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CARDIFF'S TROPICAL DISEASE: CERCARIAL DERMATITIS

by

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INTRODUCTION

ROATH LAKE is a large artificial lake situated in one of the municipal parks of Cardiff, and well known as a pleasure-spot, for angling, boating, and for its waterfowl.¹ Roath Park, in which the lake is situated, is also noted for its recreational facilities and splendid botanical gardens, which include one of the finest rose gardens in Great Britain. An attraction of the lake up until 1949, now largely forgotten, was the bathing pool in its south-east corner, adjacent to the dam. The changing-cubicles and spring-boards have been removed, and the concrete embankment which formerly was the edge of the pool is now used for angling contests.

The purpose of this paper is to review the investigation into, and discovery of, the cause of a health hazard occurring at the bathing pool in 1928.

SKIN ERUPTIONS ON BATHERS

During the summer of 1928 frequent complaints were received by the authorities that rashes had appeared on persons who had bathed in the pool and, on investigation, it was discovered that a few complaints had also been made during the previous summer. On 4 July 1928, Mr. A. A. Pettigrew, the Chief Officer of Parks, communicated with Dr. Ralph M. F. Picken, Medical Officer of Health for the City, who began an investigation.

Dr. C. J. McSweeney, the Deputy Medical Officer of Health, reported that a large number of bathers had developed rashes within a few hours of bathing in the lake. In all of them the rash was a papular dermatitis of a blotchy character, rather like early chickenpox except that it remained papular and had a different distribution. In many of the papules a central point resembling a puncture could be discerned. The rash had appeared within a few hours of bathing, was attended by intense irritation, and when scratched bled rather freely. No definite distribution was noted, although some bathers noted that mainly exposed parts of the body were affected. In one very severe case the forehead, centre of face, and chin alone escaped; this woman, who was a constant bather in the lake, said that she had not developed so many fresh lesions on her trunk since she had taken to wearing a tight bathing costume. Her case

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¹ W. Rees, *Cardiff, a history of the city*, Cardiff, The Corporation of the City of Cardiff, 1969, pp. 15, 32, 300, 321.

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pointed towards the cause of the rash being in the water rather than on it or about it, as the only portion of her body which escaped was that portion which would not be in contact with the water. All patients seen agreed that the liability to attack was greater when they frequented the semi-stagnant water at the lake margin, and none felt any bites, neither were any insects seen.

Throughout the whole of the summer session in 1928 the rash continued to make its appearance. Probably several hundred persons were affected. One bather who continued undeterred by the rash to bathe in the lake during the whole season developed fresh crops of lesions after each bathe, the number of lesions seeming to bear some relation to the length of time spent in the water.

THE SEARCH FOR THE CAUSE OF THE RASH

Vigorous inquiries into the possible cause of the skin eruptions were promptly instigated. Chemical and bacteriological analyses revealed that the water was of a fairly high degree of organic purity, and of good bacterial quality, the number of organisms developing at 37°C. being 14 per c.c.; no *Bacillus coli* were present. Mr. Colin Matheson, Keeper of Zoology at the National Museum of Wales, reported early in August 1928, that the water and material from the concrete embankment contained: "larvae of a midge, *Ceratopogon venustus* (numerous); a beetle, *Helophorus* sp.; leeches, *Nephelis* sp.; "water-louse", *Asellus aquaticus*; "water-flea", *Daphnia pulex*; four species of water-snail, *Bithynia tentaculata* (numerous), *Lymnaea stagnalis* (numerous), *Planorbis planorbis* (numerous), and *Planorbis vortex*; and a bivalve, *Sphaerium corneum*; finally the three-spined stickleback, *Gasterosteus aculeatus*, the only vertebrate present". The plant material was found to contain "water milfoil (*Myriophyllum spicatum*), curled duckweed (*Potamogeton crispus*) and other species of *Potamogeton*, also small patches of filamentous algae mainly if not entirely *Cladocera* sp." Mr. H. A. Hyde, Keeper in Botany at the Museum, stated that he was not aware that any of the above plants was likely to cause irritation when brought into contact with the human skin.² Mr. Matheson was at first inclined to think that the rashes might be due to bites by some small dipterous insect of the Chironomid type, especially as the females of the various species of the genus *Ceratopogon* are known to be bloodsuckers. Against this was the fact that every case occurred in bathers—never in those walking beside the pool. He then found accounts of "schistosome dermatitis" in the United States by Professor W. W. Cort (1928).³ At first the outbreaks of dermatitis which had occurred for a number of years at Douglas Lake, Michigan, were of unknown aetiology, but they were finally traced to the cercaria stage of a trematode, *Cercaria elvae*,⁴ occurring in the water-snail, *Lymnaea emarginat-angulatta* Sowerby, and in other snails. This form of dermatitis appeared in a number of widely separated localities, of which, however, France was the only European country mentioned, and a number of species of cercaria other than *C. elvae* could

