Who discovered that intestinal worm infections could be diagnosed by finding eggs in the faeces?

David I Grove MD FRACP  Department of Medicine, University of Western Australia, Queen Elizabeth II Medical Centre, Nedlands, Western Australia

Identification of eggs in the faeces is the standard, time-honoured and practical method for demonstrating the presence of worms in the intestines. But to whom is the credit due for discovering this diagnostic technique? Nearly thirty years ago, Théodoridès handed the accolade to Davaine in an article1 celebrating the publication 100 years earlier of Davaine's paper describing the diagnosis of helminth infection by microscopical examination of the stools. A Frenchman, Casimir-Joseph Davaine (1812–1882), practised as a physician in Paris and researched various facets of microbiology and parasitology, despite the fact that he had neither his own laboratory nor an official academic appointment. In 1857, Davaine communicated his observations to the Société de Biologie.2 He recalled that in 1853, while examining the faeces of a dog with cholera, he had noticed many Trichocephalus (Trichuris) eggs in the stools. Davaine then produced some faecal material that he had obtained recently from a person who had died from meningitis, demonstrated large numbers of Trichuris eggs therein, and reported that large numbers of adult worms had been found in the caecum. He indicated that these ova were distinctive and easily recognizable, and remarked that a diagnosis of worms in the intestinal tract, regarded until that time as impossible, was now made easy by microscopical examination of the faeces:

"Le diagnostic de la présence de ces vers dans le tube digestif, regardé jusqu'aujourd'hui comme impossible, est donc désormais facile par l'inspection microscopique des fèces."3

To reinforce his point, Davaine then described the case of a child who had many Ascaris eggs in the stools and who expelled subsequently five or six adult worms. Finally, he mentioned that Fasciola hepatica ova could be found in the faeces of infected sheep.

Three years later (1860), Davaine extended these observations and publicized their importance in his magnificent textbook of parasitology.4 He published a plate illustrating the appearances of eggs of the worms now known as Ascaris lumbricoides, Trichuris trichiura, Enterobius vermicularis, Taenia solium, Diphyllobothrium latum, Fasciola hepatica and Dicrocoelium dendriticum. The significance of this event was endorsed enthusiastically by an anonymous commentator in the British Medical Journal in 1863 in a section headed 'The week':

"M. Rayer, in presenting Dr. Davaine's "Treatise on Entozoa" to the Academy of Medicine, pointed out the novel facts contained in it. Amongst others, it was pointed out that M. Davaine has shown the presence of ova of entozoa in the faeces when no worms were visible in them—a fact of possible service in diagnosis."4

But matters were not as simple as this. The latter annotation brought forth a response from a slightly injured W H Ransom, who observed that he had described this phenomenon before Davaine.5 William Henry Ransom (1823–1907) had been apprenticed with a doctor at King's Lynn, then studied at University College, London, where he graduated in 1848. After travelling in Germany and France, he settled in Nottingham in 1850 and was physician to the General Hospital from 1854 to 1890. He devoted much of his spare time to studying the embryology of fish and the development of galls in plants; for this work he was elected FRS in 1870. In 1856, Ransom had published an article in the Medical Times and Gazette on this very subject.6 In that paper, he remarked that while making observations on helminth infections in domestic animals in 1852, he took to examining microscopically the faeces of dogs and cats. He had done this as the presence of eggs indicated to him whether or not it was worthwhile killing the animals in order to obtain adult worms. One idea led to another: 'A very natural suggestion sprung from this, viz:—that I might in the same way diagnose the existence of Ascaris lumbricoides in man.'6

Very few suitable patients presented themselves, however, and it was some time before he was able to confirm this hypothesis. In July 1854, he was consulted by a 9-year-old girl who complained of weakness. She had never passed tapeworm proglottids in her faeces, but Ransom found numerous Taenia ova and a few Trichuris eggs on microscopical examination of her stools. He incorrectly drew the conclusion that the former ova were from a new species of tapeworm. Ransom provided an illustration of one of these eggs (Figure 1) and it is clear that they are from either Taenia solium or T. saginata (eggs from both worms look the same). Early in the following year, he admitted to hospital a 12-year-old girl who had a history of abdominal pain of six weeks' duration and who had passed two roundworms after treatment with an aperient. On microscopical examination of her stools, he found numerous Ascaris lumbricoides ova (Figure 2).

