THE CHROMOSOMES OF AN EARWIG, FORFICULA SCUDDERI BORM.¹)

A. B. MISRA

The Benares Hindu University, India

(From the Zoological Institute, Faculty of Science, Hokkaido Imperial University, Japan)

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The chromosomes of Dermaptera have been favourite objects of study since the works of Carnoy ('85) and St. George ('87). They were followed by a number of other investigators, who studied the chromosomes in several species of earwigs, but our knowledge of the subject remains incomplete and unsatisfactory as is shown to be the case by the summaries of the subject presented by Schrader ('28) and Harvey ('16).

Soon after the publication of Schrader's treatise in 1928, Morgan ('28) added considerably to our knowledge of the subject by publishing the results of his studies on five species of earwigs. He found the diploid numbers of chromosomes in the males of Labidura bidens and of Labia minor to be 12 and 14 respectively, both having an X-Y complex in which the X is a single chromosome. According to him, Anisolabis annulipes and Anisolabis maritima, however, possess the diploid number of 25 (or 11 pairs of autosomes plus an XX-Y complex). The full complement of chromosomes in the male of Forficula auricularia is 24 or 25, depending upon the degree of fusion, or separation, of the two X components in different individuals.

Morgan ('28) also pointed out that the discrepancies in the results of the previous students of the chromosomes of Forficula auricularia were due to their inability to understand the irregular behaviour of the XX-Y complex, and suggested that the X chromosome in earwigs was either fragmenting from a large element into two small daughter chromosomes in some cases, or else two small chromosomes were fusing to form a large X chromosome, and that the differences in the observed diploid and haploid numbers given by earlier workers were accountable on this basis.

Recently, Sugiyama ('33) has published some observations on Anisolabis marginalis and Asana and Makino ('34) have reported upon Labidura riparia.

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According to SUGIYAMA ('33), there are 25 chromosomes in the spermatogonia of Anisolabis marginalis, 12 in the primary spermatocytes, and 12 or 13 chromosomes in the secondary spermatocytes. He seems to accept MORGAN's interpretation of the sex chromosomes being an XX-Y complex because he says that "the number of the heterochromosomes may be counted to be as many as three." ASANA and MAKINO ('34) have recorded 14 chromosomes in the case of Labidura riparia. The male in this case has an X-Y complex, the female X-X. No numerical deviations in the number of chromosomes were noticed nor were lagging chromosomes observed by them in this case.

Figs. 1-9. The chromosomes of Forficula scudderi. (1/12 oil imm. and K. 20 X ocular). FLEMING's fixation and HEIDENHAIN's stain. 1-2, metaphase polar view of spermatogonia. 3-4, metaphase polar view of primary spermatocyte. 5, side view of primary spermatocyte metaphase. 6-7, daughter complexes of primary spermatocyte anaphase. 8, chromatoid body. 8, metaphase polar view of secondary spermatocyte, X-class. 9, the same, Y-class.

During my stay in Sapporo, specimens of Forficula scudderi BORM. came to hand, and, in view of the conflicting opinions expressed by several of the workers on forficulid chromosomes, it seemed worthwhile to investigate the chromosomes of this species.

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Observations

*Forficula scudderi* shows 24 chromosomes in the metaphase of the spermatogonium, including the X and Y elements (Figs. 1–2). The chromosomes have the form of simple rods or ovals. In the primary spermatocytes, 12 bivalent chromosomes are clearly recognizable, as seen in Figs. 3–4. In the metaphase of the primary spermatocytes, in side view, the chromosomes present dumbbell-shaped appearance, and the XY bivalent lies at the periphery of the spindle, the X chromosome being, of course, larger in size than its mate, Y (Fig. 5). In the anaphase, the X and Y chromosomes separate, going to opposite poles of the spindle as shown in Figs. 6 and 7, thereby giving rise to two kinds of secondary spermatocytes which are represented in Figs. 8 and 9. The chromosomes of *Forficula scudderi* did not show variation in number, or any other kind of irregularity.

In view of the discrepancies in the sex-chromosomes of earwigs as noted by Morgan ('28), Prof. Oguma advised me to pay particular attention to the sex-chromosomes of *F. scudderi* with a view to detect splitting or fragmentation, if any, in its X chromosome or any sign of compositeness. The X chromosome of *F. scudderi* was, therefore, carefully examined, but no split or tendency to fragment could be detected in it. Figures 10 and 11 represent photomicrographic enlargements of the XY-complex in the meta- and the anaphases of the primary spermatocytes. It will be seen that the X chromosome is a completely spherical body, and its partner, Y, is associated with it in the characteristic manner. These photographs, therefore, clearly demonstrate the simple nature of the X chromosome in this species.

Discussion

On referring to the literature, it becomes evident that two types of sex-chromosome complexes exist in the Dermaptera, viz., X-Y and XX-Y. It is very difficult to say, in the present state of our knowledge, whether XX-Y type is the result of the fragmentation of the X chromosome in an original simple X-Y complex, or whether the X-Y complex has been derived from the fusion of the two X's represented in the XX-Y complex into a single one. *Forficula scudderi* has an X-Y complex, and in this respect, resembles *Labidura riparia, Labidura bidens* and *Labia minor* more than any other Dermapteran species so far studied. Curiously enough, the chromosomal complex of *Forficula scudderi* differs considerably from the only other worked out species belonging to this genus—*Forficula auricularia*—in which, according to Morgan, XX-Y complex exists. The two species of *Forficula* are,
therefore, dissimilar in respect of the type of the sex-chromosomes. *Forficula scudder* also resembles *Labidura riparia* in that there is no fluctuation in the chromosomal number, nor any other kind of irregularity in its meiotic divisions.

**Literature cited**


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