An Idiogram Study of the Chromosomes in Some Species of Reptiles¹

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I Introduction

The order Reptilia is a group of animals in which the chromosomal survey has strikingly progressed in late years. Earlier accounts published by Loyez (1905), Trinci (1908), Delcq (1921) and Painter (1921) gave no sufficient evidence appreciable at present, as shown in the list published by Oguma and Makino, 1937. Thanks to the studies carried out by Nakamura (1927, 1928a, 1928b, 1931a, 1931b, 1932, 1935a, 1935b, 1935c, 1935d), Matthey (1931, 1933) and Oguma (1934, 1937), the knowledge of reptilian chromosomes became valid and has extended over 75 species covering 22 families at the present time. The present study which records the results of the investigation of ten species of reptiles including geckos, lizards and snakes will furnish additional evidences to the above.

The expenses for collecting the material used in this work were defrayed for the most part by the "Scientific Research Expenditure of the Department of Education".

II Material and Methods

The present investigation has been undertaken with the species of reptiles which cover five families. In nine species of them the chromosomes were studied with the testicular material, with the exception of a single species in which the embryonal gonads (ovaries) were adopted as the material. All the specimens employed here were secured and prepared by the senior author (S.M.) in his sojourns at Sakhalin, Ogasawara-jima, Amami-oshima, Okinawa and Formosa taking place during species used and their localities collected are listed in Table 2.

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The gonads were fixed both in Nakamura-Champy's solution and Hermann's mixture, immediately after collection. Following the usual paraffin method section were prepared and subjected to the Heidenhain's iron-haematoxylin method of staining with the counterstaining of light green.

III Observations

Family Gekkonidae

Referring to the literature, the chromosomes of four species have already been reported in this family. The chromosomes of *Tarentola mauritanica* and *Gymnodactylus milliusi* have been studied by Matthey (1931, 1933) and those of *Gekko japonicus* and *Hemidactylus bowringii* by Nakamura (1932). Recently Asana and Makino (1948, unpublished) added here the accounts pertaining to *Hemidactylus flavoviridis*. In the present paper the additional contribution may be made by the study of the following two species, *Gehyla variegata ogasawarasimae* and *Hemidactylus frenatus*, of which the former has furnished new material to cytology.

1. *Gehyla variegata ogasawarasimae* (Okada)

The embryonal ovaries comprise the material for the study. They were obtained in July 1936 at Chichishima of Ogasawara islands, and fixed in Hermann's mixture.

The number of chromosomes determined by examination of four nuclear plates of oogonia, is 63 without exception in every case (Figs. 1-2). The chromosomes are all rod-shape of various sizes, ranging from elongated rods to short dot-like ones, all being terminal in their spindle-fibre attachment. They show a gradual diminution in length, so that it is impossible to sort them into such distinct groups as macro- and micro-chromosomes, as done in some other lizards or snakes. The larger elements are radially arranged in the periphery surrounding the smaller ones in the central area.

The number of chromosomes here established for the female complex of this species is undoubtedly odd, and this is clearly due to the inclusion of a solitary unmated chromosome in the complex. This evidence is sufficiently suggestive of the heterogametic nature of the female cell in this form, since one knows two clear-cut cases, one in *Lacerta vivipara* (Oguma 1934) and the other in *Amyda japonica* (Oguma 1937), in both of which the female heterogamety has been highly established based on finding out the odd number of chromosomes in the female sex.¹ Unfor-

¹ The similar evidence was established by Makino and Asana (1948) in two agamid lizards (Chromosoma 3: 208-219).

Unfortunately due to the insufficient material, the present study failed to investigate the chromosomes of the male, so that the actual identification of the solitary element, the X, was impossible in this study. But the evidence presented seems to show the fact that the unmated element is represented by one of the smaller chromosomes, since the larger ones which distribute in the peripheral zone of the metaphase plate are found to constitute homologous pairs of equal size. According to Oguma (1937), the sex chromosome of the soft-shelled turtle (*Amyda japonica*) is one of minute comma-shaped chromosomes. Recently the senior author (Makino and Asana 1948) has also found the similar condition of the sex chromosome in two species of agamid lizards. Further the noticeable fact is the karyotype of this form which is highly different from those of any species of this family hitherto recorded by the previous authors. On this respect some mentions may be made later.