In his letter of 1863, Ransom indicated to the editor of the British Medical Journal: 'It is less with a view of raising a question of priority that I write, than from a desire to see this point taken up by my professional brethren in this country more than it has been up to this time.'7 He then went on to say that: 'The method of diagnosis is easy, and readily applied. A half-inch objective suffices.'8

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Ransom did, however, take up the question of priority. He drew attention to the publication by Carl Wedl in 1854 in his book on histopathology of a figure illustrating bodies seen in an intestinal concretion, the size of a cherry stone, taken by H Ulrich from an inguinal abscess. One of these objects is clearly the egg of *Trichuris trichiura*, and another resembles an ovum of *Ascaris lumbricoides* (Figure 3).

Ransom was not aware, however, of a comment on schistosomiasis made by Theodor Bilharz (1825–1862), a German doctor working in Cairo, in a letter written on 2 August 1852 to Carl von Siebold in Germany, and published in the following year in von Siebold’s *Zeitschrift für wissenschaftliche Zoologie*: ‘I have also found eggs in the stool of a patient with acute dysentery.’ This was almost a throw-away line, however, and Bilharz did not, either at that time or subsequently, develop the idea that this phenomenon could be utilized in diagnosis. He seems, rather, to have been more concerned with the pathogenesis of disease, as he was somewhat confused as to the interrelations between the urinary and intestinal forms of schistosomiasis. Moreover, he failed to distinguish between the terminal-spined eggs of *Schistosoma haematobium* and the lateral-spined ova of *Schistosoma mansoni*, and was no doubt swayed by the relative ease of examining urine as compared with faeces.

In retrospect, it seems that Bilharz was the first to find and recognize a worm egg in human faeces, but he did not develop this observation into a diagnostic tool. Wedl was the first to illustrate and name a helminth egg in material derived from intestinal contents. Ransom appears to have been the first person to both conceive the idea and to publish data specifically for the purpose of indicating that intestinal heminthiasis could be diagnosed by microscopical examination of the faeces. Davaine arrived at the same conclusions independently, but later, and publicized the value of the procedure.

However, none of these authors was the first to describe the presence in human faeces of the bodies that we now recognize as helmint ova. In 1849, J G Swayne, a lecturer in midwifery at the Bristol Medical School, published a paper in the *Lancet* on ‘organic bodies’ discovered in the evacuations of patients with cholera. He illustrated one of these ‘cells’ (Figure 4), which is clearly an egg of *Ascaris lumbricoides*. The nature of these bodies was completely obscure to investigators of the day, most of whom thought that they were of vegetable origin. The possibility that they were helmint ova was entertained, but rejected, by the Reverend M J Berkeley, a naturalist, who had been called in to adjudicate on their nature:

‘Care, meanwhile, should be taken to ascertain, by means of sure chemical tests, whether the bodies are of an animal or vegetable nature. But even should it be decided in favour of the former view, it will still remain to discover what they are, as it should seem that no ova of entozoa are known which can be reconciled with them.’

Remarkably, none of these observers apparently knew what an *Ascaris* egg looked like!

It is difficult to know why this technique took so long to be developed. It is true that there were some authorities, even in the early parts of the nineteenth century, who were staunch believers in the spontaneous generation of helminths. A consequence of this belief was that since eggs in the faeces had no role in transmission of the parasites, little attention was paid to them, thus reducing the likelihood that their diagnostic utility would be considered. Of probably greater significance is the fact that microscopes
Figure 4. The object 'a' was seen in the evacuations of cholera patients and was called an 'organic cell' by J G Swayne in 1849. It is clearly an egg of Ascaris lumbricoides. It was compared with 'b' which was said to be a 'uredo' (the intermediate stage of a rust fungus) from a specimen of brown bread.

were not common and were rarely used in clinical practice. James Paget underscored this point when he recounted his discovery of the muscle parasite, Trichinella spiralis, in 1836 while a medical student at St Bartholomew's Hospital:

'I wanted to examine the entosoon with a microscope, and there was none in the hospital. I thought I might get help from Mr. Children, who was then chief of the Natural History Department of the British Museum... He, however, had no microscope, but suggested that "Robert Brown might help me"... he let me look at his specimens with his little single microscope.'

Following the time of Paget, two relevant observations were made. In 1843, Gruby and Delafond in France discovered microfilariae in the blood of a dog, then in 1862 Bilharz in Cairo found ova of Schistosoma haematobium in the urine of a patient. These observations should have stimulated interest in analogous methods of diagnosing intestinal helminthiasis. Perhaps it was simply that faeces were too unpleasant and complex a material with which to work.