² C. Matheson, 'Notes on *Cercaria elvae* Miller as the probable cause of an outbreak of dermatitis at Cardiff', *Trans. R. Soc. trop. Med. Hyg.*, 1930, 23: 421-424.

³ W. W. Cort, 'Schistosome dermatitis in the United States (Michigan)', *J. Am. med. Ass.*, 1928, 90: 1027-1029. W. W. Cort, 'Further observations on schistosome dermatitis in the United States (Michigan)', *Science, N.Y.*, 1928, 68: 388.

⁴ H. M. Miller, 'Notes on some furcocercous larval trematodes', *J. Parasit.*, 1923, 10: 35-46.

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produce the disorder in man. It was suggested further that the severity of the condition produced by the penetrations of *C. elvae* and other species into the human skin might be due in part to the reactions of an abnormal host.

During the summer of 1929 a number of cases of dermatitis again occurred among bathers at the lake. The numbers were considerably smaller than in 1928, but this decrease would appear simply to have been due to the abstention of a large number of regular bathers who were unwilling to run the risk of further attacks.

Mr. Matheson pursued a line of investigations suggested by Professor Cort's findings in Michigan, and later wrote to the Medical Officer of Health that specimens of the water snail *Lymnaea stagnalis* from the lake had been found to be infected with large numbers of the cercarial stages in the life-history of two parasitic worms, these having been seen both in the vicinity of the top of the shell and moving about in the surrounding water. Microscope slides of these cercariae, and subsequently consignments of live snails from the lake, were sent to an expert on helminthology at the British Museum, who reported that one of these species of cercariae was morphologically closely related to, if not identical with, *Cercaria elvae*, the form shown to be responsible for the outbreaks of similar dermatitis in the United States. One experimenter succeeded in producing a "rash" on his skin with this cercaria. The physical conditions at the Roath Park Lake seemed to be similar in many respects to those of many of the localities investigated in the United States in this connexion. In view of the above facts, and also because previous examinations of the larger fauna of the lake and the chemical and bacteriological examination of the water had revealed nothing which could cause the trouble, there appeared to be a very strong probability that these parasites of the water-snails were at least partly responsible for the outbreak. The only practicable method of dealing with this problem was considered to be the destruction of the snails by the use of some chemical reagent suitable for this purpose yet not too expensive.⁵ The snail *L. stagnalis* was a recent addition to the Welsh fauna, having first been described by Bacchus in 1915.⁶ By 1919 it was also found in the Glamorgan Canal, which runs from the Merthyr Valley to the Cardiff docks.

Roath Lake was duly treated, in March 1930, with copper sulphate to a concentration of just over 1 in 500,000 parts of lake water, this being a recognized method of destroying a similar snail which carries the cercaria of the liver fluke infecting cattle, sheep, and other herbivorous animals. Nevertheless, early in July 1930, there was a recurrence of the eruption, and numerous cercariae were again found in snails recovered from pools above the lake. The treatment was therefore repeated, and bathing proceeded until the end of the season without further complaints.⁷

The helminthologist at the British Museum, Dr. H. A. Baylis, meanwhile carried out exhaustive investigations on the two cercariae found in specimens of *L. stagnalis* from Roath Lake, in conjunction with Mr. E. L. Taylor of the Veterinary Laboratory,

⁵ R. M. F. Picken, *Annual report for 1929 of the medical officer of health and school medical officer*, Cardiff, City and Port of Cardiff, 1929, pp. 83-85.

