177. *The Chromosome Numbers and the Multiple Chromosomes in Gryllinae.*

By Hikokuro HONDA, Ph. D.

Professor of Zoology, Manchuria Educational College.

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The number of spermatogonial chromosomes in *Gryllotalpa vulgaris* has been reported to be 12 by Vom Rath ('91, '92, '95), 17 by Senna ('11), and 16 by Voinov ('12, '14). Payne ('10, '16) also worked on this species and has reported that it is 12 in the individuals from Germany and 15 in those from Italy. In *Gryllotalpa borealis*, Payne ('12, '16) has shown that the spermatogonial number is 23.

Of the subfamily Gryllinae a few species of *Gryllus* have been studied. The spermatogonial chromosome number in *Gryllus assimilis* (*lactuusus*?) has been reported by Baumgartner ('04) to be 29. Brunelli ('09) has described 21 spermatogonial chromosome in *Gryllus desertus*. *Gryllus domesticus* has been worked by Baumgartner ('04), Gutherz ('07, '08, '09) and by Meek ('13). These investigators observed the same number of spermatogonial chromosomes and it is reported to be 21.

I have been working on several species of the subfamily, and I wish here to consider their chromosome number and particularly the multiple chromosomes in one of the species. There are 25 chromosomes in the spermatogonial metaphase complex of *Gryllus mitratus*. One of them is the accessory chromosome (the sex chromosome) and it is larger than the euchromosomes. In the metaphase complex of the first spermatocyte, there are 12 tetrads and the accessory, which passes earlier to the pole than the other chromosomes. Conditions of the chromosomes in the second spermatocyte of this species and of the other species considered in the present paper, will be described in a later article.

In *Nemobius scikii*, a very small species, I have observed 17 chromosomes in the metaphase complex of the spermatogonial division. There are 8 tetrads and the accessory chromosome in the first spermatocyte metaphase.

In *Loxoblemmus arietulus* I have found three kinds of chromosome

conditions: In class *a*, the number of spermatogonial chromosomes is 15. In class *b*, it is 14. In other words the number of chromosomes is here reduced by one, owing to the association, of two chromosomes. This multiple chromosome is V-shaped. In class *c*, the spermatogonial number is 13. The multiple chromosomes are introduced from both the male and female. The accessory chromosome, as in the case of the other species, is V-shaped. The spermatogonial metaphase complex of class *a*, therefore, shows 5 V-shaped chromosomes and 10 rod-shaped ones; in class *b*, there are 6 V-shaped and 8 rod-shaped chromosomes; and in class *c*, we observe 7 V-shaped and 6 rod-shaped chromosomes. Some of the rod-shaped chromosomes in these three classes may be hook-shaped.

In several species of the Orthoptera, the presence of multiple chromosomes has been shown by other investigators. McClung ('17) has described the multiple chromosomes of *Hesprotettix* and *Mermiria*. Payne ('12, '16) has shown that in *Gryllotalpa borealis* the large V-shaped element of the unequal tetrad always passes to the same pole as the accessory chromosome in the first spermatocyte division.

In the subfamily Gryllinae the presence of multiple chromosomes has never been reported. I have found them only in *Loxoblemmus arietulus*, where they are present, in the 5 species described in the present paper and in some other species, which will be taken up in the future.

The multiple chromosomes of this species are formed by the linkage of two non-homologous euchromosomes and are V-shaped. In the first spermatocyte metaphase of class *b*, the two tetrads are linked together, end to end, to form a large V-shaped octad. The linked member of the octad always pass to the same pole, and the other two free elements pass to the opposite pole, independently of the accessory chromosome. In the metaphase of the first spermatocyte of class *c*, two V-shaped multiples are joined at their free ends since they are homologous, and form an elongated ring. In this case also the linked members always pass to the same pole.

In the first spermatocyte metaphase of this species, we observe 7 tetrads and the accessory in class *a*; 5 tetrads, a V-shaped octad and the accessory in class *b*; 5 tetrads, a ring-shaped octad and the accessory chromosome in class *c*.

The spermatogonial metaphase complex of *Nemobius fasciatus* shows 15 chromosomes. So far as my observations go, all 14 euchromosomes are rod-shaped. As has been stated above, members of class *a* of *Loxoblemmus arietulus* have the same number of chromosomes as this

species, but the presence of V-shaped chromosomes in the former convinces us at a glance that the relation between these species is not so close. Of 7 tetrads in the first spermatocyte metaphase, the largest tetrad may be heteromorphic, one of the elements being hook-shaped, and the other rod-shaped. In just one individual, the third largest tetrad is heteromorphic, one element being hook-shaped, and other rod-shaped.

The chromosome number is the smallest in *Loxoblemmus doenitzi*, among those species I have studied. There are 11 chromosomes in the spermatogonial metaphase complex. The chromosome conditions of this species resemble those of *Loxoblemmus arietulus*, a close relation between them, therefore, will be noticed on comparing their spermatogonial complexes. We observe 5 tetrads and the accessory in the metaphase of the first spermatocyte.

To summarise, the spermatogonial chromosome numbers in the subfamily Gryllinae, which have been studied by other investigators and myself, are as follows ;

<i>Gryllus assimilis</i> (Baumgartner)	28
<i>Gryllus mitratus</i> (Honda)	25
<i>Gryllus desertus</i> (Brunelli)	21
<i>Gryllus domesticus</i> (Baumgartner, Guthertz, Meek)	21
<i>Nemobius csikii</i> (Honda)	17
<i>Nemobius fasciatus</i> (Honda)	15
<i>Loxoblemmus arietulus</i> (Honda)	15
	14
	13
<i>Loxoblemmus doenitzi</i> (Honda)	11

The highest number is 29 and the lowest is 11. Species with 27, 23 and 19 chromosomes are wanting in the table. In an unidentified species of *Gryllodes*, however, the number of spermatogonial chromosomes is 19. In *Gryllodes berthellus*, it seems to be 23, but it appears to be smaller in some individuals. The chromosome conditions of this species and of the unidentified species of *Gryllodes* will be described in a later article.

Fig. 1. Geological map of the Tanohata district.
 T stands for the Tanohata zoned pluton; A-1~A-7, rock types (rock names are shown in Table 1); P, pegmatite; KO, the Koshizu pluton; U, the Uchinosawa pluton; M, the Matsumaesawa pluton; O, the Otanabe pluton; KA, the Kawaguchi pluton. A-A', B-B' and C-C' are lines of sections described in Fig. 4.