2. *Hemidactylus frenatus* Dumeril et Bibron

The present material consists of testes from two specimens which were collected at Tainan and Karenko, Formosa, in March and April of 1940. They were fixed in Nakamura-Champy's solution.

In the polar view of the spermatogonial metaphase there are observable 46 distinct chromosomes arranging radially in the equatorial plate (Figs. 3-4).

Figs. 1-8. 1-2. Oögonial metaphases (63 chromosomes) of *Gehyla variegata ogasawarasimae*. 3-5, *Hemidactylus frenatus*, 3, spermatogonium. 4, primary spermatocyte. 5, secondary spermatocyte. 6-8, *Japarrula polygonata polygonata*. 6, spermatogonium. 7, primary spermatocyte. 8, secondary spermatocyte.

Considered from their external appearance all of them seem to be of telomitic in the spindle fibre attachment. They considerably vary in length, ranging from long rods to dot-like ones.

The metaphase plate of the primary spermatocyte contains 23 bivalent chromosomes (Fig. 5), of which eleven are distinctly larger than others and assume the shape of ring or V, lying at the periphery. The remaining smaller ones are dot-like and scatter in the central area of the nuclear plate.

The chromosomes of the present species are nearly alike to those reported by Nakamura (1932) for *Hemidactylus bowringii*, not only in their number but also in other respects of morphology. Recently Asana and Makino (1948 unpublished) have studied the chromosomes of the Indian species of this genus, *Hemidactylus flavoviridis*, finding the same karyotypes.

Remarks: So far as the authors are aware, one knows at present seven species of the Gekkonidae, in which the chromosomes have been investigated more or less extent, the data from the present study being inclusive. Working with *Gekko japonicus*, Nakamura has found 38 chromosomes for the male diploid complement, which consist of four distinct V-shaped element and 34 rod-shaped and dot-like ones. With the exception of *Gekko japonicus* mentioned above, the following species, *Gymnodactylus milliusi* (Matthey 1933), *Tarentola maurentanica* (Matthey 1931), *Hemidactylus bowringii* (Nakamura 1932), *H. flavoviridis* (Asana and Makino 1948), *H. frenatus* (this paper) and *Gehyla variegata ogasawarashimae* (this paper) are all characterized by possessing the karyotype composed of rod-shaped components of telomitic nature, notwithstanding that the number of chromosomes is considerably different from one another, being 38 ($\sigma 2n$) in *Gymnodactylus*, 42 in *Tarentola* ($\sigma 2n$), 46 ($\sigma 2n$) in *Hemidactylus bowringii*, *H. flavoviridis* and *H. frenatus*, and 63 ($\varphi 2n$) in *Gehyla*. In comparison of the chromosomes between the above species, it is evident that *Gehyla variegata ogasawarashimae* is highly prominent not only in its chromosome number but also in the karyotype among them. The chromosome number, 63, established for this species is the largest in the Gekkonidae so far recorded. And also, the karyotype of this form is unique and furnishes a new example for the Gekkonidae.

Family Agamidae

Reference to the literature shows that the chromosomes of three species of this family have hitherto been reported upon. Matthey (1931) has given some accounts on the chromosomes of *Agama stellio* and *Uromastix hardwicki* and Nakamura (1935) has studied in some detail those

of *Japarula swinhonis*. Asana and Makino (1948) have recently made clear the chromosomes of the following three Indian forms, *Sitana ponticeriana*, *Calotes versicolor* and *Uromastix hardwicki*. The present study records the chromosomes of *Japarula polygonata polygonata*, a closely related species of *J. swinhonis* by Nakamura (1935).

3. *Japarula polygonata polygonata* (Hallowell)

Two pairs of testes obtained at Shuri, Okinawa, in March 1941 provided the material for this study. They were fixed in Nakamura-Champy's solution. The diploid number of chromosomes observed in the spermatogonial metaphase plate of this species is, without exception, 46 (Fig. 6). The diploid complement consists of telomitic chromosomes of various length, ranging in size from long rods to short dot-like ones. Close examination makes clear that 24 of them are represented by rod-like chromosomes and the remaining 22 are dot-like ones. Namely, the distinction of the chromosomes into the larger and smaller groups is more remarkable in this species than in the former. The haploid constitution in the primary spermatocyte metaphase is 23 in number which consist of 12 bivalents of larger size assuming the form of ring or V, and 11 smaller dot-like ones (Fig. 7). The secondary spermatocyte metaphase shows 23 dyad elements (Fig. 8). There are again observable 12 larger rod-like elements and 11 dot-like ones.