⁶ D. R. Bacchus, 'New records for Glamorgan', *J. Conch.*, Lond., 1915, 15: 194.

⁷ R. M. F. Picken, *Annual report for 1930 of the medical officer of health and school medical officer*, Cardiff, City and Port of Cardiff, 1930, p. 85.

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Ministry of Agriculture and Fisheries.⁸ They identified the cercaria responsible for the dermatitis as *C. ocellata* and concluded that the species described by Miller as *C. elvae* was probably identical. *C. ocellata* was originally described by La Vallette St. George in 1855, who did not deal with its morphology as completely as did later writers.⁹ Its excretory system remained imperfectly known until Dubois¹⁰ gave a careful account of it, showing that there was little or no morphological difference between *C. elvae* and *C. ocellata*. Subsequently, *C. ocellata* was found in France and Germany, where it caused similar rashes on bathers.

LIFE-CYCLE, BEHAVIOUR AND MORPHOLOGY OF THE CERCARIAE

Cercaria ocellata is the final stage of larval development of a non-mammalian schistosome, *Trichobilharzia ocellata*. An egg of the schistosome develops into a miracidium, the first larval stage, which is a ciliated larva infective to the mollusc *Limnaea stagnalis*. The larval stages then develop in the visceral mass of the snail. The miracidium develops into an elongated, irregularly-constricted sporocyst, a thin-walled sac containing masses of proliferating cells. Daughter sporocysts produce infective cercariae which escape from the snail. The sporocysts are without a special birth-pore, and the cercariae emerge from them by rupturing the wall, apparently at any point.

The cercariae swim erratically by a rapid lashing of the tail, with either body first or, more commonly, the tail. They also move by means of the oral and ventral suckers after the manner of a "looper" caterpillar or leech. The cercariae usually emerge from the snails at about mid-day, and having a very powerful positive phototaxis they can come into contact with any animal swimming at the surface of the water, or coming to it to drink. *Cercaria ocellata* is an apharyngeal, furcocercous form, from 0.40 to 0.46 mm. in length and from 0.11 to 0.12 mm. in width, possessing a pair of well-developed eye-spots.

THE FINAL PROOF

Taylor and Baylis¹¹ discuss experiments to test the power of this cercaria to penetrate the skin of mammals and its ability to produce a dermatitis in man. Water containing cercariae in contact with the skin produced within five minutes a distinct pricking sensation which continued throughout the experiment. A redness of the skin followed which increased in intensity, and a tingling sensation replaced the pricking. Next day the irritation had increased, and small papules appeared over all of the infected area. Both eruption and irritation increased up to the fourth day, and the lesions only subsided gradually, being still very plain in four weeks, and not having altogether disappeared in seven.

⁸ E. L. Taylor and H. A. Baylis, 'Observations and experiments on a dermatitis-producing cercaria and on another cercaria from *Limnaea stagnalis* in Great Britain', *Trans. R. Soc. trop. Med. Hyg.*, 1930, 24: 219-244.

⁹ Adolf Johann Hubert von La Valette St. George, baron, *Symbolae ad trematodum evolutionis historiam. Dissertatio inauguralis*, Berolini, 1855, pp. 1-38.

¹⁰ G. Dubois, 'Les cercaires de la région de Neuchâtel', *Bull. Soc. neuchâtel, Sci. nat.*, 1929, 53: 3-177.

¹¹ Taylor and Baylis, *op. cit.*, note 8 above.

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Vogel¹² applied water containing *C. ocellata* to the flexor surface of his forearm, and twenty-four hours later excised the affected portion of skin for histological examination. Eleven cercariae were found in the epidermis, some of them immediately below the stratum corneum, while others had penetrated into the cutis. Some authors have stated that the point of entry of cercariae is always a hair-follicle, but in the present case this was not so. A well-marked "track" was made by the cercariae, and there was softening and destruction of epidermal cells along its course, attributed to the secretion of the penetration glands, acting as a kind of "external digestion" of the host's tissues.

