THE CHROMOSOMES OF *THELYPHONUS INDICUS* STOLICZKA

by A. R. KASTURI BAI *and* M. D. PARTHASARATHY, *Department of Zoology, Central College, Bangalore*

(Communicated by B. R. Seshachar, F.N.I.)

(*Received September 9*; *read December 6, 1957*)

ABSTRACT

The diploid chromosome number of *Thelyphonus indicus* is 44 with 42 autosomes and an XY pair of sex chromosomes. The number is at variance with that in the only other species, *T. sepiaris*, whose chromosomes are known. Another interesting difference lies in the sex chromosome mechanism which is of the XY type in the Indian species while an XO mechanism has been reported in *T. sepiaris*. The X in the present species is the largest chromosome in the whole series and Y the smallest. All chromosomes are acrocentric.

While a great deal of knowledge has accumulated in recent years regarding the chromosomes of spiders, other Arachnida have not received the same attention. Of these, the sub-order Uropygi, consisting of interesting and aberrant forms deserves special mention. It includes large forms of tropical and subtropical distribution. Only two genera have been studied, i.e. *Thelyphonus sepiaris* by Millot and Tuzet (1934) and *Hypoctonus formosus* by Warren (1939). But these accounts, and especially that by Millot and Tuzet, are so defective and incomplete, that it was felt that an Indian species, *T. indicus*, would be worth examining. This examination has revealed a number of interesting points regarding the chromosomes and their behaviour, and generally the spermatogenesis, and a brief account is given here.

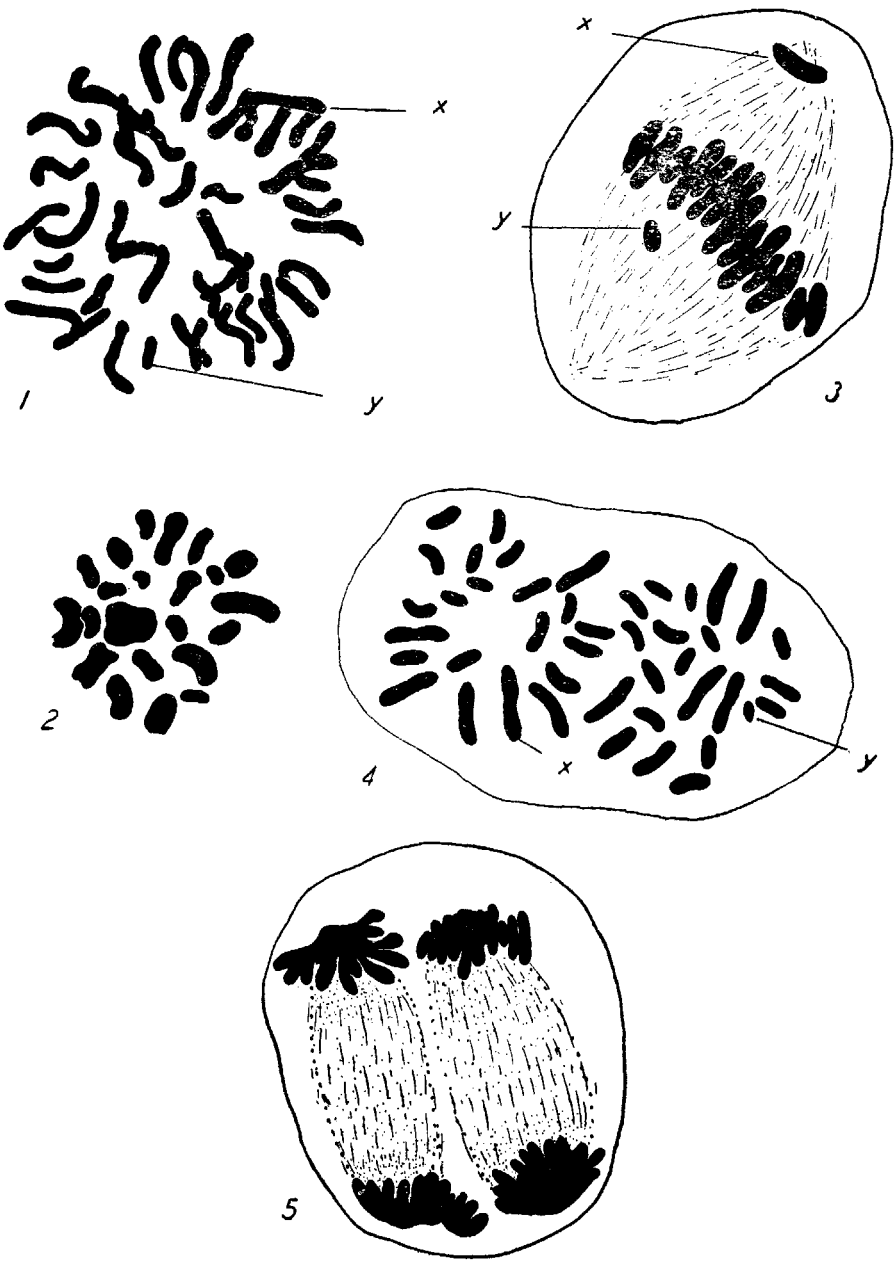
Specimens of *Thelyphonus indicus* were collected during the monsoon months of June to September around Bangalore and the testes fixed in Bouin's fluid, Carnoy's mixture and Flemming with and without acetic acid. Sections of the material were cut and stained with Heidenhain's haematoxylin and crystal-violet; Feulgen squashes were also made.

