ACTA ZOOLOGICA ET PATHOLOGICA ANTVERPIENSIA N° 76/1981, p. 73-118

DESCRIPTION OF THE ORCEIN STAINED KARYOTYPES OF 36 LIZARD SPECIES *(LACERTILIA, REPTILIA)* BELONGING TO THE FAMILIES TEIIDAE, SCINCIDAE, LACERTIDAE, CORDYLIDAE AND VARANIDAE *(AUTARCHOGLOSSA)*

by

DE SMET Willem H.O.*

(Received for publication on 9 January 1981)

The karyotypes of 36 species of lizards belonging to five different families of the suborder Autarchoglossa have been investigated. The results concern behaviour of the chromosomes after staining with acetic orcein. The results of the chromosome banding techniques will be the subject of another paper.

Teiidae :	*Ameiva chrysolaema* COPE
	Tupinambis nigropunctatus SPIX
	Tupinambis teguixin (L.)
Scincidae :	*Chalcides chalcides* (L.)
	Chalcides ocellatus polylepis WERNER
	Eumeces schneideri (DAUD.)
	Mabuya capensis (GRAU)
	Mabuya carinata (SCHNEID.)
	Mabuya multifasciata (KUHL)
	Mabuya quinquetaeniata de JEUDE
	Mabuya varia (PETERS)
	Riopa sundevallii (SMITH)
	Tiliqua scincoides (WHITE)
Lacertidae :	*Acanthodactylus pardalis* (LICHTENST.)
	Acanthodactylus scutellatus DUM. & BIBR.
	Lacerta agilis L.

* Laboratorium voor Algemene Biologie en Dierkunde - R.U.C.A., Groenenborgerlaan 171, 2020 Antwerpen, Belgium.

	Lacerta melisellensis BRAUN.
	Lacerta hispanica BLNGR.
	Lacerta muralis brueggemanni BEDR.
	Lacerta ocellata DAUD.
	Lacerta sicula campestris (DE BETTA)
	Lacerta viridis (LAUR.)
	Lacerta vivipara (JACQ.)
	Psammodromus algirus (L.)
Cordylidae :	*Gerrhosaurus flavigularis* WIEGM.
	Gerrhosaurus major BLNGR.
	Cordylus giganteus A. SMITH.
	Cordylus jonesii BLNGR.
	Cordylus vittifer (REICH.)
	Platysaurus guttatus A. SMITH
	Platysaurus minor FITZS.
	Pseudocordylus subviridis A. SMITH
Varanidae :	*Varanus bengalensis* L.
	Varanus exanthematicus (DAUD.)
	Varanus griseus (DAUD.)
	Varanus salvator (LAUR.)

I. MATERIALS AND METHODS

The animals were intraperitoneally inoculated with a 0,5 % colchicine solution. After one to three hours the animals were anesthesized until death. The spleen and gonads were removed. Tissue fragments were finely minced with sharp scissors and treated with 0,9 % Na-citrate solution. The cells were fixed in methanol-acetic acid (3 : 1) and spread on ice-chilled microscope slides. Staining of the chromosomes followed the classical acetic-orcein method. At least 30 metaphase plates of each animal were examined. A Leitz Orthoplan microscope equiped with an Orthomat photographic apparatus was used. The length of the single chromosomes and the position of the centromeres was measured five times with a curvimeter on prints magnified to 4000× (fig. 1).

Chromosome description and nomenclature for centrometric position follows the system of LEVAN et al. (1964). With the terms macro- and microchromosomes we refer to those chromosomes longer or shorter than 1μ (OHNO : 1970). The position of the centromeres of the microchromosomes was

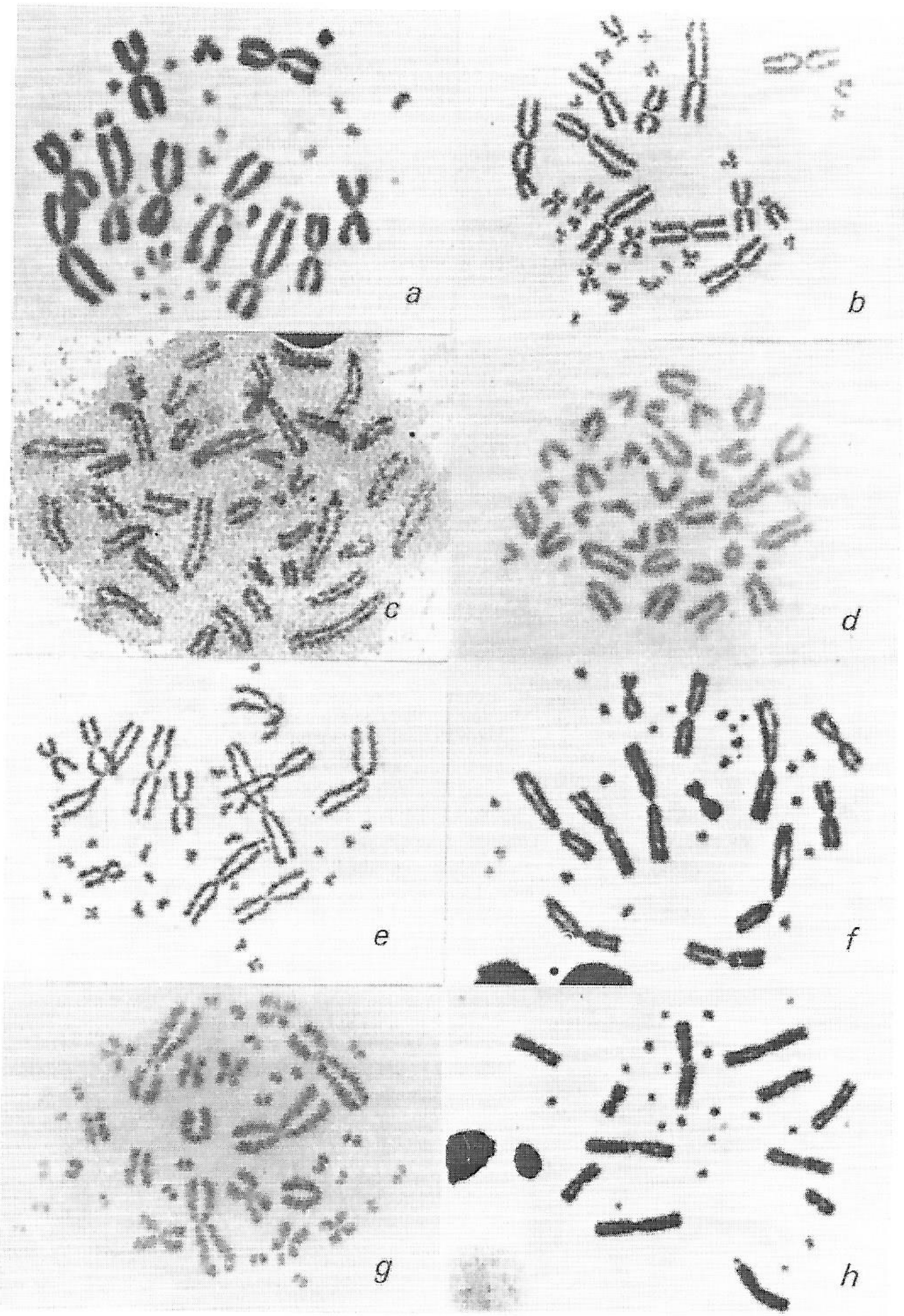

Fig. 1 – Metaphase plates of the somatic-cell chromosomes :

(a) *Tupinambis teguixin;* (b) *Tiliqua scincoides;*
(c) *Acanthodactylus scutellatus;* (d) *Lacerta agilis;*
(c) *Gerrhosaurus major;* (f) *Cordylus vittifer;*
(g) *Varanus griseus;* (h) *Platysaurus guttatus.*