Mathias showed in 1930 that the cercariae attached themselves to the skin of chickens and ducks, and threw off their tails.¹³ Some of the birds died after a few days, and others were killed after three weeks, but no developing trematodes were found in the blood-vessels. Taylor and Baylis concluded that mammals are not suitable hosts for the adult form of *C. ocellata*, and that it belongs to the family schistosomidae, closely related to *Bilharziella*, a blood fluke of birds. The species was later shown to be *Trichobilharzia ocellata*. The second cercaria present in the water-snails of Roath Lake (*Cercaria X*) was found to attack, and often kill, fish. After penetrating the skin it migrates to the eye-lenses, but is unable to penetrate human skin. It was identified as *Diplostomum spathaceum*, parasitic in birds.

CONCLUSION

Cercarial dermatitis is commonly known as "swimmer's itch", "bather's itch", or "sedge-pool itch". It is always connected with paddling or swimming in infected water. A somewhat similar dermatitis is noted in schistosomiasis in association with cercarial penetration in *Schistosoma haematobium*, *S. mansoni* and *S. japonicum* infections. "Sawah itch" in Malaya is caused by cercariae of a cattle schistosome, and "Paddy itch" is a lakeside disease in Japan, caused by *Gigantobilharzia sturniae*. Other types of cercariae producing dermatitis have been documented, some occurring in salt water, where a marine snail is the immediate host. These cercariae are developmental forms of various trematodes of birds and perhaps of other vertebrates. Though they cause skin lesions they do not develop to maturity in man. Local folklore has it that the species responsible for the dermatitis in Roath Lake was named "*Schistosoma roathii*", but there is no record of this. It seems likely that pollution has now succeeded where copper sulphate failed, as no cercariae appear to have been isolated from the lake for ten years, though recurrence of the trouble did occur several times up until 1943, the lake being treated with copper sulphate on each occasion. The bathing pool was closed on 1 July 1949. Several moves were made to re-open it, but these failed, mainly due to contamination of the lake by sewage giving rise to a very high *B. coli* count. The prevailing anxiety about typhoid fever and poliomyelitis at this time also contributed to the pool's demise. In 1957 it was suggested that the lake be restocked with brown trout to feed on the snails, but unfortunately it does not eat *Limnaea stagnalis*. At about this time, the "Taff Swim", a round-the-lake race, was staged, apparently without ill-effects to the participants,

¹² H. Vogel, 'Hauptveränderungen durch *Cercaria ocellata*', *Derm Wschr.*, 1930, 90: 577-581.

¹³ P. Mathias, 'Sur *Cercaria ocellata* La Vallette', *Annls Parasit. hum. comp.*, 1930, 8: 151-160.

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but none the less regular bathing was discouraged.

The Roath Lake dermatitis has taken its place in history and is now almost forgotten, but not without being mentioned in Sir Philip H. Manson-Bahr's *Manson's tropical diseases*,¹⁴ and also in *A synopsis of tropical medicine*.¹⁵ The ailment thus surely merits the title "Cardiff's tropical disease".

SUMMARY

The investigation into a skin rash affecting bathers at Roath Lake, Cardiff, Wales, during the summers of 1927–1930 is described. The rash, a papular dermatitis, was discovered to be due to penetration of the skin by the larva *Cercaria ocellata* present in the lake water. *C. ocellata* is the final stage of larval development of a non-mammalian schistosome *Trichobilharzia ocellata*. Similar dermatitis had previously been described in association with cercarial penetration in various forms of schistosomiasis in tropical countries. An outbreak similar to that in Cardiff in Michigan, U.S.A., in 1928 was probably due to the same organism. Subsequently *C. ocellata* was found in France and Germany where it caused similar rashes on bathers, but no other cases were recorded in Great Britain.

¹⁴ Sir Philip H. Manson-Bahr, *Manson's tropical diseases*, 16th ed., London, Baillière, Tindall & Cassell, 1966, pp. 605–606, 928–929.

¹⁵ Sir Philip H. Manson-Bahr, *Synopsis of tropical medicine* 3rd ed., London, Cassell, 1957, p. 195.