Remarks: Nakamura (1935) has studied the male chromosome complex of *Japarula swinhonis*, and reported that there are 24 rod-like chromosomes of intergrading sizes and 22 dot-like ones. The chromosomes of the closely allied form *Japarula polygonata polygonata* here concerned are fairly alike to those of *J. swinhonis* as mentioned above, corresponding to their taxonomical kinship between the two, either in the number of chromosomes or in the general morphology. Recently Asana and Makino (1948) has investigated the chromosomes of *Sitana ponticeriana*, a species from India, and found the similar chromosome constitution to the above forms, establishing 46 diploid and 23 haploid chromosomes. In comparison with the chromosomes of these three species, it is evident that there is no marked difference among them.

Further Asana and Makino (1948) has studied the male chromosomes of two other agamid lizards from India, *Calotes versicolor* and *Uromastix hardwicki*. These two forms were proved to possess the similar karyotypes: the number of chromosomes is 34 in diploid which consist of 12 V-shaped macro-chromosomes (12 V's) and 22 dot-like micro-chromosomes (22 D's). If it be assumed that each of the 12 V-shaped elements may be conceived as double, consisting of two rods associated at their points of fibre attachment, the 34 chromosomes (12

V's+22 D's) of *Calotes* and of *Uromastix* also are rearranged into 46 telomitic chromosomes, namely 24 rod-elements (24 R's) and 22 dot-elements (22 D's), which are found to occur in *Japaraula* and *Sitana*. Thus the numerical and morphological differences found in these forms can be readily explicable based on the fusion of 24 rod-shaped chromosomes, two by two, into 12 V-shaped multiples. The closely related karyological relationship was proved as above to occur between these agamid lizards.

Matthey (1931) reported that the chromosomes of both *Uromastix hardwicki* and *Agama stellio* are 36 in number and comprise 12 V-shaped macro—and 24 dot-like micro-chromosomes. After the close reinvestigation of the chromosomes of *Uromastix hardwicki* from India, Asana and Makino (1948) reached to the conclusion that the number of chromosomes recorded for this species by him is erroneous, as mentioned above.

Summing up the above data, there are two types of the chromosome complex, closely related with each other, in the Agamidae so far as the scope of the observation is concerned. The one is the *Japaraula*-type which consisting of 46 telomitic chromosomes; to this type *Japaraula swinhonis*, *J. polygonata polygonata* and *Sitana ponticeriana* belong. The other is the *Calotes*-type which contains 34 chromosomes consisting of 12 V-shaped and 22 dot-like ones. *Calotes versicolor* and *Uromastix hardwicki* possess the karyotype belonging to this type.

Family Scincidae

Comparatively less progress has been made in the chromosome survey of this family than in the others. Our knowledge in this direction is limited only three species. Matthey (1931) has studied the chromosomes of *Chalcides tridactylus* and *Scincus officinalis*, giving the chromosome number as 28 and 32 respectively. According to Nakamura (1931), the chromosomes of *Eumeces latiscutatus* were different from both of the above species, showing 26 in $2n$. Generally speaking, the number of chromosomes found in this family is low, as compared with those of other families. In this study the chromosomes of four species have been examined, of which two species have furnished new material for cytology.

4. *Cryptobrephalus boutonii nigropunctatus* (Hallowell)

The specimens for study were secured at Ogasawara in July 1936. The testes were fixed in modified Champy's mixture after Nakamura.

Careful examination of several metaphase plates shows that there are 28 chromosomes in the spermatogonium (Fig. 9). Morphologically the diploid complement was found to be made up of 10 macro- and 18

micro-chromosomes. The macro-chromosomes are all distinct V-shape of various sizes, being median and sub-median in attachment. The members forming the smallest pair are extremely prominent on account

Figs. 9-27 9-11, *Cryptobrephalus boutonii nigropunctatus*. 9, spermatogonium. 10, primary spermatocyte. 11, secondary spermatocyte. 12-13, *Eumeces marginatus*, spermatogonia. 14-15, *Eumeces elegans*, spermatogonia. 16-19, *Sphenomorphus indicus*. 16-17, spermatogonia. 18, primary spermatocyte. 19, secondary spermatocyte. 20-22, *Vipera berus sachaliensis*. 20, spermatogonium. 21, primary spermatocyte. 22, secondary spermatocyte. 23-25, *Trimeresurus okinavensis*, spermatogonia. 26-27, *Trimeresurus flavoviridis*, spermatogonia.

of their outstanding small size. The micro-chromosomes are telomitic in the fibre attachment and range in shape from short rods to dot-like ones.

