SOME NOTES ON THE DIFFERENTIATION OF CLOSELY-ALLIED SCHISTOSOMES.

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When fresh-water snails are examined microscopically, specimens are occasionally encountered that are infested with the cercariae of more than one species. Sometimes these cercariae are easily differentiated. A snail may harbour numerous eye-spotted amphistomes and a few distomes without eye-spots, or furcocercous forms may be associated with cercariae possessing undivided tails. In some collections of semi-stagnant water, however, the same individual snail may be found infested with at least two distinct schistosomes. In 1916, I found *Physopsis africana* (in an overflow pool along the course of the Umsindusi river at Pietermaritzburg) heavily infested with two distinct schistosomes, and it was not uncommon, as Dr E. E. Warren also observed, for the two forms to develop in the same host. One of these cercariae I named *Cercaria secobii*, the other was probably the cercaria of *Schistosoma haematobium*. Soparkar (1921 *a* and *b*) has moreover noted a double infection of *Planorbis exustus* near Bombay.

The two trematode species which cause Bilharziasis in Africa were long considered to be identical, but careful work, conducted during recent years, has demonstrated essential differences in the cercarial stages of the worms. At one time it was assumed that the worms could be determined in accordance with the species of snail in which the cercariae were found. Thus Leiper (1919) stated that cercariae "developing in the *Bullinus* molluscs always produce bilharzia worms which give rise solely to terminal-spined eggs, while those which have developed in *Planorbis boissyi* always become worms which produce solely lateral-spined eggs."

But *Physopsis africana* has been shown to be the common intermediary host for both *S. haematobium* and *S. bovis* and less commonly for *S. mansoni*, the cercariae of these species resembling each other even more closely than do those of *S. haematobium* and *C. secobii*, the latter being a longer and narrower form with particularly long prongs to its divided tail (Cawston, 1917).

Though I have never succeeded in following the development of schistosomes in any other species of fresh-water snail than *Physopsis africana*, the presence of schistosomes in various other species which I have found infested in Natal streams and the development of *S. mansoni* and *S. haematobium* in other forms recorded by Porter (1920) shows that there are conditions under

which these schistosomes may develop in other snails than those that serve as their common intermediary host. (See also Cort, 1918.)

In a specimen of *Physopsis africana* which I sent him from Natal, Faust (ix. 1920) has reported the presence of the cercariae of *S. haematobium* and *S. mansoni*, as well as *Cercaria octadena* which he (ix. 1921) regards as a developmental stage of *S. bovis*. Since *S. bovis* in Natal has only been recorded from experimental animals and possibly some Natal boys and, as *S. mansoni* has been seen in only one patient in Natal and in experimental animals, it is difficult to understand how one individual snail from the Durban suburbs can have been exposed to infestation by the miracidia of all three schistosomes. However, the observation shows that the development of miracidia in *Physopsis africana* is of no value as a means of differentiating these three schistosomes.

The association of such closely allied species in the same individual host is of great interest and emphasises the need of identifying the various schistosomes in their free-swimming stage (Faust vi. 1920). The methods of locomotion of the various cercariae and the relative length of their prongs are of more differential value than their various total lengths. A determination of the number of pairs of mucin glands is one of the most reliable means of determining the species to which a cercaria belongs; but the chief means of differentiating cercariae is by a comparison of the adult forms and, where there is mixed infestation and the cercariae are not readily distinguishable, the task becomes more complex. Soparkar states that the "structural correlation between a known cercaria and one under investigation may at best be *suggestive* of their possible identity, but the final proof must rest with the experimental rearing from them of identical adults."

I have treated guinea-pigs with cercariae from a snail which was heavily infested with eye-spotted cercariae resembling *C. frondosa* but, on post-mortem dissection, have found schistosomes which could not possibly have developed from eye-spotted forms. If the cercariae responsible for the infection were so few as to be overlooked amongst the commoner species of parasite, it will be readily understood how difficult it is to determine those cercariae which represent the larval stage of the rarer schistosomes. It is certainly surprising to obtain successful experimental infection by using schistosomes that are so few as to be overlooked, when other animals which are injected and fed on very numerous schistosomes on several occasions show no sign of infection at the end of four months.

With a large number of snails bred in captivity, and exposed to infection with the various miracidia, it should be possible to correlate the various cercariae with the adult worms used in the experiments, but the rarer schistosomes are hard to obtain and the miracidia of fasciolae take a long time to hatch out. However, from clean bred *Physopsis africana* to which numerous ova of *S. haematobium* (readily obtained in Natal) are added we can obtain typical cercariae of *S. haematobium* at will. We have yet to determine the life-history of many cercariae commonly encountered in fresh-water snails from

various parts of South Africa. A comparison of the various schistosomes found in South African snails and of closely allied forms occurring elsewhere, of which particulars are appended, may be of interest to those who are engaged in the study of such parasites in South Africa.

		Approximate length of cercaria in mm.	Pairs of mucin glands in cercaria
S. haematobium	(*C. crispa*)	0·52	3 acidophilic with large nuclei
S. mansoni	(*C. spinosa*?)	0·39	2 acidophilic with large nuclei 4 basophilic with small nuclei
S. japonicum	—	0·5	5 acidophilic with large nuclei
S. ?	(*C. indicae*)	0·39	5 acidophilic
S. bovis	(*C. octadena*?)	0·43	2 acidophilic 2 basophilic ? pharynx
S. ?	(*C. oculata*)	0·35	3 acidophilic with small nuclei
S. ?	(*C. sccobii*)	0·55	4 all neutrophilic
S. ?	(*C. gladii*)	0·92	3 with small nuclei

		Testes in adult	Ova in utero
S. haematobium	(*C. crispa*)	About 4	Numerous spine-pointed
S. mansoni	(*C. spinosa*?)	About 8	Usually one lateral-spined
S. japonicum	—	About 7	Numerous ova, practically aspinose
S. bovis	(*C. octadena*)	—	Numerous spine-pointed

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