Nevertheless, the key observation was made in the decade following the publications of Swayne and Berkeley, and, as already mentioned, Davaine in 1860 described and illustrated the appearances in the faeces of ova from seven different species of worms. From that point, however, progress was once more desultory in both making use of the knowledge gained and in making similar advances in other intestinal helminthic infections. Thus, even that eminent and indefatigable British helminthologist, T Spencer Cobbold, who in 1864 wrote the first major textbook on helminthology in the English language, was slow to appreciate the facility and value of this diagnostic technique. For example, when describing a patient with Fasciolopsis buski infection in 1875, the diagnosis was only made because adult flukes were passed in the stools. Apparently he was not in the habit of examining faeces from patients whom he suspected of having a helminth infection. Indeed, with respect to that particular infection, it was not until 1891 that a lone Englishman, J H Walker, working in British North Borneo, illustrated eggs that he had found in the faeces and which were then identified as those of Fasciolopsis buski by an anonymous commentator in the British Medical Journal.

The lack of enthusiasm with which this diagnostic technique was adopted is further emphasized by the Italian parasitologists Grassi and the brothers Parona in 1878. Forty years after Dubini's discovery of adult hookworms in 1838, they remarked:

'The celebrated work of Heller states that the diagnosis should be etiologic: thus far no one has discovered either Ancylostoma or its ova in stools. Nothing further is found in the famous book by Cobbold, nor is anything instructive gained from the very recent work of Davaine.'

They then went on to announce:

'The diagnosis of Ancylostoma is very easy. To do this rapidly, it suffices to examine a little faeces... diluted with any medium, at the microscopic magnification of at least 90 diameters. If the material is fresh, only Ancylostoma ova undergoing segmentation will be found; if it is stale, embryos and larvae will also be found.'

At about the same time as Grassi and his collaborators investigated hookworm, Louis Normand in France in 1876 discovered worms in the faeces of soldiers who had contracted diarrhoea while in French Indochina. He did not at first realize that these worms, which were named Anguilla lucteralis, were in fact the progeny of the larger worms that he found subsequently and were called Anguilla intestinalis by his colleague, Bavay. These two forms were later shown to be different stages in the life cycle of the same parasite and were eventually renamed Strongyloides stercoralis.

It took even longer for the diagnosis of schistosomiasis by this technique to become established. Although, as has already been mentioned, Bilharz had reported in 1853 that he had found schistosome eggs (he did not specify whether they had lateral or terminal spines), and despite the fact that other observers such as Zancarol in 1885 had indicated that schistosome ova in the faeces of patients who had been living in the West Indies were generally appreciated that schistosome infection could be diagnosed by this method. It was not until 1902 that Patrick Manson, while searching for hookworm ova, serendipitously found Schistosoma eggs, all of which had lateral spines, in the faeces of an anaemic Englishman who had been living in the West Indies. Indeed, it was this observation which ultimately led to the description by Sambon in 1907 of Schistosoma mansoni as a species distinct from Schistosoma haematobium. In contrast, events moved much more quickly with respect to schistosomiasis japonica. Later in the same year that Kataurada first described the adult worm, Kawanishi in Japan in 1904 reported that Schistosoma japonicum infection could be diagnosed by finding the distinctive ova in the stools. Finally, it is not clear who first made use of this technique in Clonorchis sinensis infections, although Roux and Tardieu in 1912 appear to have been amongst the first.

Microscopic examination of the faeces for helminth ova may be unpleasant and time-consuming, but its efficacy is unsurpassed, even though many attempts have been made in the past few years to develop alternative techniques such as immunoassays. Humanity owes a debt of gratitude to the labours of these pioneer investigators.
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References
2 Davaine C. Sur le diagnostic de la présente des vers dans l'intestin par l'inspection microscopique des matières expulsées. C R Soc Biol 1867;second series; 4:188-9
6 Ransom WH. On the diagnosis of, and treatment for, round worm; and on the occurrence of a new species of Toenia in the human body. Medical Times and Gazette 1866;new series;12:598–600
9 Swayne JG. Observations on the report of the College of Physicians relative to the organic bodies discovered in evacuations of cholera patients. Lancet 1849;ii:530–2
10 Berkeley MJ. On the large cells observed in cholera evacuations by J G. Swayne, Esq., M.D., Dr Budd, and others. London Medical Gazette 1849;44:1035–7
12 Paget J. On the discovery of Trichina. Lancet 1866;i:269
19 Zancarol A. A specimen of Bilharzia, &c., with ova in the intestines of the bladder and large intestine. Trans Pathol Soc London 1882;33:410–12

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