The testes are paired convoluted tubes extending through the abdomen on either side of the ventral nerve cord. Each tube is oval in cross section and, when active, shows cells in practically all stages of spermatogenesis, the earlier stages being found in the periphery and the later ones, along with the sperms, in the centre. A full study can therefore be made of the entire process.

Spermatogonia occur as isolated cells in the periphery of the tubule and examination of their division stages reveals that the chromosome number in them is 44. Analysis of the chromosomes shows that (a) all chromosomes are acrocentric, (b) the sex complement consists of a pair of dissimilar chromosomes with X as the largest chromosome and Y the smallest. The sex chromosomes always appear to lie at the periphery of the gonial metaphase plate.

The spermatogonia pass through far fewer mitotic divisions than in most Arachnida; perhaps 2 to 3 divisions alone occur. No evidence of any grouping of the descendents of the original spermatogonium to form cysts was seen, the various meiotic stages being distributed in a more or less haphazard manner in the tubule. A pronounced polarization of the chromosomes is seen, both in the leptotene as well as in the pachytene stages.

Diakinesis reveals 22 bivalents, 21 formed of the autosomes and one of the XY pair. The latter can be easily recognized by their behaviour and movement



TEXT-EIG. 1

Fig. 1.—Metaphase plate of spermatogonium. ×4500.
Fig. 2.—Metaphase-1 showing the bivalents. ×4500.
Fig. 3.—Segregation of the X and Y chromosomes. ×4500.
Fig. 4.—Metaphase plate of second meiotic division. ×4500.
Fig. 5.—Two spindles lying in a common cell matrix. ×4500.

on the spindle also. Both X and Y move toward the poles earlier than the autosomes and even there, X reaches its pole earlier than Y does its pole.

One of the interesting features of spermatogenesis is the precocious second meiotic division. It has been noticed as a regular phenomenon that the two second division spindles lie in a single cell matrix. The two spindles as well as their components are clear and distinct but apparently there has not been a sufficient interval between the first meiotic division and the second, for the cytosome to divide and constitute the secondary spermatocytes.

A closer examination reveals that there is practically no interphase between the two meiotic divisions and no sooner the first division is completed, than the two chromosome groups are incorporated into the two spindles of the second division. Sometimes the two spindles lie parallel in the cell matrix but often they lie without any special orientation. Apparently the second division is completed in this position and instances where the four spermatid nuclei are found in the same cytoplasmic matrix are quite common, the cytosomal division taking place soon after. But more often, the cytosomal division takes place slightly earlier, resulting in binucleate cells. In any case, this precocious second division does not seem to affect spermatogenesis in any manner, for sooner or later cytosomal division follows and uninucleate spermatids result. We have never found abnormal spermatids of any kind. Tripolar spindles are often encountered but they are probably abnormalities and do not lead to normal cells. During spermiogenesis the nucleus of the spermatid condenses. It later becomes bell shaped and spirally twisted to form the characteristic sperm head of the animal.

Discussion

Thelyphonus sepiaris and *Hypoctonus formosus* are the only species in the sub-order Uropygi (Arachnida) whose chromosomes have been studied so far. Millot and Tuzet (1934) described 24 chromosomes and one heterochromosome as making the haploid number in *Thelyphonus sepiaris* while Warren (1939) counted only 12 chromosomes in *Hypoctonus formosus*. In the latter species, according to the author, all chromosomes seem to fuse into a single large homogeneous ring at metaphase which splits transversely into two half loops at anaphase and later condense into oval masses moving to the two poles. It is difficult to understand this phenomenon in the light of modern views on chromosome structure and morphology and a clear evaluation of the significance of these findings must await a re-examination of the chromosomes of this organism by modern methods. The description of the chromosomes of *Thelyphonus sepiaris* is more easily understood but the authors (Millot and Tuzet, 1934) admit to the possibility of one or two errors in regard to their number.

It is interesting that the number and behaviour of the chromosomes in the Indian species of *Thelyphonus* should be so different from those of *T. sepiaris*. The diploid number here is 44 with two clearly defined and dissimilar sex chromosomes which have been identified as X and Y. The chromosomes are all acrocentric and distinct at all stages and do not show the fusion described for *Hypoctonus formosus* by Warren (1939).

This is the first account of XY type of sex chromosome mechanism in the Uropygi. The account by Millot and Tuzet would lead one to believe that it is of the XO type in their species of *Thelyphonus* while in *Sarax sarawakensis* (Amblypygi), the same authors describe an XO mechanism. It is too early to assess the significance of this difference and until we have information on more species of this sub-order, any general conclusions regarding the evolution of chromosomes within the group would be premature.

Acknowledgement

The authors' grateful thanks are due to Dr. B. R. Seshachar for his guidance and encouragement.

References

Millot, J. and Tuzet, O. (1934). Bull. Biol. France-Belg., t. LXVIII, Fasc. 1, 77–83.
Warren, E. (1939). *Ann. Natal Museum*, 9, Part 2, 307–344.

Issued February, 26, 1958.