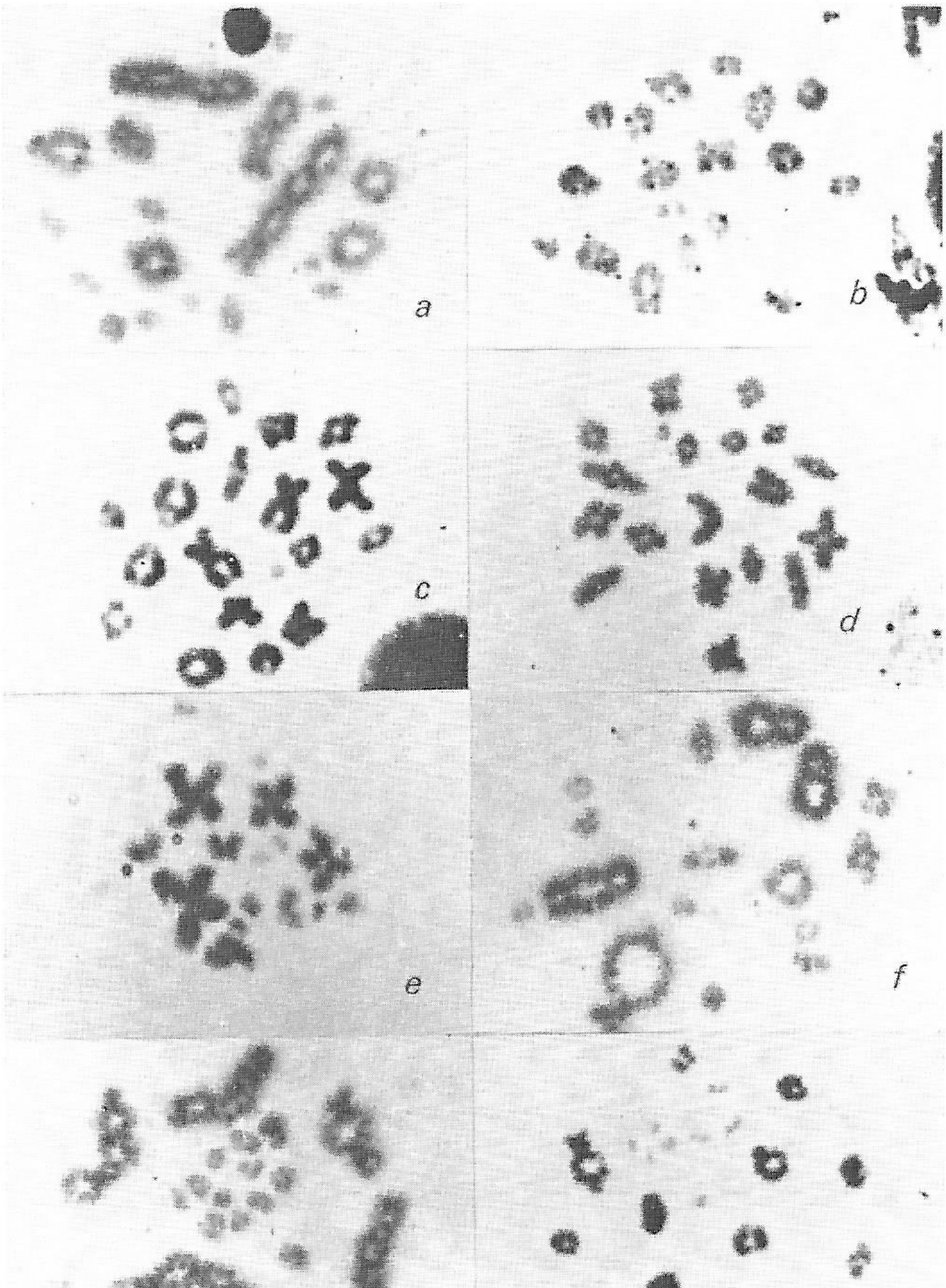

Fig. 2 – Male meiotic cells.

(a) *Varanus exanthematicus* diakinesis;
(b) *Lacerta vivipara* diakinesis;
(c) *Lacerta muralis brueggemanni* diakinesis;
(d) *Lacerta hispanica* diakinesis;
(e) idem Metaphase II;
(f) *Mabuya capensis* diakinesis;
(g) *Tupinambis nigropunctatus* diakinesis;
(h) *Ameiva chrysolaema* diakinesis.

in many cases difficult to identify. In those cases the microchromosomes were listed as telocentric and represented as such in the idiograms. The « nombre fondamental » (N.F.) was determined following MATTHEY (1949), taking however into consideration the 1μ limit of the micro-chromosomes.

II. SPECIES SURVEY

2.1 Teiidae

1. Ameiva chrysolaema COPE, 1 ♂. (Fig. 3)

The 2n chromosome number is 50. The total chromosome length is 30.9μ. The length of the chromosomes progressively decreases from 4.9μ or 15.7 % to $\pm$0.1 μ or 0.3 %. There are 11 pairs of macro- and 14 pairs of microchromosomes. All macrochromosomes and probably the microchromosomes too are acrocentric. Diakinesis (fig. 2h) shows 25 bivalents.

N.F. = 22 I + 28 m = 50.

2. Tupinambis nigropunctatus SPIX, 1 ♂. (Fig. 4)

The 2n chromosome number is 38. The total chromosome length is 43.2 μ. The length of the chromosomes varies from 7.1 μ or 16.3 % to $\pm$ 0.5 μ or 1.2 %. There are 8 pairs of macro- and 11 pairs of microchromosomes. The macrochromosomes 1-5 are distinctly larger (7.1 - 4.6 μ) than the pairs 6-8 (1.8 - 1.2 μ). Pairs 1 to 5 are metacentric. The other chromosomes are probably meta- to submetacentric. Pair 2 has satellites on the longest arms. Diakinesis (fig. 2g) shows 5 large and 14 small bivalents.

N.F. = 32 (16 V) + 22 m = 54.

3. Tupinambis teguixin (L.), 1 ♂. (Fig. 1a, 5)

The 2n chromosome number is 36. The total chromosome length is 57.7 μ. The largest chromosome is 11.5 μ or 19.9 % and the smallest $\pm$ 0.4 μ or 0.7 %. There are 9 pairs of macro- and 9 pairs of microchromosomes. Pairs 1 to 5 are metacentric and relatively larger (11.5 - 6.8 μ) than the smaller pairs 6 to 9 (2.7 - 1.3 μ). Pair 6 is submetacentric, while pairs 7 and 8 are metacentric. The remaining chromosomes are probably meta- to submetacentric. Pair 2 has satellites on the longest arms.

N.F. = 36 (18 V) + 18 m = 54.

