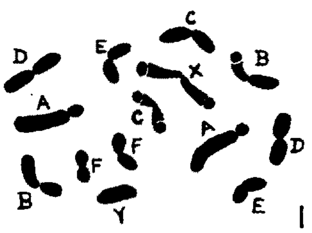
Chromosome Structure and Meiosis in a Pentatomid Bug

Considerable attention has of late been paid to studies on the chromosomes of heteroptera (MAKINO[1], WHITE[2]). In India, MANNA[3] has recently published quite an exhaustive account of chromosomes of Indian heteroptera and has reviewed the problem of chromosome number in as many as six sub-families, comprising a total of eleven tribes and has also discussed the problem of supergeneric classification in this group. The object of the present paper is to present a brief account of the structure of mitotic chromosomes and their meiotic behaviour in a species of Indian Pentatomid, *Bagrada picta* (F), belonging to the sub-family Pentatominae and tribe Pentatomini. The materials were collected at Delhi and their testes fixed in Sanfelice's fixative. Sections were cut at 12 μ in thickness and stained in Iodine crystal violet. Diagrams have been reproduced at a uniform magnification of 3670.



1

Fig. 1.–Spermatogonial prophase showing the morphology of chromosomes.

An inspection of the spermatogonial prophase (Fig. 1) or of metaphase plates (Fig. 2) reveals the chromosome number to be $2n = 14$ in the male. The chromosomes are typically heteropteran in form at the spermatogonial metaphase. It has been found after critical examination of a few spermatogonial prophase that the chromosomes are monocentric. The various chromosomes on the basis of their structure are as follows:

(1) X-chromosome—Longest in the complement and having a median primary constriction (*X*).

(2) A pair of long chromosomes with a subterminal primary constriction (*AA*).

(3) A pair of long chromosomes with a median primary constriction (*BB*).

(4) Two pairs of medium sized chromosomes with a median primary constriction (*CC*, *DD*).

(5) Y-chromosome—A medium sized chromosome without any constriction, apparently a rod-shaped one (*Y*).

(6) Two pairs of short chromosomes with a median primary constriction (*EE*, *FF*).

At the growth phase of meiosis, the sex chromosomes remain fused and, therefore, appear as a single heteropycnotic body lying close to the nuclear membrane, while other chromosomes are seen very faintly. There is always a single spherical nucleolus which is seen as a brownish body under the phase contrast microscope where the sex chromosome mass appears as a dark green structure and other chromosomes as filaments. This stage, therefore, corresponds to the earlier stage of meiosis. The single nucleolus is rarely found associated with the heteropycnotic sex chromosome mass (*R.M.*). At diplotene, there is usually a single chiasma per bivalent while occasionally two are seen in the longest bivalent. The two sex chromosomes remain as separate univalent structures. At metaphase I (Fig. 3), all the six autosomal bivalents, each containing a single terminalized chiasma, are found arranged regularly on the equatorial plate

2

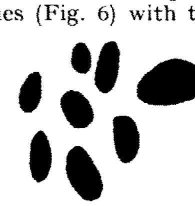
Fig. 2.–Spermatogonial metaphase.

with the central region of the ring-like arrangement being always occupied by one or the other chromosomes (Fig. 4), the X-chromosome always remaining on the periphery. The first division anaphase is equational for

3

Fig. 3.–Metaphase I, side view.

the sex chromosomes (Fig. 5). At this stage separation is not found to be parallel since the chromosomes show a bent. The second division metaphase plates show only seven chromosomes (Fig. 6) with the sex chromosomes



4

Fig. 4.–Metaphase I, polar view.

forming a pseudobivalent. Anaphase *II* is reductional for the sex chromosomes and consequently one of the daughter nuclei contain the *X* while the other the *Y* chromosome (Fig. 7).

5

Fig. 5.–Anaphase I, showing equatorial division of the *x*-chromosome.

The existence of a localised centromere in the heteropterans has been doubted by SCHRADER[1], HUGHES-SCHRADER[2] and HUGHES-SCHRADER and RIS[3], who have mostly studied coccids belonging to homoptera. The

[1] S. MAKINO, *An atlas of the chromosome numbers in animals* (Iowa, 1951).

[2] M. J. D. WHITE, *Animal Cytology and Evolution* 2nd Ed. (Cambridge University Press, 1954).

[3] G. K. MANNA, Proc. zool. Soc. Bengal. *4*, 1 (1951).

[1] F. SCHRADER, Cytologia *6*, 422 (1935).

[2] S. HUGHES-SCHRADER, Z. Zellforsch. *13*, 742 (1931); Biol. Bull. Woods Hole *78*, 312 (1940); J. Morph. *70*, 261 (1942); Advances in Genetics. *2*, (1948).

