

The Relapsing Fever Spirochaetes

J. W. S. Macfie & Warrington Yorke

To cite this article: J. W. S. Macfie & Warrington Yorke (1917) The Relapsing Fever Spirochaetes, Annals of Tropical Medicine & Parasitology, 11:1, 81-85, DOI: [10.1080/00034983.1917.11684127](https://doi.org/10.1080/00034983.1917.11684127)

To link to this article: <http://dx.doi.org/10.1080/00034983.1917.11684127>



Published online: 24 Mar 2016.



Submit your article to this journal [↗](#)



View related articles [↗](#)



Citing articles: 1 View citing articles [↗](#)

THE RELAPSING FEVER SPIROCHAETES

BY

J. W. S. MACFIE

AND

WARRINGTON YORKE

(Received for publication 25 May, 1917)

The spirochaetes found in the blood in relapsing fever in different parts of the world have been separated both by morphological features and biological reactions into a number of so-called species, but so far as morphology is concerned there appears to be great dissimilarity between the descriptions of different authors when dealing with the same organism.

The species most generally recognised are *S. recurrentis*, *S. carteri*, *S. novyi*, and *S. duttoni*, the organisms found in the relapsing fevers of Europe, Asia, America, and Africa respectively. Novy and Knapp (1906) appear to be mainly responsible for considering as distinct species the spirochaetes found in American, Indian, and African relapsing fever. They give a table in which the distinctive morphological characters are set forth. The length of the American and Indian spirochaetes is stated to be 8μ to 20μ , whereas that of the African is 16μ to 30μ . The other differential points mentioned relate to the width of the filament, the number of turns, the distance of the turns, and the width of the turns or spirals. Many of the modern text-books of Tropical Medicine appear to have followed Novy and Knapp. It has, however, been suggested that the spirochaetes of all the above infections may be varieties of a common type transmitted by different arthropods, and Nuttall (1912) writes that *S. recurrentis* may be the only true species and that the various specific names given to the spirochaetes causing relapsing fever in man, although convenient to distinguish strains or races of different origin, 'cannot be regarded as valid names, in the sense of scientific nomenclature, for virulence and immunity reactions are not adequate tests of specificity.'

An opportunity having occurred of examining the spirochaetes

of European, Indian, and African relapsing fever, it was decided to study the variation in length of these parasites by the method employed previously in the case of *S. eurygyrata* and other spirochaetes (Macfie, 1916). The materials used were in the case of Indian relapsing fever and *S. duttoni* specimens preserved in the collection at the Liverpool School of Tropical Medicine, and in the case of European relapsing fever blood films made in 1915 from two patients infected in the Balkans. All the specimens were dried blood films, fixed with absolute alcohol, and stained by the Romanowsky method.

In order to determine the variations in length of these spirochaetes, eight blood films showing *S. duttoni*, eight showing *S. carteri*, and four showing *S. recurrentis* were selected, and in each of these twenty-five spirochaetes, taken as they came, were drawn with the aid of a camera lucida and measured by the compass method. In all the blood films more or less coiled or twisted spirochaetes were found, and others that showed very slight undulations, so that any measurements taken across the waves would have been quite unreliable.

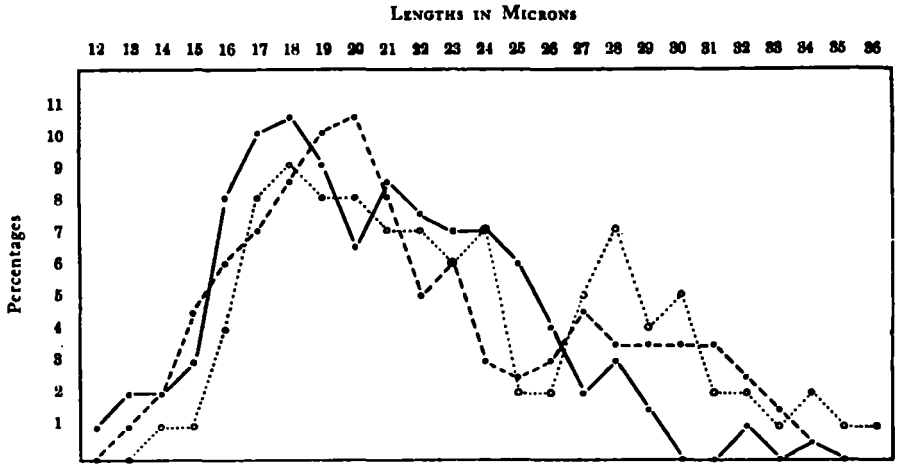
In this way 200 specimens of *S. duttoni*, 200 of *S. carteri*, and 100 of *S. recurrentis* were measured (see Table). *S. duttoni* varied

The distribution according to length, by percentages, of Relapsing Fever spirochaetes.