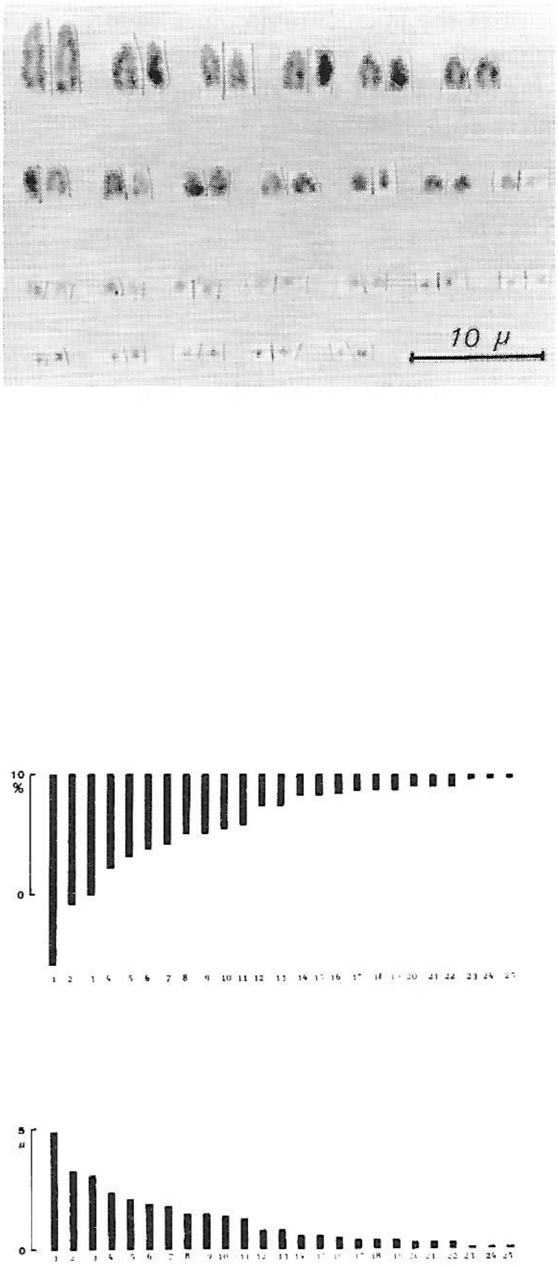

Fig. 3 – *Ameiva chrysolaema*

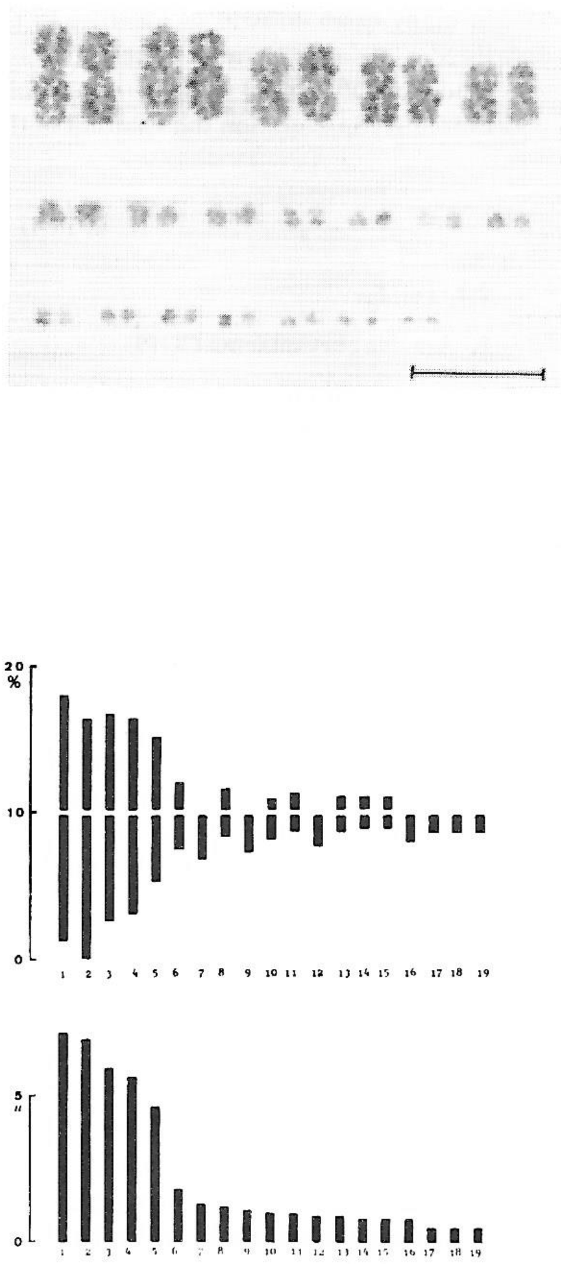

Fig. 4 – *Tupinambis nigropunctatus*

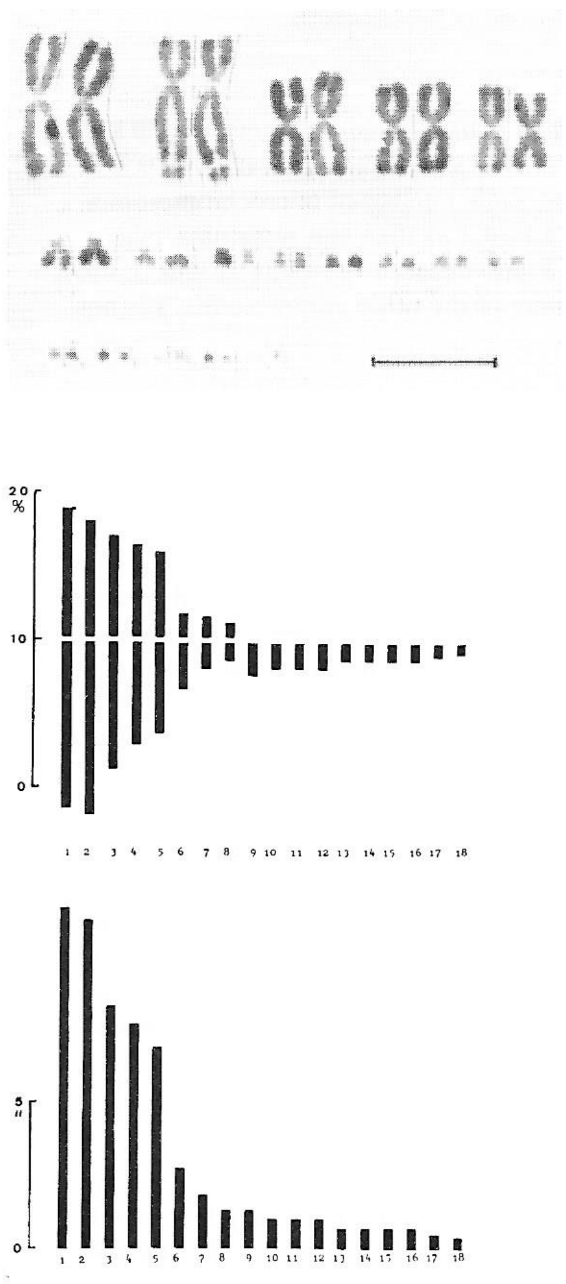

Fig. 5 – *Tupinambis teguixin*

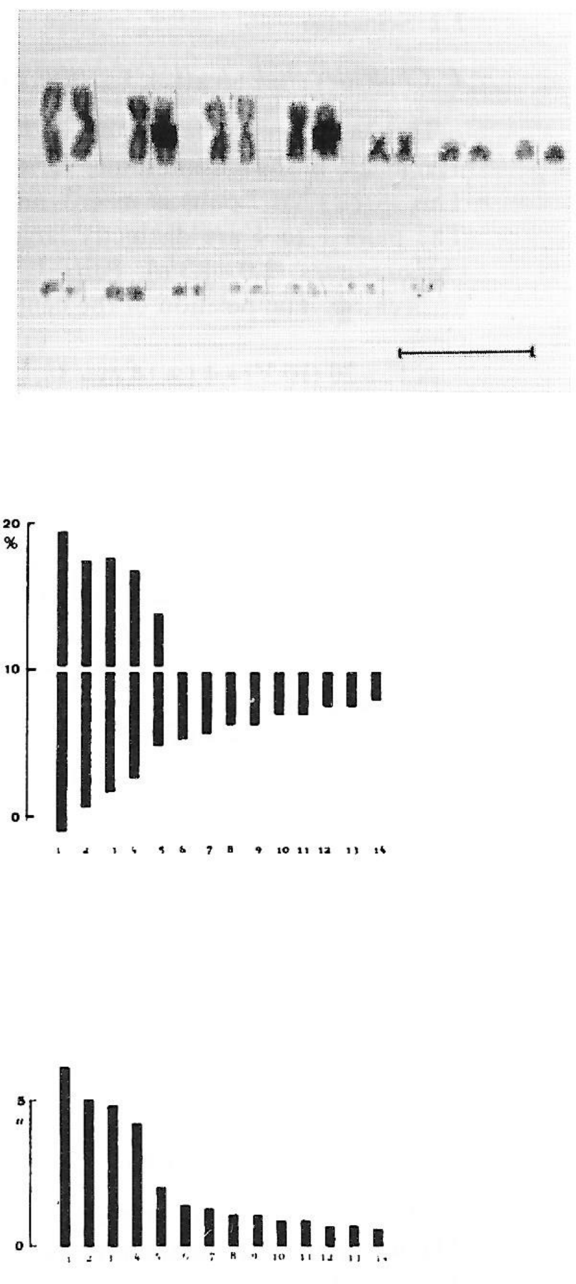

Fig. 6 – *Chalcides chalcides*

2.2 Scincidae

4. Chalcides chalcides (L.), 1 ♀. (Fig. 6)

The 2n chromosome number is 28. The total chromosome length is 30.8 μ. The length of the chromosomes varies from 6.1 μ or 19.8 % to $\pm$ 0.7 μ or 2.3 %. This species has 7 pairs of macro- and the same number of microchromosomes. The pairs 1 to 4 are distinctly larger (6.1 - 4.2 μ) than the remaining macrochromosomes (2.0 - 1.3 μ). Pairs 1 to 5 are metacentric; pairs 6 and 7 are acrocentric. The position of the centromere of the other chromosomes was not clear.

N.F. = 20 (10 V) + 4 I + 14 m = 38.

5. Chalcides ocellatus polylepis WERN., 1 ♀. (Fig. 7)

The 2n chromosome number is 28. The total chromosome length is 44.7 μ. The length of the chromosomes varies from 8.9 μ or 19.8 % to $\pm$ 0.9 μ or 2.0 %. There are 10 pairs of macro- and 4 pairs of microchromosomes. The first four pairs are distinctly larger (8.9 - 5.9 μ) than the remaining macrochromosomes (3.0 - 1.3 μ). All chromosomes are metacentric, with the exception of the submetacentric pair 7. Pair 7 shows a secondary constriction just above the centromere.

N.F. = 40 (20 V) + 8 m = 48.

6. Eumeces schneideri (DAUD.), 1 ♀. (Fig. 8)

The 2n chromosome number is 32. The total chromosome length is 56.2 μ. The length of the chromosomes varies from 10.1 μ or 17.9 % to $\pm$ 0.9 μ or 1.6 %. This species has only one pair of microchromosomes. Pairs 1 and 2 are metacentric and clearly larger (10.1 - 8.8 μ) than the remaining chromosomes. From pair 3 to 16 the length more or less progressively decreases. The pairs 3 and 6 are also metacentric. Pairs 12 and 14 are submetacentric, the remaining chromosomes are acrocentric.

N.F. = 24 (12 V) + 18 I + 2 m = 44.