The primary spermatocyte metaphase shows 14 bivalent chromosomes (Fig. 10), of which four larger elements assume the shape of multiple ring. They evidently correspond to four pairs of large V-shaped chromosomes in the diploid set. The metaphase of the secondary spermatocyte shows 14 dyads (Fig. 11). The macro- and micro-chromosomes are again distinct in this case.

The chromosome number of the present species is entirely accordant with that reported by Matthey (1931) for *Chalcides tridactylus*. But a comparison of the chromosomes between them reveals a marked difference. According to Matthey (1931) the chromosome complement of *Chalcides* consists of 8 V-shaped macro-chromosomes, and 20 rod- and dot-like ones. Closer comparison is, however, impossible, since the figures presented by Matthey (1931) are not extremely clear.

5. *Eumeces marginatus* (Hallowell)

In two pairs of testes obtained at Okinawa in March and April 1941 the present study was carried out. They were fixed in modified Champy's solution after Nakamura.

Spermatogonial chromosomes are 26 in number (Figs. 12-13). They can clearly be sorted into macro- and micro-chromosomes as in some other lizards. The macro-chromosomes consist of V-shaped chromosomes of various sizes, which are disposed radially in the periphery. In some cases, the arms of V-shaped elements are so widely opened that the chromosomes appear as rod. The micro-chromosomes are 14 in number and terminal in attachment.

Owing to the unfavourable season of collection, the maturation divisions were entirely absent in the present material.

Nakamura (1931) has reported upon the chromosomes of a related species, *Eumeces latiscutatus* with detailed description. The general configuration of the chromosomes of *Eumeces marginatus* seems to be identical with that of *E. latiscutatus*, either in the number of chromosomes or in the morphological characteristics.

6. *Eumeces elegans* (Boulenger)

The present material consists of testes from two specimens, one collected at Tainan, Formosa in March 1940 and the other at Okinawa in April 1941. They were fixed in Nakamura-Champy's solution.

The diploid number of chromosomes in the spermatogonial metaphase is 26, which can clearly be classified into two categories, 12 V-shaped macro- and 14 rod- or dot-like micro-chromosomes (Figs. 14-15).

Six pairs of V-shaped chromosomes are all submedian in spindle attachment, showing a size diminution, though there are two pairs of nearly identical chromosomes, namely the third and the fourth largest ones. The micro-chromosomes consist of seven pairs of rod- or dot-like chromosomes with terminal attachment.

From the observations above mentioned, it is clear that three species of *Eumeces* uniformly possess the diploid number of 26 which consist of six pairs of V-shaped chromosomes and seven pairs of rod- and dot-like ones. Morphological comparison reveals that there is no essential difference in the chromosomes of these three species, not only in the number, but also in other morphological features.

7. *Sphenomorphus indicus* (Grey)

The present material came from two different localities, Koshun, Formosa in March 1940, and Izumi, Okinawa in March 1941. The testes were fixed in Hermann's mixture and in Nakamura-Champy's solution.

The spermatogonial division shows 28 chromosomes in metaphase (Figs. 16-17). They are divided into two kinds of chromosomes, namely macro- and micro-chromosomes. The macro-chromosomes are 10 in number, all being of distinct V-shape. The micro-chromosomes consist of 18 rod- and dot-like telomitic chromosomes, scattering in the central area of the plate. The largest pair of the rod-like chromosomes is larger than the arms of the smallest V-shaped chromosomes.

The primary spermatocyte metaphase shows 14 bivalent chromosomes (Fig. 18), of which the larger elements take the shape of multiple ring excepting some smaller chromosomes which are heavy V- or cross-shaped. The nine smaller elements are thick V or rod in form. The same number of chromosomes, 14, was again observed in the secondary spermatocyte (Fig. 19), which are provided with the half set of the diploid chromosomes.

