-Col. in 1913, and Consulting Physician for tropical diseases to the Base Hospitals for Indian Troops in England in December, 1914. In 1915, he was sent to Alexandria to investigate dysentery prevailing in the Dardanelles. He became Consultant for Malaria to the War Office and in 1917 was sent to Salonika on a malaria survey. The ship he was on was torpedoed “in a landlocked bay close to the Leucadian Rock (where Sappho is supposed to have drowned herself)”—Ross gives a graphic account of the incident in his “Memoirs.” In 1918 he became Temporary Colonel in the R.A.M.C. and was demobilized in the same year. In 1925 he became Consultant in Malaria to the Ministry of Pensions.

Ronald Ross, like all men with decided opinions, had his share of enemies. His friend, Mr. John Masefield, the Poet Laureate, speaking at a memorial service, held at St. Martin-in-the-Fields on August 22, 1933, referred to Ross as “that forceful, vigorous personality, so full of eagerness and interest, with a resolute, pugnacious mind and fierce yet kindly intelligence.” This admirably
expresses the writer’s view of Ross, judged from personal relations extending
over thirty-four years, but he could offend others when “pugnacious.” Dr.
Carmichael Low wrote of Ross last year that “it was difficult for him to cope
with inanition and incompetence.” For this he could scarcely be blamed and
he certainly was “helpful to young men and appreciated the work of others,”
but the work had to be patently honest. Sir Malcolm Watson described Ross as
a “kindly and genial man, loved by those around him.” Undoubtedly he was
offensive at times in speech and writing through using expressions which might
have been omitted, but in judging him, his eighteen years of service in India,
with repeated setbacks, especially when doing his best to carry on his malaria
work, should be taken into account. Already in India, in urging on work that
he regarded as all important, he showed indifference to consequences which
hammed him and merely caused irritation.

The prolonged and bitter controversy with Grassi on questions of priority
of discovery in relation to mosquitoes and malaria, harmed both of them and
served no useful purpose. The fact that Ross received the Nobel Prize in
1902 and Grassi received no such recognition, may well be accepted in final
judgment of the case, notwithstanding what was written by Grassi as late as
1924 under the title “Twenty-five years after.” Ross’s pioneer work came as
a revelation and, as Wenyon justly pointed out, it was a relatively simple
matter to confirm Ross’s work in greater detail and with good technique.
Ross did the fundamental work that pointed the way when he showed how
avian malaria is transmitted and traced the first stages in the development of
human malaria parasites in Anopheles. Grassi and his colleagues showed that
the three species of human malaria parasites then known developed in a similar
manner in Anopheles to what Ross had observed with Proteosoma and they
were the first to infect men experimentally by means of infected mosquitoes’
bites. The work of the Italian investigators was of outstanding importance.
It was carried out with the best technique then known and was needed to
convince many zoologists that Ross’s observations were essentially correct.

Ross was a man of many parts. To repeat, as a youth of seventeen, he
wanted to be an artist. He was not interested in medicine. During his first
six years in India he gave most of his time to mathematics. In his last letter
from India when about to embark for home in 1899, he asked the writer “Can
you tell me whether Immunity has been ever studied mathematically?” In
1904–05, when he served as Examiner for the Diploma in Tropical Medicine
and Hygiene at Cambridge,* Ross, in the intervals of the examination, bought
mathematical books in the town. To quote Mr. Masefield again “He was an
extraordinary man, for he made himself famous as a poet, and was an eminent
mathematician, a clever painter, and a skilled musician.” He began writing

* This diploma was the first of the kind to be established. Manson, Ross and Nuttall
were examiners.
poems and plays as a lad. In 1883–1929, he published several plays, short
dramas, romances, fables, and numerous poems. These, his papers on mathe-
matics, various medical reports, and his papers dealing with his outstanding
work in relation to malaria, are mostly comprised in a list at the end of his
"Memoirs." The perusal of the "Memoirs," as Wenyon has rightly indicated,
affords a considerable insight of Ross's character when read between the lines.

During his long sojourn in India, Ross had seen much of the serious effects
of malaria on the population. Malaria affects more people, taking the world's
population as a whole, than any other disease. Whilst Ross was fascinated
by the scientific problem which Manson urged upon him to try and solve,
Ross's underlying motive which led him to undertake the task, was humani-
tarian, as he often assured his friends. As soon as he had incriminated Ano-
pheline mosquitoes as vectors, he promptly advocated, apart from further
research, preventive measures directed against them. Brilliant results followed
in certain places, notably in Ismailia in Egypt, the Federated Malay States,
in Havana and Panama (malaria and yellow fever), and such measures have
since been taken in many parts of the world.

The last occasion on which "Mosquito Day" was celebrated by a lunch,
the menu and attendance being Indian, was on August 20, 1931, at the Ross
Institute, and Hospital for Tropical Diseases. This institution was opened
on July 25, 1926, by H.R.H. The Prince of Wales. It was founded in honour
of Ronald Ross, who served as Director-in-Chief. The Institute was established
with the aid of funds collected in many parts of the world for the purpose of
honouring Ross.* In 1929, a Ross Award Fund was started, which closed in
1932 at £15,513—this fund materially added to Ross's peace of mind.

Ronald Ross died on September 16, 1932, at the Ross Institute after a long
illness. He lies buried beside his wife at Putney Hill Cemetery. By his
marriage in 1889 to Rosa, daughter of E. Bloxam, who died in 1931, he had two
sons and two daughters (Dorothy, Ronald, Charles and Sylvia).

G. H. F. N.

REFERENCES.


* Steps have recently been taken to secure an amalgamation of the Ross Institute with
the London School of Hygiene and Tropical Medicine, which it is hoped will be effective.
OTTO STAPF—1857–1933.

Otto Stapf was born on March 23, 1857, at Ischl, Austria, his father being Oberbergrat of the town. His boyhood was spent at Hallstatt, where his family moved about 1859, his father being in charge of the salt springs there which feed the famous baths at Ischl. His botanical studies were carried out at Vienna under Professor Wiesner, and in 1882, after he had obtained his Ph.D. degree, he became Assistant to Professor Kerner von Marilaun; he was appointed Privaldozent in the University in 1887.

Early in his botanical career, he turned his attention to the Botany of the Near East, maintaining his interest in this subject all his life, and he edited the botanical results of the Polak Expedition to Persia (1882) and elaborated most of the families. The account was published by the Royal Academy of Sciences of Vienna in 1885 and 1886.

He also worked out the plants collected by Dr. F. Luschac in Lycia and Mesopotamia in 1881–83. With this equipment he was well prepared to make a botanical journey to Persia himself in 1885, and his sketch of the vegetation of South and Central Persia is a valuable contribution to knowledge. The plants he collected on this expedition, amounting to 1100 species, were subsequently acquired by Kew in 1891.

On his return to Vienna, Stapf commenced his critical studies of the genus Ephedra, and his Monograph, which is characteristically careful and thorough in all its details, so typical of all his work, was published in 1889. The preparation of this Monograph not only caused Stapf to visit the principal European Herbaria, but also brought him in touch with Kew, and early in 1890, when sending Sir Joseph Hooker a copy of his Monograph, he expressed his desire to leave Vienna, since he was not wholly satisfied with his position there. Fortunately for the progress of Systematic Botany in this country, Sir William Thistleton-Dyer was able to offer Stapf the post of Assistant for India in the Kew Herbarium, vacant by the promotion of W. B. Hemsley; he reached England in November, 1890, and commenced his work at Kew in January,