7. Mabuya capensis (GRAY), 1 ♂. (Fig. 9)

The 2n chromosome number is 32. The total chromosome length is 42.4 μ. The length of the chromosomes varies from 8.7 μ or 20.6 % to $\pm$ 0.4 μ or 0.9 %. There are 8 pairs of macro- and the same number of microchromosomes. Pairs 1 to 5 are metacentric, the pairs 6 to 8 are submetacentric. The structure of the

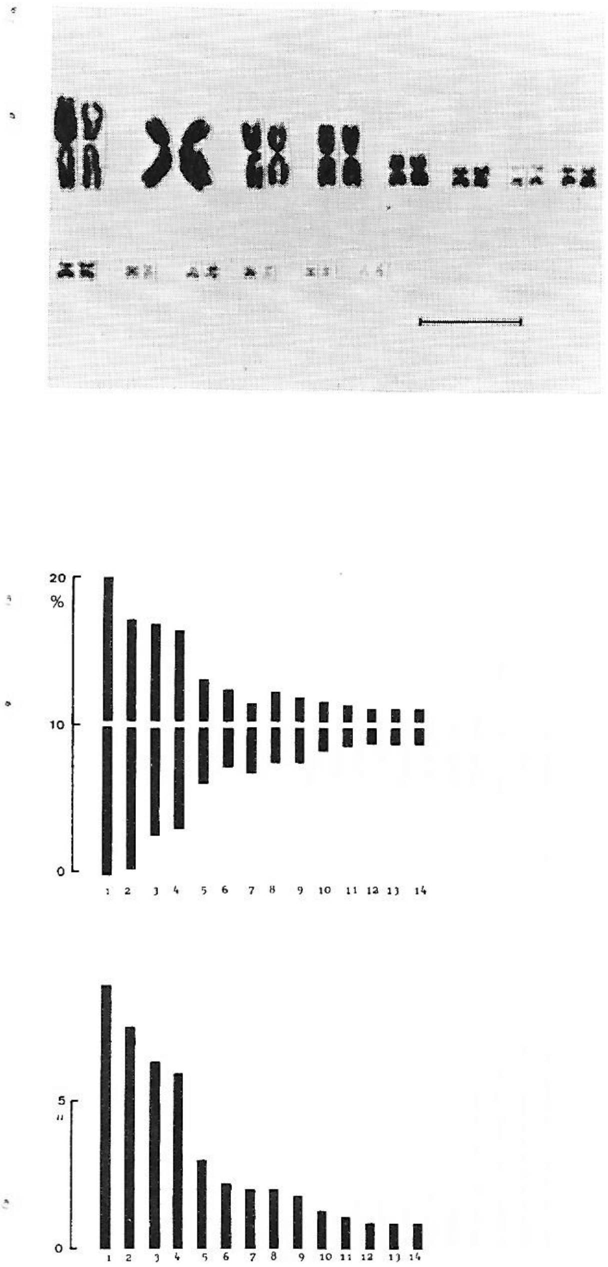

Fig. 7 – *Chalcides ocellatus polylepis*

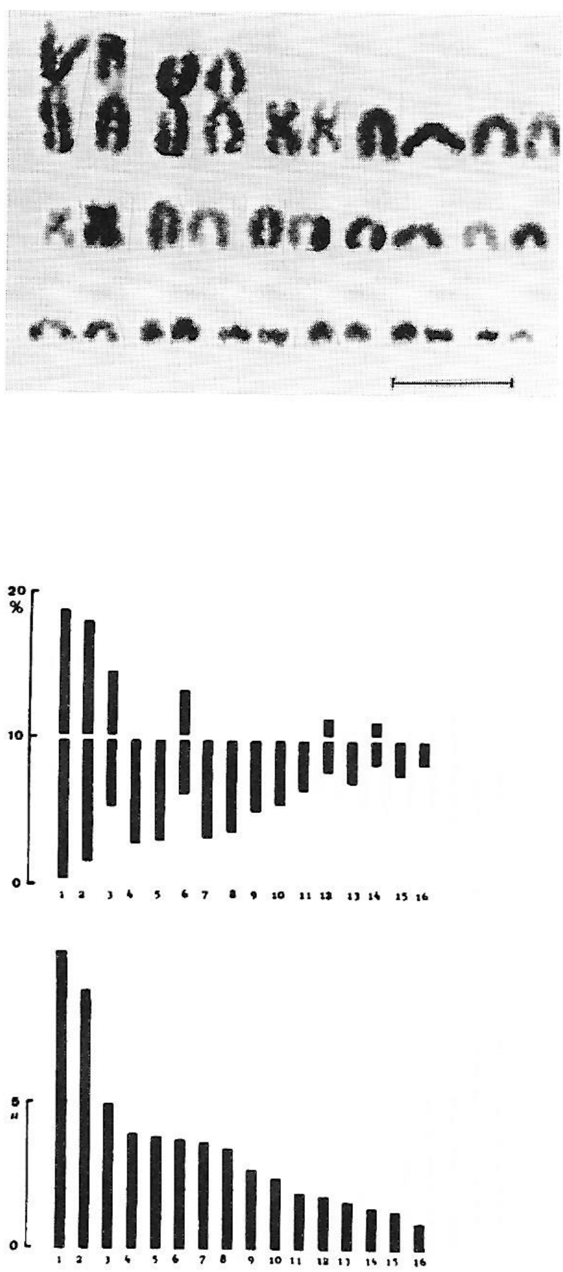

Fig. 8 – *Eumeces schneideri*

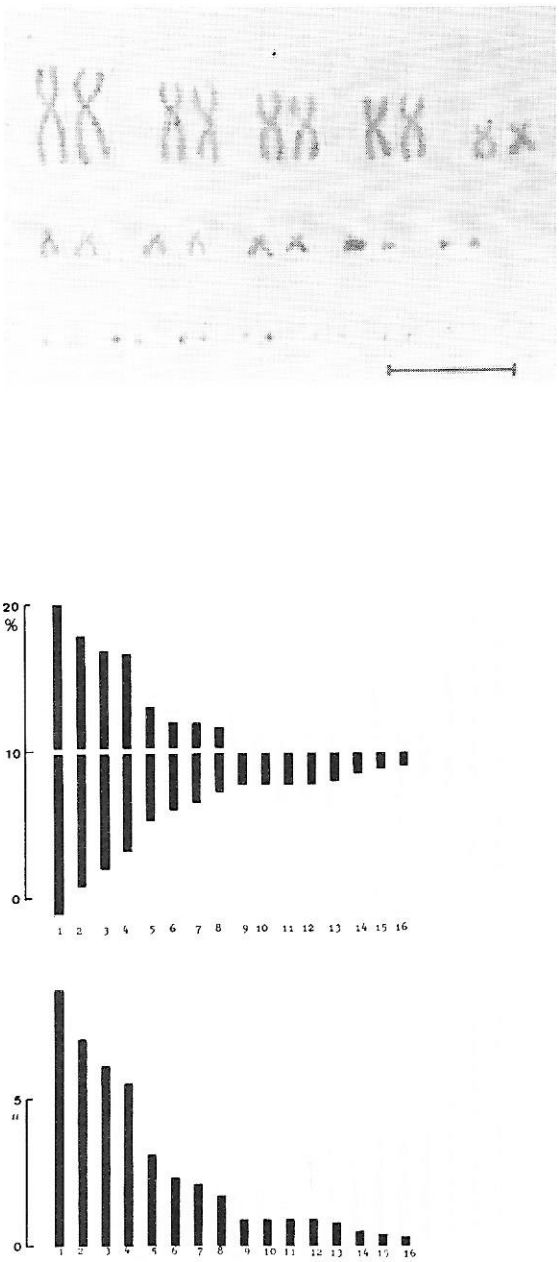

Fig. 9 – *Mabuya capensis*

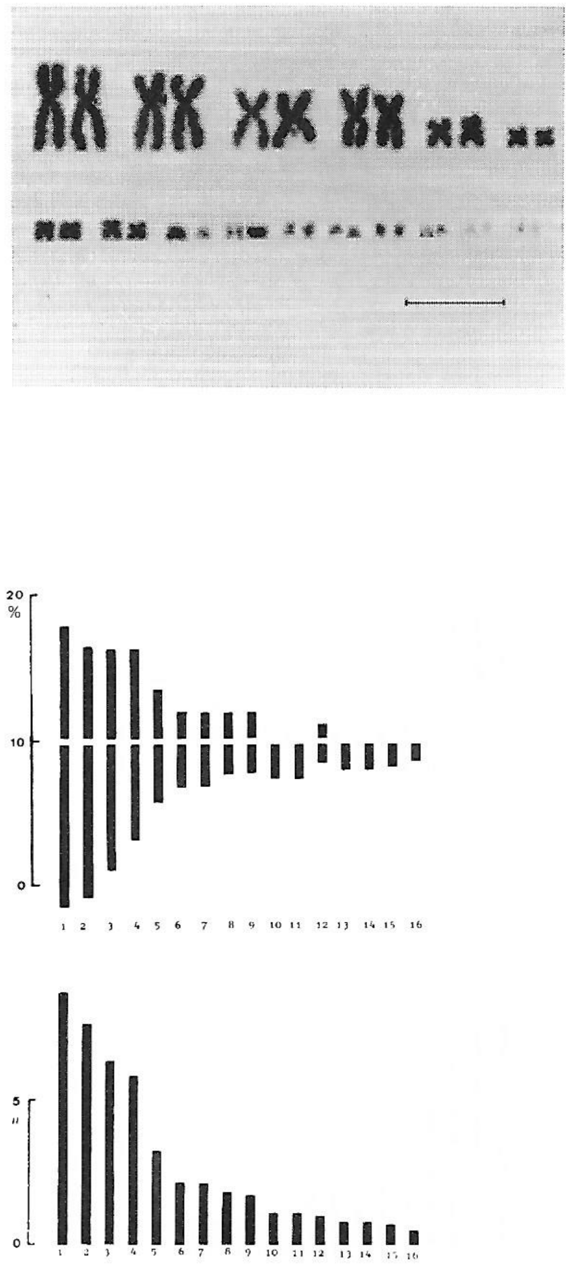

Fig. 10 – *Mabuya carinata*

microchromosomes is not clear. Diakinesis (fig. 2f) and metaphase II (fig. 2e) show half of the diploid number. Secondary constrictions are present above and under the centromeres of the chromosomes n° 1 and 2.