Type of Relapsing Fever	Number of spirochaetes measured	LENGTH IN MICRONS												
		12	13	14	15	16	17	18	19	20	21	22	23	24
African, <i>S. duttoni</i> ...	200	1	2	2	3	8	10	10.5	9	6.5	8.5	7.5	7	7
Indian, <i>S. carteri</i> ...	200	...	1	2	4.5	6	7	8.5	10	10.5	8	5	6	3
European, <i>S. recurrentis</i>	100	...	...	1	1	4	8	9	8	8	7	7	6	7

Type of Relapsing Fever	Number of spirochaetes measured	LENGTH IN MICRONS												Average length
		25	26	27	28	29	30	31	32	33	34	35	36	
African, <i>S. duttoni</i> ...	200	6	4	2	3	1.5	...	...	1	...	0.5	...	...	20.56
Indian, <i>S. carteri</i> ...	200	2.5	3	4.5	3.5	3.5	3.5	3.5	2.5	1.5	0.5	...	...	21.86
European, <i>S. recurrentis</i>	100	2	2	5	7	4	5	2	2	1	2	1	1	23.07

in length from 12μ to 34μ , average 20.56μ ; the biometric curve was low and extended, rising to a peak at 18μ , with a secondary crest at 21μ (see Graph), and showing the commonest lengths of the



Graph showing the variations according to lengths, by percentages, of *S. duttoni* (●—●—●—), *S. carteri* (●- - -●- - -), and *S. recurrentis* (○·····○·····).

spirochaetes to be 16μ to 19μ . *S. carteri* varied in length from 13μ to 34μ , average 21.86μ ; the curve showed a peak at 20μ , a subsidiary crest at 23μ , and the commonest lengths of the spirochaetes were 18μ to 21μ . *S. recurrentis* ranged from 14μ to 36μ in length, average 23.07μ ; a large number of double forms had been present in the blood at the time when the films were made, and these, together with the fact that only a small number of parasites were measured, made the curve an irregular one. The commonest lengths of the spirochaetes were, however, 17μ to 20μ .

Comparing these measurements, it will be seen that the differences between these three types of spirochaetes are but slight. The range of length is practically the same, the groups comprising the commonest lengths overlap, and the crests of the curves formed by distributing the parasites according to length occur close together. These observations show that *S. duttoni*, *S. carteri* and *S. recurrentis* do not differ appreciably as regards length.

There is a very marked difference between blood spirochaetes and the extra-vascular species previously measured (Macfie, 1916) as

regards variations in length. This difference is apparent even without measurements, but is most clearly seen in biometric curves. A similar difference has also been observed in the case of *S. marchouxi* (Annual Report of the Accra Laboratory, 1916). The curves representing the variations in length of extra-vascular spirochaetes were relatively short, and showed a sharp crest, those of blood spirochaetes are much more extended, and although in each there is a crest it is not so sharp, and the commonest lengths of the parasites comprise only a small proportion of the total. This difference is apparently due to the greater number of dividing forms found in the blood, and to the fact that the double forms do not separate so early. Multiple forms, some of them of extreme length, are relatively more often found in blood-inhabiting species. The daughter spirochaetes making up a double cell are also frequently of different lengths which is unusual in extra-vascular species. The result of these differences is in the case of blood spirochaetes to extend the curve to the right and to reduce the prominence of the crest.

The morphology of the spirochaetes found in these three types of relapsing fever was similar also in other respects. The thickness of the organisms in these dried blood films was about the same, namely, approximately 0.3μ ; the ends were pointed; unstained bars or gaps occurred in the bodies of all three types; and no undulating membrane was ever observed. The terminal flagellum described by some writers was not seen, but at each end of the spirochaetes there was as a rule a part of the body about one micron long which stained more palely than the rest of the parasite.

Much importance has been attached to the number and size of the undulations of these spirochaetes, but so far as our observations go no difference could be made out in this respect between the European, Asian, and African strains. All three showed wide undulations that varied greatly both in size and number, some spirochaetes being extended as almost straight lines, others coiled into rings, but perhaps the commonest wave length was about 4μ and amplitude about 0.8μ in all three strains. In the slides from cases of European relapsing fever a few closely coiled individuals were found similar to those described by Novy and Knapp in *S. novyi*; the wave length in these specimens was about 2.2μ , and the amplitude of the wave about 0.5μ .

SUMMARY

1. There is no appreciable difference in length between the spirochaetes causing European (*S. recurrentis*), Indian (*S. carteri*), and African (*S. duttoni*) relapsing fever.

2. The spirochaetes, including double forms but not multiple individuals, range in length from 12μ to 36μ , but are most commonly about 17μ to 20μ long.

3. We were unable to discover any morphological distinctions between the spirochaetes.

REFERENCES

- MACFIE, J. W. S. (1916). The Morphology of Certain Spirochaetes of Man and other Animals. *Annals of Trop. Med. and Parasitol.*, Vol. X, pp. 305-343.
- NOVY, F. G., and KNAPP, R. E. (1906). Studies on *Spirillum obermeieri* and related Organisms. *Journ. of Infect. Diseases*, Vol. III, pp. 291-393.
- NUTTALL G. H. F. (1912). Herter Lectures, I, Spirochaetosis. *Parasitology*, Vol. V, pp. 262-274.