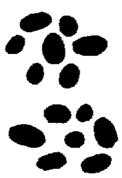
[3] S. HUGHES-SCHRADER and H. RIS, J. exp. Zool. *87*, 429 (1941).

chromosomes of coccids obey quite a different law particularly in respect to orientation and anaphase disjunction, which is parallel. It is, therefore, not unlikely that these chromosomes have a "diffuse" centromere

6

Fig. 6. Metaphase II, polar view.

similar to that of Lepidoptera (FEDELEY[1], SUOMALAINEN[2]) and LUZULA (CASTRO, CAMARA and MALHEIROS[3]). MENDES[4] has for the first time reported to have seen the position of primary constriction as a non-staining gap in an heteropteran species, *Dysdercus*, belonging to the



7

Fig. 7.–Anaphase II.

family Pyrrhocoridae. It is, therefore, not quite improbable to expect a similar centromeric constriction in the chromosomes of other heteropterans as well. An experimental verification similar to that of LACOUR[5] in LUZULA and HUGHES-SCHRADER and RIS[6] in *Steatococcus* is indeed desirable to support this statement.

I am greatly indebted to Dr. M. L. BHATIA, Head of the Department of Zoology, University of Delhi, for constant encouragement and to Dr. R. I. SAILER, Section of Insect detection and Identification, U. S. Department of Agriculture, Washington, 25, for kindly determining the specimen.

M. K. DUTT

Department of Zoology, University of Delhi, 8, India, December 21, 1954.

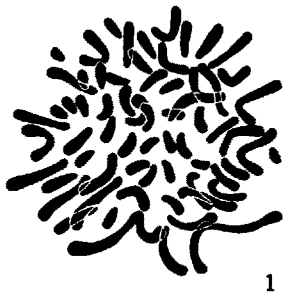
Résumé

Bagrada picta F. mâle possède 14 chromosomes dont une paire X–Y. Tous les chromosomes sont monocentriques à l'exception de l'Y chez lequel il est impossible de trouver un centromère localisé. Les autres éléments peuvent être, selon leurs dimensions et la position du centromère, rattachés à six types différents.

[1] H. FEDERLEY, Soc. sci. Fenn. *13*, 1 (1945).
[2] E. SUOMALAINEN, Hereditas. *39*, 88 (1953).
[3] D. CASTRO, A. CAMARA and N. MALHEIROS, Proc. 8th Int. Congr. Genet. Stockholm *548*.
[4] L. O. T. MENDES, Bragantia. *9*, 53 (1949).
[5] L. F. LACOUR, Heredity, Suppl. *6*, 77 (1952).
[6] S. HUGHES-SCHRADER and H. RIS, J. exp. Zool. *87*, 429 (1941).

Notes on the Cytological Feature of Male Sterility in the Mule[1]

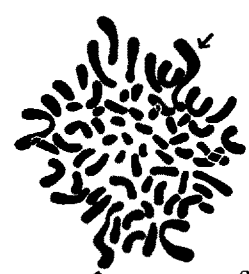
The mule and hinny are noted for their strength and endurance; they are good workers, being active and resistant to sickness. In general, mules and hinnies are sterile in both sexes, but female hybrids are said to come on heat and very rarely produce foals to the stallion or the jack-ass. There are no records of fertile male mules or hinnies.



1

Fig. 1.–Spermatogonial chromosomes of the horse.

The cytological study of the mule has remained incomplete. The chromosomes of the mule have been studied by WODSEDALEK[1] and LEON[2] who report 51 and 38 chromosomes, respectively. In the light of the results of the chromosome investigations on the horse and ass by MAKINO[3], the reinvestigation of the mule chromosomes is desirable, because the work of both WODSEDALEK and LEON is unsatisfactory by present-day standards. The present study became possible through the courtesy of Dr. Y. NISHIKAWA who placed the testicular material of a mule at the author's disposal. The specimen which furnished the material for this study was a male mule, three years of age, produced by crossing of a jack-ass with a mare.



2

Fig. 2.–Spermatogonial chromosomes of the ass.

Before dealing with the account of the mule, it seems necessary to present some descriptions on the cytological features of the horse and ass, based on the results of the present author's former studies. The number of chromosomes of the horse was reported to be 66 in diploid (MAKINO[4]). The diploid complement shows at least 12 V-shaped chromosomes, each being characterized by submedian centromeres with dissimilar arms (Fig. 1). They are very prominent in appearance in contrast to the others with terminal centromeres.

The author's observations (MAKINO[5]) revealed that in general morphology the chromosomes of the ass were very similar to those of the horse though not entirely identical. The diploid complement of the ass consists of 66 chromosomes which reduce in meiosis into 33 bivalents. There are, as in the horse, at least 12 elements

[1] Contribution No. 326 from the Zoological Institute, Faculty of Science, Hokkaido University, Sapporo, Japan. With a financial aid from the Scientific Research Fund of the Ministry of Education.

[1] J. E. WODSEDALEK, Biol. Bull. *30*, 1–56 (1916).
[2] M. VAN LEON, Ann. Gembloux *1938*, 44.
[3] S. MAKINO, Cytologia *13*, 26–38 (1943); Zool. Mag. (Tokyo) *56*, 8–15 (1944); Cytologia *16*, 288 (1952).
[4] S. MAKINO, Cytologia *13*, 26 (1943); Zool. Mag. (Tokyo) *56*, 8 (1944).
[5] S. MAKINO, Zool. Mag. (Tokyo) *56*, 8 (1944); Cytologia *16*, 288 (1952).