N.F. = 32 (16 V) + 16 m = 48.

8. Mabuya carinata (SCHNEID.), 1 ♀. (Fig. 10)

The 2n chromosome number is 32. The total chromosome length is 45.2 μ. The length of the chromosomes varies from 8.6 μ or 19.1 % to ± 0.5 μ or 1.2 %. This species has 9 pairs of macro- and 7 pairs of microchromosomes. The dividing line between the macro- and the microchromosomes is not sharp. Pairs 1 to 9 are metacentric; of the microchromosomes 4 pairs are probably meta- to submetacentric. Secondary constrictions are to be found above and under the centromeres of the chromosomes n° 1 and 2.

N.F. = 36 (18 V) + 14 m = 50.

9. Mabuya multifasciata (KUHL), 1 ♀. (Fig. 11)

The 2n chromosome number is 32. The total chromosome length is 46.0 μ. The length of the chromosomes varies from 8.0 μ or 7.4 % to ± 1.0 μ or 2.2 %. All chromosomes, the last two pairs excepted, are macrochromosomes. Pairs 1 to 7 are rather large (8.0 - 2.2 μ) and metacentric. Pairs 8 and 9 are acrocentric. The remaining smaller chromosomes are probably meta- to submetacentric. The chromosomes 1 and 2 have a secondary constriction above and under the centromere.

N.F. = 48 (24 V) + 4 I + 4 m = 56.

10. Mabuya quinquetaeniata de JEUDE, 1 ♀. (Fig. 12)

The 2n chromosome number is 33/34. The total chromosome length is 54.5 μ. The length of the chromosomes varies from 10.1 μ or 18.5 % to ± 0.9 μ or 1.7 %. This species has 13 pairs of macrochromosomes progressively shading off into 3 to 4 pairs of microchromosomes. The very small (0.4 μ) chromosome pair n° 17 was not always found in the different metaphase plates examined. All chromosomes are of the meta- or submetacentric type. Pairs 1 and 2 have a secondary constriction above and under the centromere.

N.F. = 52 (26 V) + 6/8 m = 58/60.

11. Mabuya varia (PETERS), 1 ♂. (Fig. 13)

The 2n chromosome number is 32. The total chromosome length is 30.0 μ. The length of the chromosomes varies from 6.7 μ or 22.4 % to ± 0.1 μ or 0.3 %.

