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Studies on Reptilian Chromosomes
V. Chromosomes of *Japarula swinhonis* (a Lizard)

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With 16 Text-figures

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Material and method

Japarula swinhonis is a member of the family Agamidae. The present study concerns the chromosome-complex of the male of this lizard.

Five individuals caught in May and June in the northern part of Formosa were used for material. The spermatogenetic cycle of this lizard coincides with that of *Takydromus* spp. but differs from that of *Eumeces* (NAKAMURA '31b, '34). Two individuals were kept in captivity and fed with small insects for a few weeks. Testes were fixed in both the original and the modified CHAMPY's fixative, the latter being concentrated 1.5 times as strong as the original. The chromosomes were stained with HEIDENHAIN's hæmatoxylin. All the materials have provided an abundance of dividing figures of spermatogonia and of maturation divisions. The chromosomes were fixed very satisfactorily in the modified CHAMPY's solution, but CHAMPY's original fluid did not give very adequate results. The effect of keeping the animals in captivity was not recognizable in any way.

A brief account of the present study has been given in a previous paper ('31a).

Observations

Spermatogonium

The spermatogonial chromosomes which are arranged on the equatorial plate are 46 in number (Text-figs. 1–3). They consist of telomitic rod-like chromosomes of various lengths and other dot-like ones. In Text-fig. 14 the chromosomes are assorted into apparent synaptic mates and serially aligned according to their sizes. In this figure we see that there are 12 pairs of rod-like chromosomes and 11 pairs of dot-like ones. Though the 12th pair is oval in shape and does not differ much from dot-like ones in this case, the difference may be somewhat more conspicuous in some other figures.

Arrangement of the chromosomes on the equatorial plane of the spindle is in quite the usual manner: 22 of the larger rod-like chromosomes are disposed radially, occupying the peripheral part of the plate and the others are enclosed in the centre.

First spermatocyte

The behavior of chromosomes in the growth period is exactly like that of other lizards and snakes in the corresponding stages; the convergence of threads to one side of the nucleus is not observed (NAKAMURA '28, '31, etc.).

Tetrads in the equatorial plate are 23 in number; of these 11 larger ones usually form a circle in the periphery and the remaining smaller 12 are scattered in the central area (Text-figs. 4–8). The larger 11 are usually ring-tetrads with or without prominence; the largest two may be in the form of a double-ring and the smaller ones are often in the shape of V's. The 12 smaller tetrads are dot-like or bipartite, and we can distinguish among them one comparatively large heart-shaped tetrad. There is no doubt that the larger 11 tetrads, the heart-shaped one, and the 11 smaller ones correspond respectively to the 11 pairs of rod-like chromosomes, the single pair

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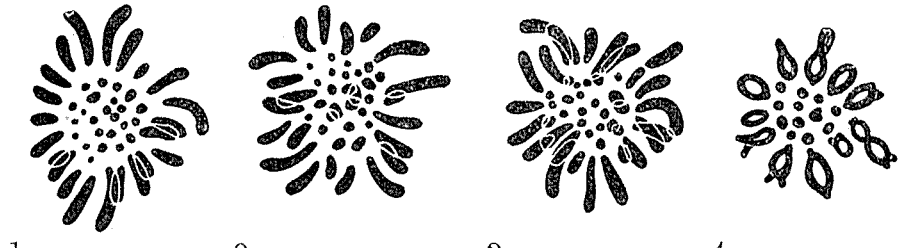
Explanation of Text-figures

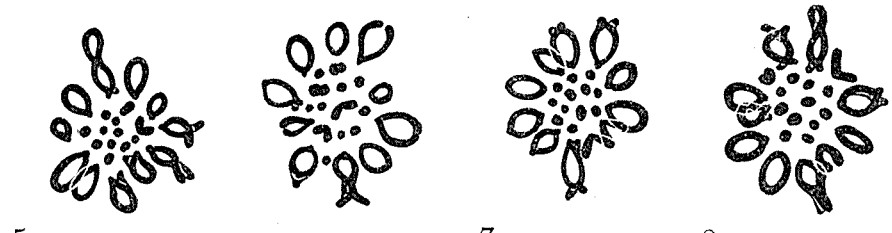
All figures are drawn with the aid of camera lucida, using Zeiss 1.5 mm. apochromatic oil-immersion objective and a K. 18 ocular, tube-length 16 cm. at a level about 25 mm. below the stage.

1–3, the spermatogonial chromosomes; 4–8, tetrads of the first spermatocytes; 9 and 10, the daughter complexes of the tetrads in the anaphase; 11–13, the dyads of the second spermatocytes; 14, the spermatogonial chromosomes, which are paired into supposed synaptic mates (from Text-fig. 1); 15, the linear arrangement of the tetrads (from Text-fig. 4); 16, the same of the dyads (from Text-fig. 11).

