CHAPTER 13

SCHISTOSOMIASIS

THE experiences of the 1914-1918 war showed that *Schistosoma* infection (*Bilharzia*) was a danger in Egypt. The Second A.I.F. was therefore alert to minimise the risk, though Egypt was not used as a training area as much as Palestine. On one occasion what was believed to be a single ovum was found in the urine of one patient in Palestine, but the lack of history of exposure and the fact that urinary symptoms arose within six months of arrival disposed of a diagnosis of schistosomiasis.

Early in 1941 attention was drawn to a section of the 2/1st Field Company, R.A.E., which had carried out exercises some months previously involving the pumping of canal water at Helwan and Sidi Ghazi. One of the men was treated in No. 1 New Zealand Hospital for schistosomiasis. He gave a history of exposure of his hands and legs to the water and as a number of other men had been similarly exposed the section was pathologically surveyed. Forty-three men were examined and two others were found to be passing ova of *S. haematobium* and red cells in the urine and to have 18 per cent eosinophilia. As a result the Australian forces in Egypt were warned of the risk. The Director of Medical Services, A.I.F., suggested that exercises involving pumping of water should be prohibited and that precautions should be taken. Instructions were also promulgated in the 9th Australian Division in 1941 prohibiting bathing in unauthorised streams. Infection by the *S. haematobium* or *S. mansoni* did not prove an appreciable risk in the Middle East.

When the centre of military activity shifted to the South-West Pacific the question of infection by *S. japonicum* was raised. The more serious and resistant lesions caused by this Asiatic form of *Schistosoma* were not likely to be encountered in the earlier campaigns in New Guinea, as its distribution began at the Philippines and spread north and east from there. The disease had not been reported from the Solomons or New Guinea. There was, however, a danger that Japanese troops might carry the infection with them and transmit it to vector snails in other islands. In 1943 an alarm was raised by a report that three American servicemen had been discovered to have bronchitic symptoms due to this Asiatic type of blood fluke. The areas involved were Buna and Guadalcanal. Fortunately this was a false alarm, as the diagnosis was not substantiated, but a full technical instruction (No. 40) was issued by the Australian Army Medical Services. Although it did not appear likely at the time that *Schistosoma japonicum* would give trouble in the Australian combat areas, the importance of the parasite lay in the severe symptoms it can cause, and a full account was therefore given in the instruction. In this, four stages in the clinical picture were distinguished, (1) skin irritation, (2) toxic or anaphylactoid features, (3) dysenteric symptoms and (4) portal cirrhosis, developing at a much later stage. The life history of this parasite

follows the same general lines as that of other blood flukes. The active miracidium, which may be seen in viable eggs, escapes in water in its free swimming state and invades certain fresh water snails, its first host, from which cercariae emerge later capable of entering the human skin. The cercariae thus enter the peripheral veins and pass through the pulmonary circulation into the systemic arterial system. Those reaching the mesenteric capillaries pass through the portal system, and become mature in the portal vein within the liver. Mature worms pass back down into the small mesenteric veins, and there deposit ova in the intestinal wall. The adults in the portal system may survive for many years, and can produce thousands of eggs which are packed in the surrounding venules, and may gain the lumen of the bowel and appear in the faeces. The deposits of ova may further cause nodule formation in the tissues of the human host, and in the colon papillomatous growths are formed which can be seen on sigmoidoscopic examination and yield ova for identification. The characteristically lateral knobbed ova may be found in the mucus from the hyperaemic colon, or in material obtained by scraping the "pseudo-tubercles" on the colonic wall. The danger of this form of schistosomiasis lay in the peri-portal cirrhosis set up by the parasites in the liver, which could be produced insidiously long after the human host had apparently recovered from the warning symptoms of invasion. These symptoms were misleading unless suspicion was aroused and might be mistaken for those of other febrile diseases, just as the nodules on the wall of the bowel might be mistaken for those of amoebiasis unless careful microscopic examination was made. Exact diagnosis was made by the finding of the ova in the faeces, but in surveys of persons exposed to infection the constant and high eosinophilia was of great value, and also if antigen was available, the immunological reactions of the skin to intradermal test, and of the serum to complement fixation. The march of symptoms in the early weeks was also highly suggestive; urticaria or other allergic manifestation, cough and signs of bronchitis, abdominal pain and tenderness, and a few months later, dysentery. Occasional systemic distribution of the nematodes could cause cerebral symptoms.

Fortunately the threat of an outbreak of this disease was never repeated in the islands south of the Philippines. But at Leyte several hundred men of the American ground forces and of the R.A.A.F. were attacked. Schistosomiasis had been recognised on Leyte long before the war, and a warning had been given in a terrain study (No. 84) published by the G.H.Q. Geographical Section, which pointed out that the vector was a fresh water snail (*Blanfordia quadrasi*) and that swimming in fresh water in infected areas was dangerous. A squadron of the R.A.A.F., No. 3 Airfield Construction Squadron, which was attached to the American forces, staged at Leyte en route for Mindoro. Local enquiries produced assurances that the inviting water in a river flowing past the camp was safe, and it was used for swimming and washing clothes. No vector snails were found in the vicinity, but it was later found that the distribution of snail breeding places was so patchy that failure to find snails in any one place gave

no foundation for safety. In any case the snails preferred small slow running streams. By the time the clinical symptoms were manifest most of the men had moved with the unit to Mindoro. The early febrile period was at first put down to sandfly fever, but soon schistosomiasis was suspected, and the 560 Australians involved were examined. Nearly half the number were found to have eosinophilia, and therefore were suspect. Another Australian unit on Leyte, the 6th Wireless Unit, was also reviewed, but no sign of schistosomiasis was discovered.

