Robert Koch: pioneer of bacteriology and Nobel prize winner

As a schoolboy I avidly read Paul de Kruif's (1926) *Microbe Hunters*. Robert Koch became my hero and I determined to become a doctor and to train as a bacteriologist. (Incidentally, my great disappointment was to find how boring the subject was, as taught at Oxford in those days. I rapidly changed my mind and decided to become a surgeon!) My school-boy role model died 100 years ago, in 1910.

Robert Koch was born in 1843 in the little town of Clausthal, in the Harz mountains of Germany. His father was a mining engineer. In 1862, young Robert entered the medical school of Göttingen, where he was strongly influenced by Jacob Henie, the Professor of Anatomy, who postulated that infectious diseases were caused by living organisms. Qualifying in 1866, Koch spent 6 months in Berlin, where one of his teachers was the great pathologist Rudolph Virchow. By now married, Koch settled down to the mundane life of a GP and district medical officer in Wollstein, in Prussian Poland, with an interlude serving as a medical officer in the Franco-Prussian War of 1870–1.

As a pastime, Koch set up a laboratory in a spare room in his home. The most important piece of equipment he possessed was a microscope, a gift from his wife. He purchased a microtome and built himself an autoclave. Anthrax was endemic in the farm animals of Wollstein, and Koch set out on a systematic study of this disease. Casimir Davaine, in France, had found a rod-shaped organism in animals dying of anthrax and had shown that the disease could be transmitted in sheep by inoculating animals with blood taken from dead victims. Koch inoculated mice with blood from spleens of animals dying of the disease, with lethal results. Blood from non-infected animals was harmless. He described spore formation in anthrax, showed that dried spores would live for a considerable time, and thus explained how the disease would lie dormant in this form in the farmer's fields, infecting animals unlucky enough to graze on the contaminated grass.

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Koch went on to develop the standard bacteriological techniques used in our laboratories today – culture on various media, staining techniques, micro-photography and so on. The Petri dish (agar poured into a flat plate), in standard use today, was devised by one of his later assistants, Julius Petri. Koch published his anthrax studies in 1876, but continued his work as a GP. However, in 1880, his obvious ability was recognized and he was appointed to head the Imperial Health Bureau in Berlin. Here, with a team of outstanding research workers from around the world, he produced a stream of important advances.

The first, in 1882, was the demonstration of the mycobacterium of tuberculosis. This elusive microbe required the development of special staining and culture techniques. Indeed, it is likely that Koch's exquisite technical skill and acumen have rarely, if ever, been excelled. The following year saw the isolation of the cholera vibrio – Koch and his German and French research team working first in Egypt and then in India, where there was no shortage of victims to investigate. Further studies included visits to Africa to investigate rindpest in cattle, and Italy to confirm Ronald Ross' work on the malaria parasite. Leprosy and plague also came under scrutiny.

In 1885, Koch became director of the splendid new Institute of Hygiene in the University of Berlin, where he attracted a series of brilliant research workers. These included Emil von Behring and Shibasaburo Kitasato, who developed the tetanus and diphtheria anti-toxins – the basis of all future work on anti-toxins, Friedrich Loeffler, who described the organisms of typhoid fever and diphtheria, Richard Pfeiffer, who isolated the influenza bacillus and George Gaffney, who isolated the typhoid bacillus and who followed Koch as director of the Institute.

In 1890, Koch established his 'postulates'. To show that an organism is the cause of a disease:

1. Its constant presence must be shown in every case of that disease
2. It must be isolated as a pure culture, which must be maintained through repeated generations of culture
3. The pure culture, removed by several generations from the original, must then reproduce the disease when re-inoculated into animals.

These rules remain as a basic tenet of bacteriological practice.

One piece of work by Koch proved a total failure. In 1891, he announced the discovery of a substance he called 'tuberculin', the heat-killed culture of the tubercle bacillus. This was put forward as a cure for tuberculosis, but it proved to be an embarrassing failure and one which cast a temporary shadow on his reputation. A modification of Koch's tuberculin is used today as the Mantoux test.

Koch received many international honours, and in 1905 he was awarded the Nobel Prize for Physiology and Medicine. He died of heart failure in the holiday resort of Baden-Baden in 1910, at the age of 66 years. Koch shares with that other genius, Louis Pasteur (1822–95), the credit for the establishment of the modern science of bacteriology. **BJHM**

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de Kruif P (1926) *Microbe Hunters.* Harcourt Inc, Orlando, Florida