The number of chromosomes of this species is the same as that of *Cryptobrephalus boutonii nigropunctatus* already described in this paper. Furthermore, the chromosomal constitution is also of similar nature in both of the two species.

Remarks: Including the data presented in this paper, the chromosomes of seven species have been worked out in the family Scincidae. As a whole, the chromosomes of this family are characterized by the relatively low number as compared with those of other families, such as 32, 28 and 26. So far as the observations go, there are 4 kinds of karyotypes in this family (Table 1).

Table 1.

(1)	4	V's+28	R's=32	(<i>Scincus officinalis</i>)
(2)	8	V's+20	R's=28	(<i>Chalcides tridactylus</i>)
(3)	10	V's+18	R's=28	(<i>Cryptobrephalus boutonii nigropunctatus</i>) (<i>Sphenomorphus indicus</i>)
(4)	12	V's+14	R's=26	(<i>Eumeces latiscutatus</i> , <i>E. marginatus</i> , <i>E. elegans</i>)

V=atелomitic V-shaped chromosomes.

R=telomitic chromosomes including rod- and dot-like ones.

As given above, three related species of *Eumeces* are nearly alike in their chromosomal constitution, without showing any essential difference. *Cryptobrephalus nigropunctatus* and *Sphenomorphus indicus* are closely related with each other in their chromosomes by possessing the identical karyotype. The numerical and morphological differences of chromosomes between *Eumeces* and *Cryptobrephalus* (and *Sphenomorphus* also) may be accounted for on the basis of the formation of multiple chromosomes by means of the fusion of the two rods at the inner end into V. If two V-shaped chromosomes of *Eumeces* be conceived as four rods, the total number becomes 28, that is the number established for *Cryptobrephalus* and *Sphenomorphus*. The similar relationship is found to occur between *Scincus* and *Chalcides*. If four V's of *Chalcides* be assumed as light rods, the induced number of chromosomes is 32 in total, which is obtained for *Scincus*. Considered from the chromosomal relation thus attained, it may be possible to deduce the taxonomical relationships that the genus *Scincus* and the genus *Chalcides* are closely related with each other, and further that the genus *Eumeces* is nearly allied to the genera *Cryptobrephalus* and *Sphenomorphus*.

Family Viperidae

An account of the chromosomes of *Vipera aspis* belonging to this family has been published by Matthey (1933), giving 42 diploid and 21 haploid numbers of chromosomes. In the present paper the chromosomes of the related species, *Vipera berus* will be described.

8. *Vipera berus sachaliensis* (Carewskij)

For study the testicular material from two males obtained in Sakhalin in May, 1933 were employed. The fixative used is Champy's solution. The spermatogonial chromosomes are, without exception, 36 in number (Fig. 20). They consist of five pairs of V-shaped, three pairs of rod-like and ten pairs of dot-like chromosomes. Of the V-shaped elements, two pairs are extremely large, one pair is medium-sized and two remaining pairs are comparatively small. They are median or submedian in attachment. The rod- and dot-like chromosomes possess the terminal structure in attachment.

In the primary spermatocyte the bivalent chromosomes are 18 in number. They consist of two large ones of multiple ring-shape, six medium ones of ring- or thick V-shape and ten small ones of heavy rod- or dot-shape. The secondary spermatocyte shows again 18 chromosomes, comprising two large V's, one medium-sized V, two small V's, three rods and ten dots (Fig. 22).

Remarks: It has been recorded by Matthey (1933) that *Vipera aspis*, closely related to the present *V. berus*, possesses the chromosome number of 42 in $2n$. According to him the chromosome complex of *V. aspis* was provided with two pairs of V's, nine pairs of rods of intergrading sizes and ten pairs of dots (4V's+18R's+20D's). But in *V. berus*, it is composed of five pairs of V's, three pairs of short rods and ten pairs of dots (10V's+6R's+20D's). As three pairs of V's in *V. berus* are assumed to correspond to six pairs of rods in *V. aspis* under comparison, the numerical and morphological differences existing in these two species can be clearly explicable by the hypothesis of the multiple chromosome formation by means of the fusion of two rods. Further detailed accounts may be referable to the paper of Nakamura (1935).

Family Crotalidae

Reference to the literature shows that the chromosomes of four species, *Agkistrodon acutus*, *A. halys blomhoffi*, *Trimeresurus macro-squamatus* and *T. gramineus stejnegeri*, of this family have been reported upon by Nakamura (1935).