The commonest symptom found among the infected men in the early stages was fever, reaching a high peak, sometimes 104°F. or 105°F. in the afternoon. Skin irritation was not a feature of this outbreak. Abdominal pain was occasional only, so too was paroxysmal cough. Pain in the neck with some stiffness was complained of by most patients: a suggestion was made that the pain was referred from the diaphragm or liver when these were penetrated by the cercariae. Urticaria was not uncommon. Eosinophilia was constant, and reached a higher average level than in other common worm infestations. Ova were difficult to demonstrate in the bowel contents, but could be found in the small, white granules sometimes seen on the mucosa of the colon. The number of eggs found was usually small: when immature eggs were found mature specimens could be found at later examination. Concentration methods were employed, allowing each emulsified and stained specimen to settle repeatedly after dilution and rejection of the supernatant layers. In each mature egg a miracidium could be seen in contractile activity. Sedimentation methods were found to be better than flotation with zinc sulphate, as they did not kill the miracidia or distort the ova. Only a small percentage of the ova had spines, owing probably to the peculiarities of the Filipino strain, which seems to resemble the Chinese strain, and perhaps to the partial or complete disappearance of the spine as the embryo grows in the egg. Immature forms were smaller and darker than the mature, and predominance of the immature ova was found to be a feature of the mild infections.

No deaths occurred among the Australian airmen, but among a number of severe and acute infections of Americans there were two fatalities. The handling of the affected men aroused considerable discussion. On the one hand, the R.A.A.F. felt that the unit was isolated, was carrying out very good work with a high morale, and that most of the men did not feel ill, and their mild infections could be treated while they continued to work. On the other hand the U.S.A. troops affected were mostly sent to the 118th General Hospital on Leyte, where all facilities existed for full investigation by the staff or by a special Schistosomiasis Commission. More detailed references to the administrative problems involved are made in the Air Force Medical History (Volume IV). It may here be pointed out that it was recognised that accurate diagnosis was desirable, but that psychoneurosis could be caused by retention in hospital of men who felt quite well. The question at issue was the reconciliation of these aims.

For treatment Fouadin 40 c.cm. in nine injections was at first used in the field, and was given to all men with eosinophilia of 10 per cent or

over even if ova could not be demonstrated, but shortage of supplies did not permit treatment of all men possibly exposed. Examination by members of the U.S.A. commission on schistosomiasis showed that of 41 untreated men diagnosed as infected 10 were excreting ova, and of 42 treated 4 were still excreting ova. Treatment was resumed, tartar emetic being used. The unit was then moved to Morotai and thence to Balikpapan where 19 new infections were discovered. Finally investigation of the whole unit was carried out at Somers near Melbourne under the direction of Group Captain A. H. Baldwin, and with advice from Brigadier N. Hamilton Fairley. Fairley's extensive experience in schistosomiasis in the 1914-1918 war and the following years was of great value, and he supplied an antigen for tests which, though 18 years old, was still potent. Later while in England he sent out his stock of infected snail livers, but unfortunately the ship carrying this material was lost. The supply of antigen was nearly exhausted by this investigation, but useful results were obtained. W. P. H. Dakin and J. D. Connellan have described the full investigations of these men and F. E. Williams of the Walter and Eliza Hall Institute the results of the complement fixation tests. The clinical histories over a period of twelve months were reviewed, and the special methods of examination were carried out. A fuller account of this work will be given in the history of the R.A.A.F. Medical Services; the findings may here be summarised as follows: In all 226 men were treated. In arriving at a diagnosis stool examinations were found of great value, though ova were scarce, and often could not be found except by sigmoidoscopy, which however was not used in the early stages of infection. A standard sedimentation procedure was used, based on the lines recommended by the United States commission on schistosomiasis, whose members gave great help in the enquiry in the field. Eosinophilia was found a most valuable sign; in a small observed series the eosinophile counts fell to normal as cure was established, as judged by other tests. Eosinophilia did not exactly parallel the intensity of the complement fixation tests, but it was found sometimes when no ova could be found. The same applied to complement fixation. Such evidence was regarded as sufficient to warrant a course of treatment. Twenty-two men who had received a course of treatment for suspicious signs were later found to respond to the complement fixation test, though no ova could be found. Though it was probable that they had been cured a routine course of tartar emetic was given. Men with a positive response to serum tests and no other signs were also treated. This delicate test was found of definite value, and disclosed some infections that would otherwise be missed. The presence of the test in the absence of other signs was thought to be due to an abortive infection, unisexual infestation, or spontaneous death of the worms.

In treatment Fouadin was disappointing: 103 men out of 177 suspected infections relapsed after its use. Tartar emetic was then used, giving a total of two grammes, in one per cent solution. It was found that a course could be given by daily injections, taking two and a half weeks in all without causing toxic symptons. The prognosis of these men should be good.

It was an unique opportunity to institute treatment of this disease so early, and the existence of serious late lesions in the untreated or chronically infected should not give rise to pessimism in this experience. When the men were discharged they were brought under the care of the Repatriation Department, and continued observation will be made as necessary. There is no risk of spreading the infection in Australia.

Considerable impetus was given to the study of this disease, and information was distributed to pathologists and hygiene officers of the army and to commanders of mobile bacteriological laboratories to enable them to cope with the problems of diagnosis. The importance of full medical intelligence of newly entered tropical areas is obvious from this outbreak, also the need for certainty of pure water supplies. In March 1945 steps were taken to promulgate these warnings and the precautionary methods necessary in areas where this disease might present a problem new and potentially troublesome to the armed forces.

REFERENCES

W. P. H. DAKIN and J. D. CONNELLAN, *Med. Journ. Aust.*, 1 Mar. 1947.
N. H. FAIRLEY, *Pract.*, Oct. 1947.