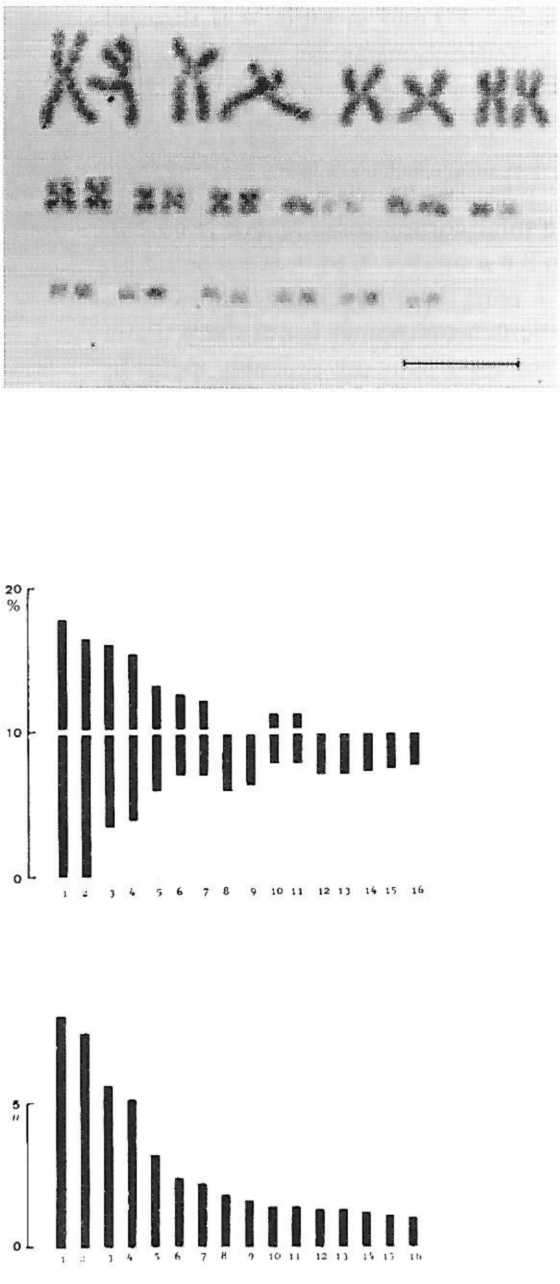

Fig. 11 – *Mabuya multifasciata*

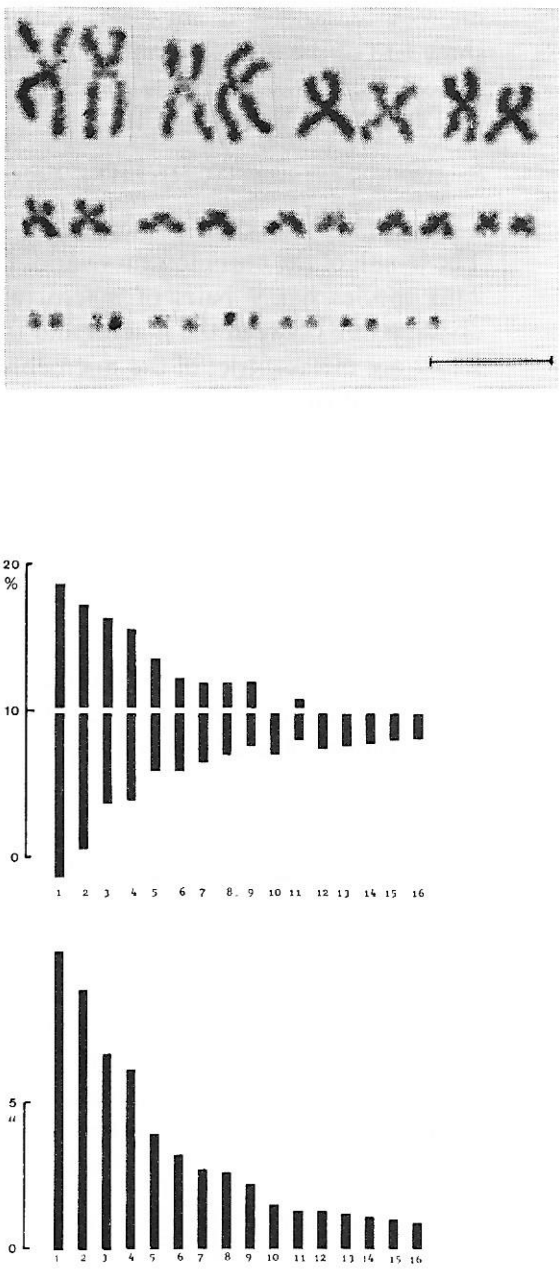

Fig. 12 – *Mabuya quinquetaeniata*

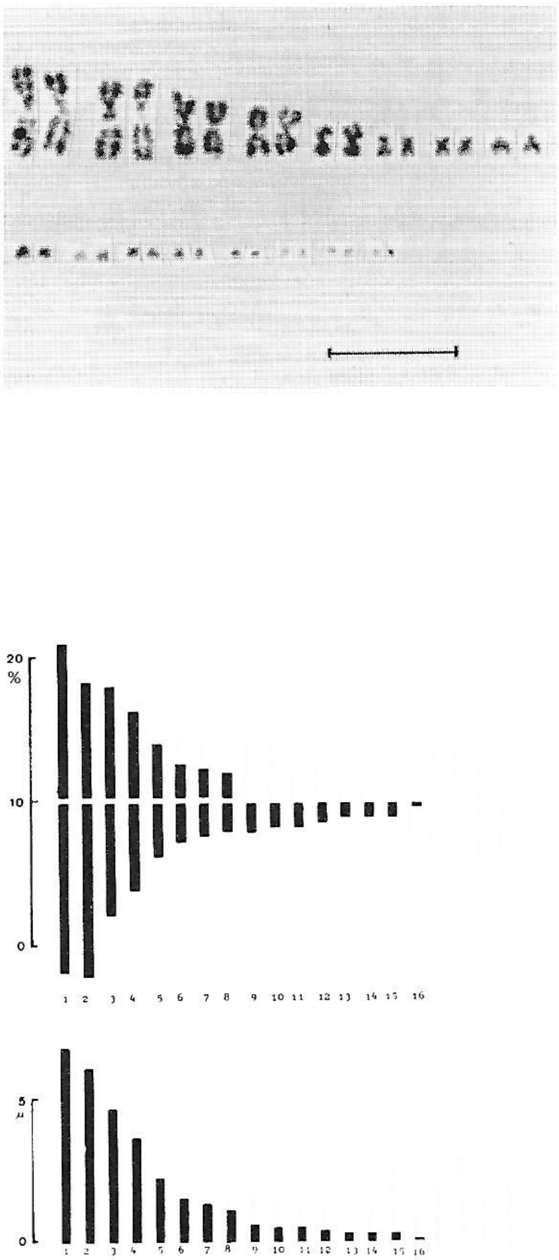

Fig. 13 – *Mabuya varia*

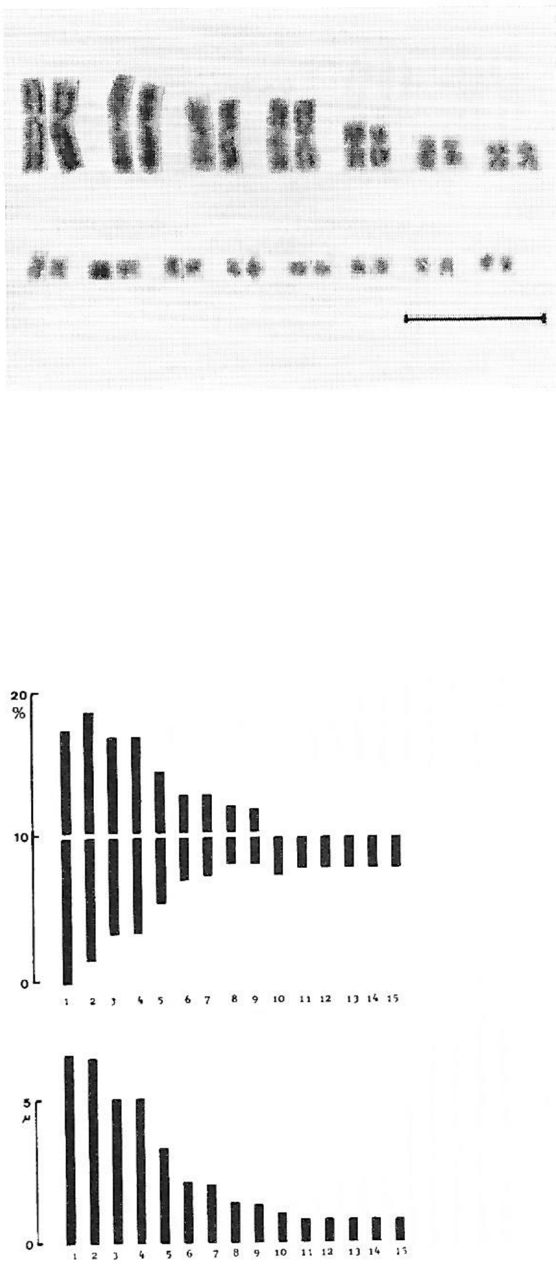

Fig. 14 – *Riopa sundevallii*

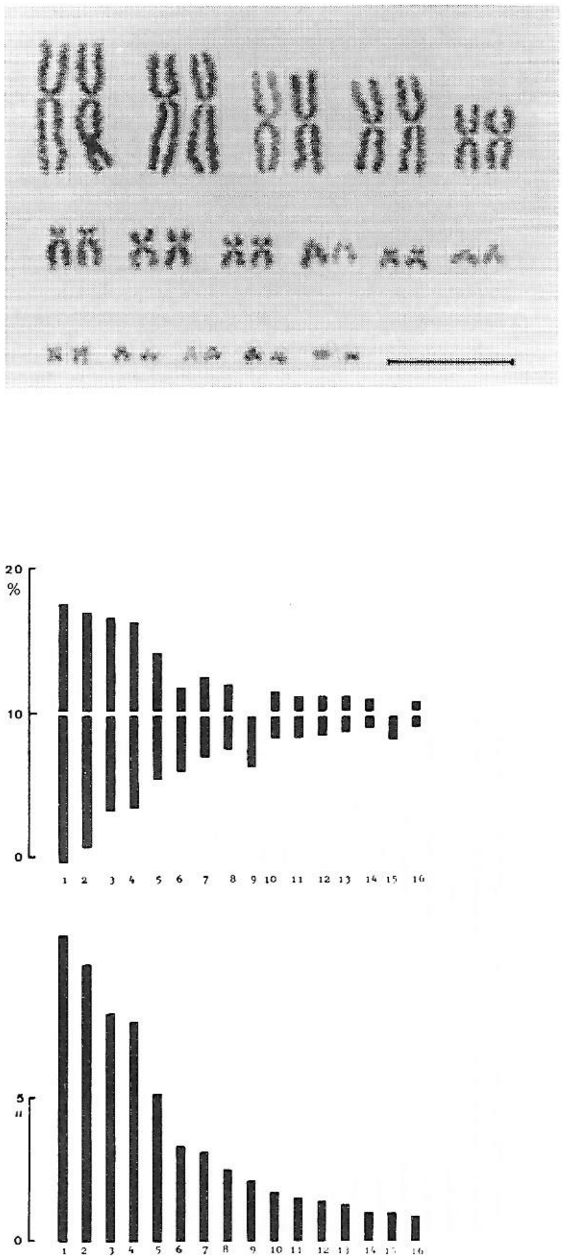

Fig. 15 – *Tiliqua scincoides*

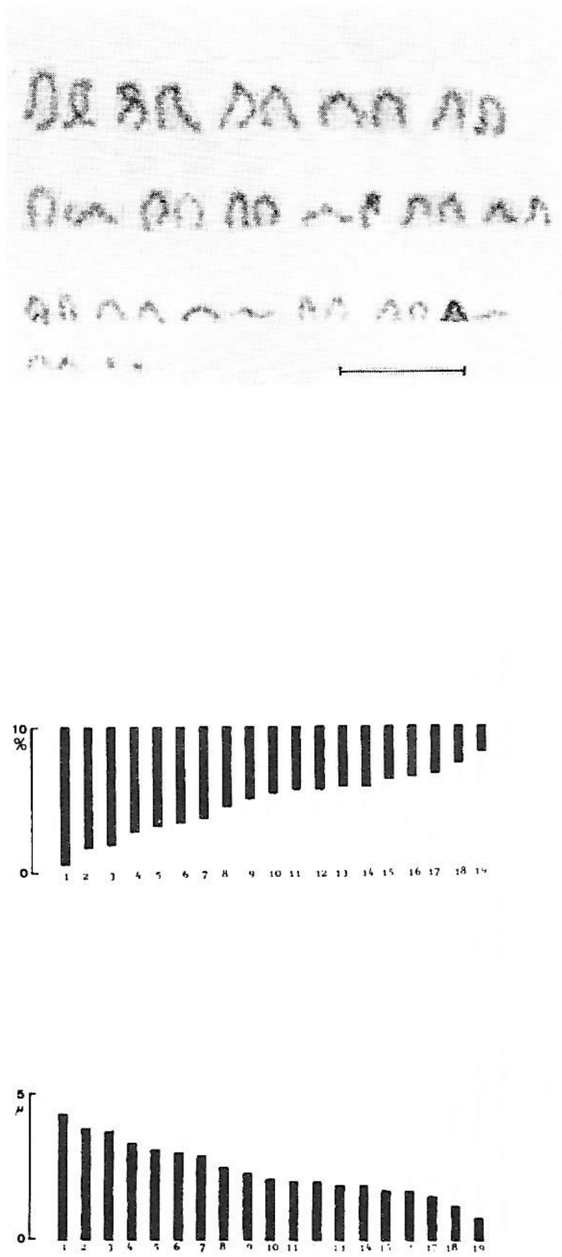

Fig. 16 – *Acanthodactylus pardalis*

There are 8 pairs of macro- and the same number of microchromosomes. All macrochromosomes are metacentric, although pair 8 could eventually be submetacentric as the position of the centromere was difficult to determine. The microchromosomes are probably meta- or submetacentric. Macro- and microchromosomes more or less gradually shade off into each other. The pairs n° 1 and 2 have secondary constrictions above and under the centromere.

N.F. = 32 (16 V) + 16 m = 48.

12. Riopa sundevallii (SMITH), 1 ♂. (Fig. 14)

The 2n chromosome number is 30. The total chromosome length is 38.0 μ. The length of the chromosomes more or less gradually decreases from 6.5 μ or 17.1 % to ± 0.8 μ or 2.1 %. This species has 9 pairs of macro- and 6 pairs of microchromosomes. All macrochromosomes are metacentric. The structure of the microchromosomes was not clear.

N.F. = 36 (18 V) + 12 m = 48.