9. *Trimeresurus okinavensis* (Boulenger)

The present material was obtained in Amami-Oshima in April 1941. The testes were fixed in Nakamura-Champy's solution. The specimen was unfavourable to observe the maturation divisions, being too young in age.

Every metaphase plate of the spermatogonium observed shows constantly 36 chromosomes as $2n$ (Figs. 23-25). The complement is remarkable in having the following constituent: two pairs of large V's, one pair of medium-sized V's, two pairs of small V's, three pairs of rods and ten pairs of dot-like ones. The smaller V-shaped elements are larger in size than the largest rod-like ones and sometimes they assume the form of curved rod.

10. *Trimeresurus flavoviridis* (Hallowell)

The present specimen was obtained from the same locality as the former. The material provided no cells undergoing maturation divisions due to young age of the animal.

The spermatogonial complement consists of 36 chromosomes, of which five pairs are V-shaped elements with the submedian constriction and thirteen pairs are rod- and dot-like ones with the terminal attachment (Figs. 26–27). Among the V-shaped chromosomes one can distinguish two pairs of large size, one pair of medium and two pairs of small elements. Among the terminal members, three pairs are rod-like chromosomes having intergrading lengths, while ten pairs are dot-like in outline having a gradational diminution of size. The result of this observation indicates, therefore, that the chromosome complex of this form is closely identical to that found in the former species, *T. okinavensis*.

Remarks: Nakamura (1935) has investigated the chromosomes of

Table 2. The species under observation and the chromosome formulae established in them

Species	Chromosome number			Locality collected
	$2n$	n	Chromosome-formula	
Family Gekkonidae				
<i>Gehgla variegata ogasawarasimae</i>	63 oog		63 R's	Ogasawara
<i>Hemidactylus frenatus</i>	46 spg	23	46 R's	Formosa
Family Agamidae				
<i>Japarula polygonata polygonata</i>	46 spg	23	46 R's	Okinawa
Family Scincidae				
<i>Cryptobrephalus boutonii nigropunctatus</i>	28 spg	14	10 V's+18 R's	Ogasawara
<i>Eumeces marginatus marginatus</i>	26 spg		12 V's+14 R's	Okinawa
<i>Eumeces elegans</i>	26 spg		12 V's+14 R's	Okinawa, Formosa
<i>Sphenomorphus indicus</i>	28 spg	14	10 V's+18 R's	„
Family Viperidae				
<i>Vipera berus sachaliensis</i>	36 spg	18	10 V's+26 R's	Sakhalin
Family Crotalidae				
<i>Trimeresurus okinavensis</i>	36 spg		10 V's+26 R's	Amami-oshima
<i>Trimeresurus flavoviridis</i>	36 spg		10 V's+26 R's	„

V=atelomitic chromosomes, including those of V- and J-shape.

R=telomitic chromosomes, including rod- and dot-like ones.

oog=oogonium. spg=spermatogonium.

two other species belonging to *Trimeresurus*, namely, *T. macrosquamatus* and *T. gramineus stejnegeri*, both obtained in Formosa. By referring to his study it is evident that the chromosome-complexes of these two Formosan forms are very closely related to those of the two Amami-Oshima species dealt with in this paper, and that there is detected no essential difference under comparison of the chromosomes in these four species of *Trimeresurus*, all being characterized by the uniform complex formulated as $10V's+6R's+20D's=36$. It can be stated from this evidence that these four species of *Trimeresurus* are closely allied with each other, not only in the taxonomical relation but also in the karyological constitution.

Extensive studies made by Nakamura (1935) revealed that the chromosome-complex formulated as $10V's + 6R's + 20D's = 36$ is found widely distributed through the Ophidia. On this basis he stated that the chromosome-complex, $10V's + 6R's + 20D's = 36$, was considered as the fundamental complex of snakes.

Summary

The chromosomes of ten species of reptiles were investigated in male germ cells through spermatogenesis, with special regard to the karyotype. Table 2 gives the chromosome relationship in the species under study which are arranged in systematic order.

By way of summary it may be said that the chromosomal relation of reptiles is on the whole closely related within the genus, but it seems not the same with the family, since a family includes various karyotypes considerably different in the chromosome constitution.

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