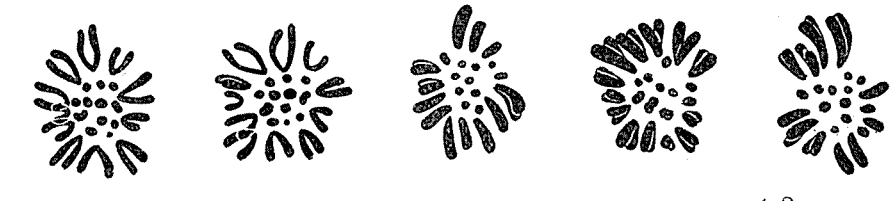
Text-figures 1–16



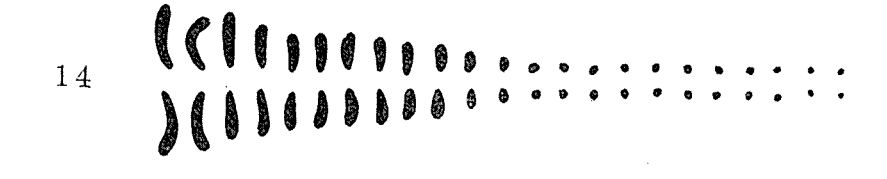
1 2 3 4



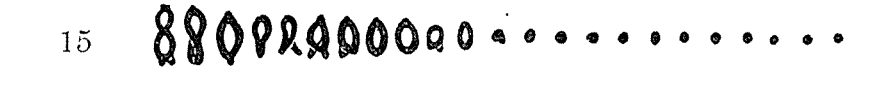
5 6 7 8



9 10 11 12 13



14



15

16

of very short rod-like chromosomes and the 11 pairs of dot-like ones of the spermatogonial complex (Text-fig. 15).

In the anaphase all the tetrads divide into identical daughter halves. Text-figs. 9 and 10 show two sets of dyads in dividing spermatocytes. There are 11 larger dyads of single V's and 12 bipartite and dot-like dyads in each set.

Second spermatocyte

In the second spermatocyte 23 dyads appear in the metaphase (Text-figs. 11–13). Of these 12 are single V's of various sizes and these are situated perpendicular to the equatorial plane of the spindle. The remaining 11 are bipartite and dot-like. In the majority of the equatorial plates, the 12 larger and 3 of the smaller dyads are arranged in the periphery and the eight small ones in the centre.

All the dyads divide into single rod-like or dot-like daughter monads and each spermatid receives 23 monads.

Remarks

I. Chromosome-complex

The chromosome-complex of the male of *Japarula swinhonis* consists of 46 chromosomes, which are made up of 22 rod-like chromosomes of various sizes, 2 very short rod-like or oval ones and 22 dot-like ones. MATTHEY ('31) has studied the male chromosome-complexes of *Agama stellio* and *Uromastix hardwicki* both belonging to Agamidae. He found in them similar chromosome-complexes. The chromosomes are 36 in number and comprise 12 V-shape macro- and 24 dot-like micro-chromosomes. In *Japarula* the chromosomes may be sorted into 24 rod-like macro- and 22 dot-like micro-chromosomes, but the macro-chromosomes are of intergrading sizes and the smallest pair is very short, so that the differentation of chromosomes into such categories is not so clear-cut as in other lizards.

Concerning the basic number of chromosomes in reptiles MATTHEY ('33) is of opinion that the fundamental complex consists of 48 chromosomes and that the 12 V-shaped chromosomes of lizards correspond to certain 24 chromosomes of the fundamental complex, which are combining into twos, while the 24 dot-like chromosomes of the lizards correspond to remaining 24 chromosomes of the fundamental complex. In *Japarula* the number of chromosomes is nearly the same as the fundamental number given by MATTHEY. Conse-

quently, it is likely that the 12 V-shaped chromosomes of *Agama* and *Uromastix* correspond to 12 rod-like pairs of *Japarula*. However, the chromosome-complex of the former two includes 24 dot-like chromosomes while that of *Japarula* has 22 such. It is not clear whether the two dot-like chromosomes of the 24 of the former have been fused with some of the rod-like ones or have been obliterated. On the whole, the chromosome-complex of *Japarula swinhonis* does not differ greatly from those of *Uromastix* and *Agama*, in spite of the fact that the chromosomes differ so much in number and shape in the two groups.

II. Sex-chromosomes

The serial alignment of chromosomes reveals that they are made up of 23 synaptic pairs. Although the assortment of snaptic mates in Text-fig. 14 is a mere approximation, it is clear that each pair consists of isomorphic chromosome-mates. Since OGUMA ('34) has found two X-chromosomes in the male of *Lacerta vivipara* and one X-chromosome in the female, a certain pair among the 46 chromosomes of *Japarula* should be XX pair. This conclusion agrees with what MATTHEY has found in *Uromastix* and *Agama*.

However, it is not clear which pair in *Japarula* is really the sex-chromosomes. In *Agama* and *Uromastix* MATTHEY has assumed that the sixth tetrad which is composed of two V-shaped dyads comprises the sex-chromosomes. According to this assumption each V-shaped chromosome corresponds to two rod-like ones of the fundamental complex; accordingly there should be four sex-chromosomes in that fundamental complex as well as in *Japarula*. But OGUMA has found two X-chromosomes in the male of *Lacerta*, so it is likely that two short rod-like X-chromosomes exist in *Japarula* and other agamid lizards also.

The chromosome-complex of this lizard is, accordingly, to be formulated as $44+X+X=46$.

Summary

1. The chromosome-complex of the male of *Japarula swinhonis* consists of 46 chromosomes, which are made up of 22 rod-like chromosomes of intergrading sizes, two very short rod-like or oval ones and 22 dot-like ones.

2. The sex-chromosomes are a pair of X-chromosomes. By maturation divisions they are distributed, one into each resulting

spermatid. Accordingly, the male of this lizard is homogametic as regards the sex-chromosomes.

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