13. Tiliqua scincoides (WHITE), 1 ♀. (Fig. 1b, 15)

The 2n chromosome number is 32. The total chromosome length is 60.6 μ. The length of the chromosomes varies from 10.6 μ or 17.5 % to ± 1.0 μ or 1.6 %. This species has 13 pairs of macro- and 3 pairs of microchromosomes. Pair 6 is submetacentric. The pairs 9 and 15 are telocentric. The remaining chromosomes are metacentric.

N.F. = 48 (24 V) + 2 I + 6 m = 56.

2.3. Lacertidae

14. Acanthodactylus pardalis (LICHTENST.), 1 ♂. (Fig. 16)

The 2n chromosome number is 38. The total chromosome length is 45.7 μ. The length of the chromosomes progressively decreases from 4.3 μ or 9.4 % to ± 0.8 μ or 1.8 %. All chromosomes can be regarded as macrochromosomes, the last pair excepted. All chromosomes are acrocentric.

N.F. = 36 I + 2 m = 38.

15. Acanthodactylus scutellatus (DUM. & BIBR.), 1 ♀. (Fig. 1c, 17)

The 2n chromosome number is 38. The total chromosome length is 85.2 μ. The length of the chromosomes progressively decreases from 8.8 μ or 10.3 % to

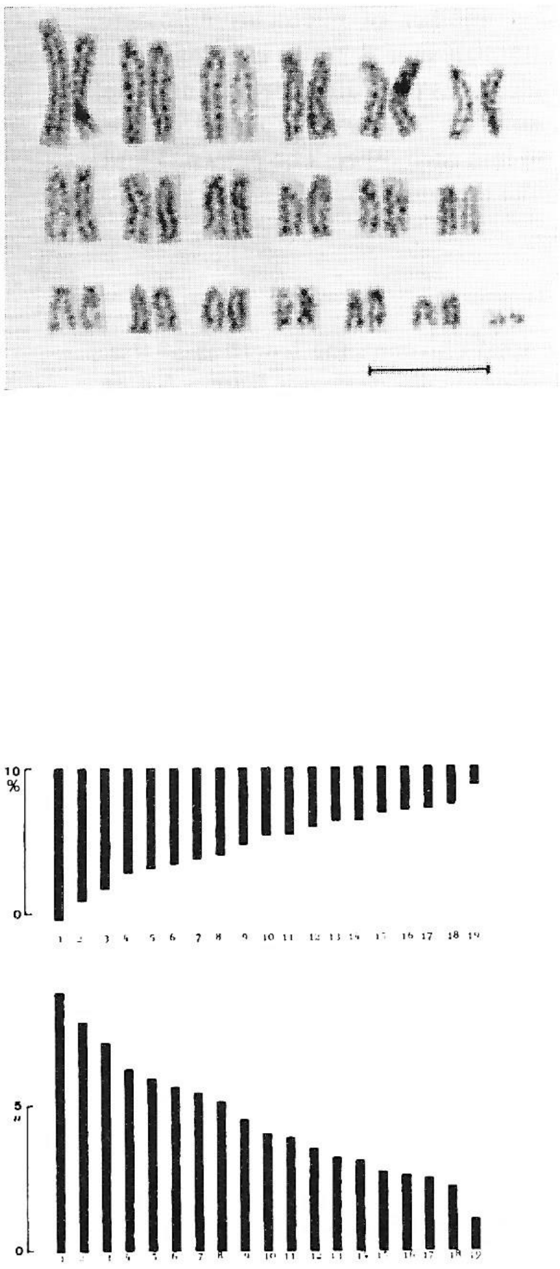

Fig. 17 – *Acanthodactylus scutellatus*

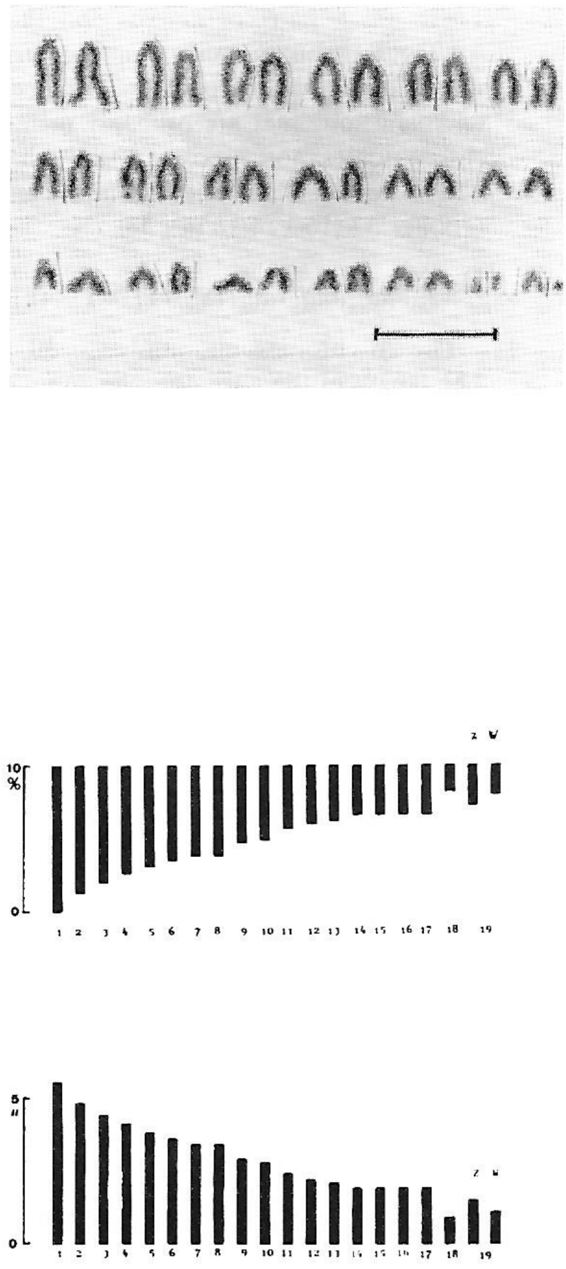

Fig. 18 – *Lacerta agilis*

± 1.0 μ or 1.3 %. This species has 18 pairs of macro- and one pair of microchromosomes. All chromosomes are acrocentric, with the exception of the smallest pair that probably has a subterminal centromere.
N.F. = 36 I + 2 m = 38.

16. Lacerta agilis L., 1♀. (Fig. 1d, 18)

The 2n chromosome number is 38. The length of the chromosomes progressively decreases from 5.5 μ or 10.0 % to ± 0.9 μ or 1.6 %. With the exception of the last pair, all chromosomes can be regarded as macrochromosomes. All chromosomes are acrocentric. The Z chromosome is n° 18. It is acrocentric, 1.5 μ long and represents 2.7 % of the length of the autosomes + Z. The W chromosome is 1.1 μ long and 1.6 % of the length of the autosomes + Z. Pair 8 shows a terminal secondary constriction.
N.F. = 36 I + 2 m = 38.

17. Lacerta melisellensis BRAUN, 1 ♀. (Fig. 19)

The 2n chromosome number is 38. The total chromosome length is 50.3 μ. The length of the chromosomes progressively decreases from 5.5 μ or 10.9 % to ± 0.6 μ or 1.2 %. All chromosomes are macrochromosomes, the last pair excepted. They are all acrocentric. The Z chromosome is 1.5 μ long and represents 3.0 % of the length of the autosomes + Z. In size it is between chromosomes n°s 16 and 17. The W chromosome measures 0.4 μ or 0.8 % of the lentgh of the autosomes + Z.
N.F. = 36 I + 2 m = 38.

18. Lacerta hispanica BLNGR., 1 ♂. (Fig. 20)

The 2n chromosome number is 38. The total chromosome length is 26.0 μ. The length of the chromosomes progressively decreases from 2.4 μ or 9.2 % to ± 0.4 μ or 1.5 %. Taking into consideration the 1 μ limit for the microchromosomes, 11 pairs of macro- and 8 pairs of microchromosomes can be distinguished. All chromosomes are acrocentric. Diakinesis (fig. 2d) shows half of the diploid number.
N.F. = 22 I + 16 m = 38.

19. Lacerta muralis brueggemanni BEDR., 2 ♂, 3 ♀. (Fig. 21)

The 2n chromosome number is 38. The total chromosome length is 33.1 μ. The chromosomes progressively decrease from 3.5 μ or 10.6 % to ± 0.4 μ or

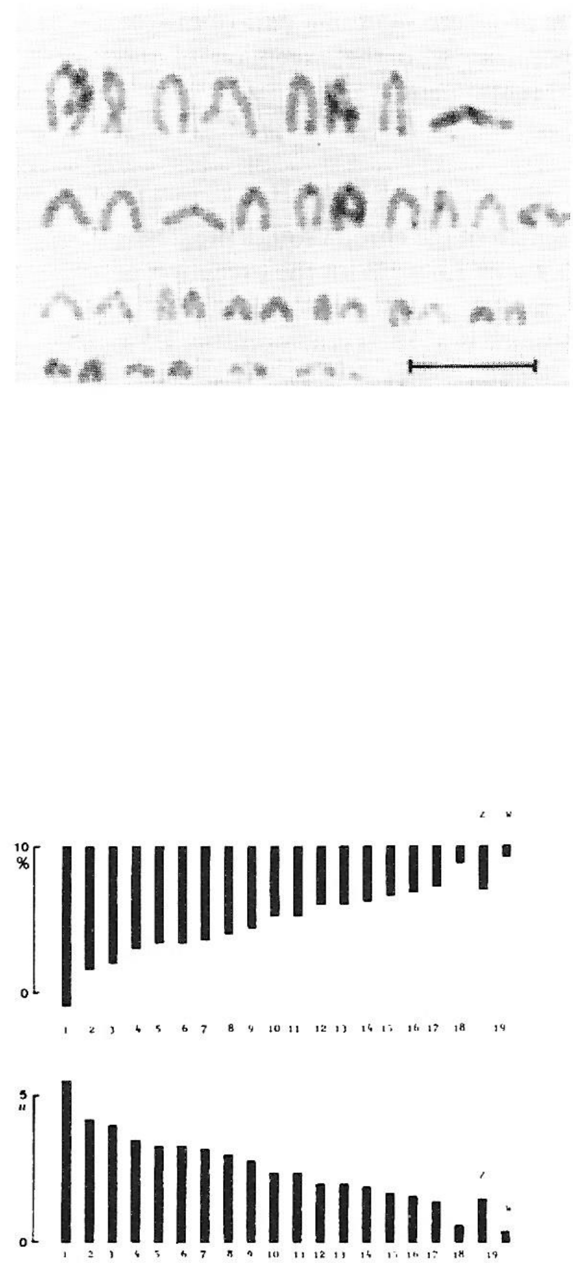

Fig. 19 – *Lacerta melisellensis*

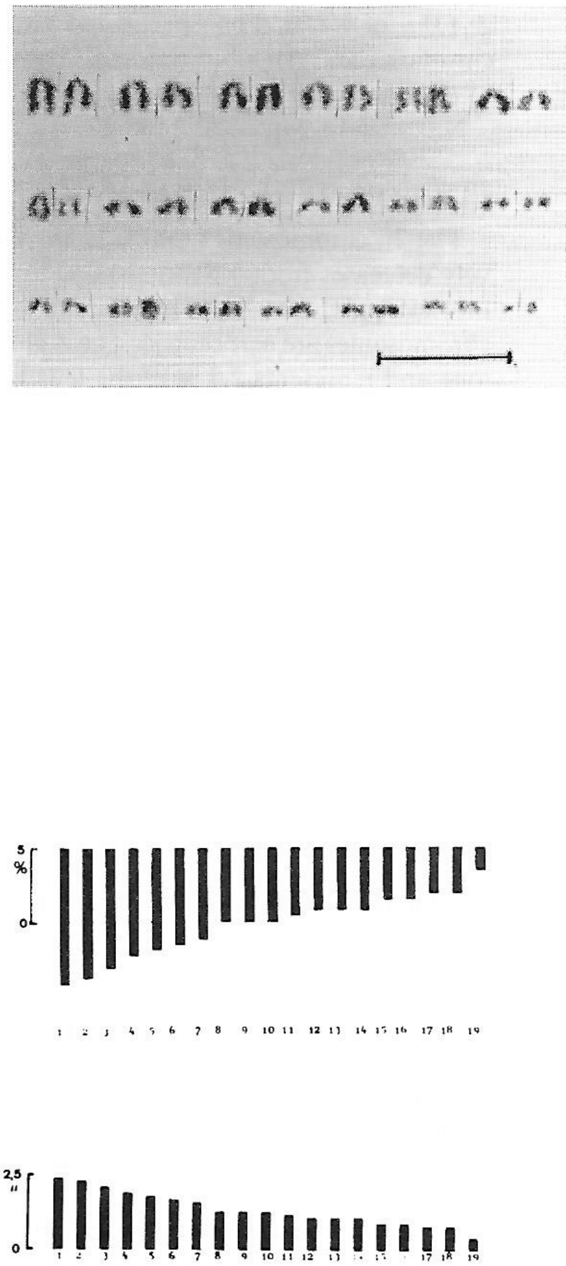

Fig. 20 – *Lacerta hispanica*

1.2 %. Taking into consideration the 1 μ limit for the microchromosomes, 14 pairs of macro- and 5 pairs of microchromosomes can be distinguished. All chromosomes are acrocentric. Diakinesis (fig. 2c) shows half of the diploid number.

N.F. = 28 I + 10 m = 38.

20. Lacerta ocellata DAUD., 1 ♂. (Fig. 22)

The 2n chromosome number is 36. The total chromosome length is 25.7 μ. The length of the chromosomes varies from 4.8 μ or 18.6 % to ± 0.4 μ or 1.6 %. The first pair of chromosomes is metacentric and distinctly larger than the remaining chromosomes which are acrocentric. From pair 2 to 18 the length of the chromosomes progressively decreases. According to the 1 μ limit for the microchromosomes, 10 pairs of macro- and 8 pairs of microchromosomes can be distinguished.

N.F. = 4 (2 V) + 18 I + 16 m = 38.

21. Lacerta sicula campestris (DE BETTA), 1 ♀. (Fig. 23)

The 2n chromosome number is 38. The total chromosome length is 43.3 μ. The length of the chromosomes progressively decreases from 4.5 μ or 10.4 % to ± 0.9 μ or 2.1 %. All chromosomes must be regarded as macrochromosomes, the last pair excepted. All chromosomes are acrocentric. The Z chromosome measures 2.0 μ or 4.6 μ of the length of the autosomes + Z. Its length is situated between chromosomes n°s 8 and 9. The W chromosome is about five times smaller (0.4 μ) than the Z or 0.9 % of the length of the autosomes + Z.

N.F. = 36 I + 2 m = 38.

22. Lacerta viridis (LAUR.), 1 ♂, 2 ♀. (Fig. 24)

The 2n chromosome number is 38. The total chromosome length is 76.4 μ. The length of the chromosomes progressively decreases from 7.7 μ or 10.1 % to ± 1.0 μ or 1.4 %. With the exception of the last pair, all chromosomes must be classified as macrochromosomes. All chromosomes are of the acrocentric type. The Z chromosome is n° 18. It is an acrocentric chromosome, 2.1 μ long or 2.8 % of the length of the autosomes + Z. The W chromosome measures 0.9 μ or 1.2 % of the autosomes + Z. Pair 7 shows a terminal constriction.

N.F. = 36 I + 2 m = 38.

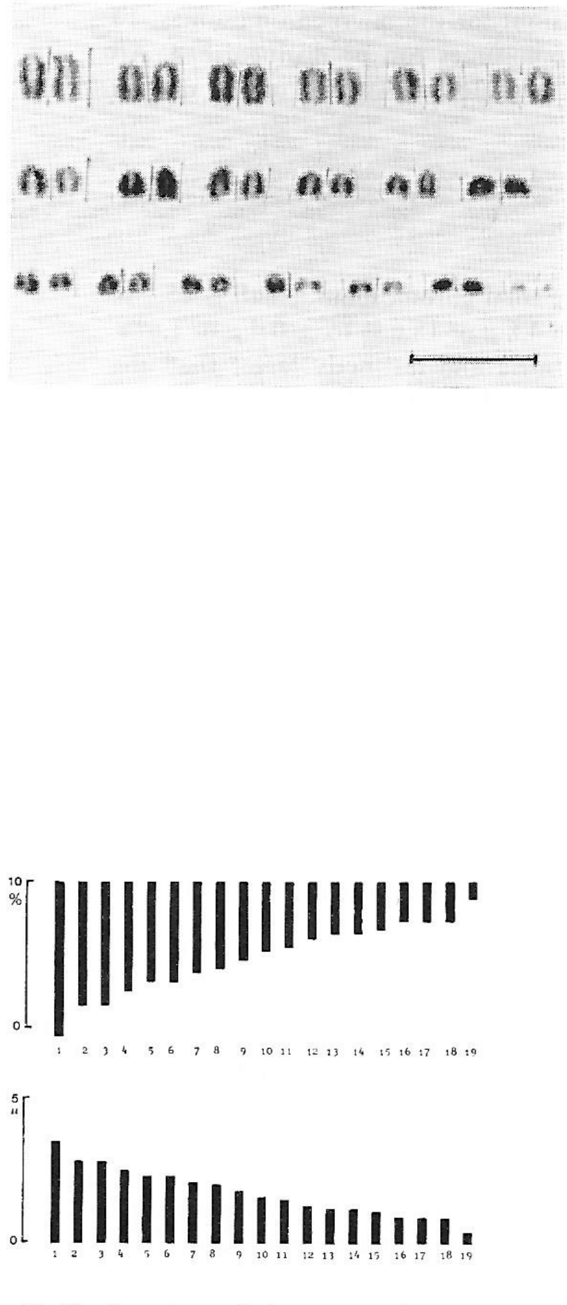

Fig. 21 – *Lacerta muralis brueggemanni*

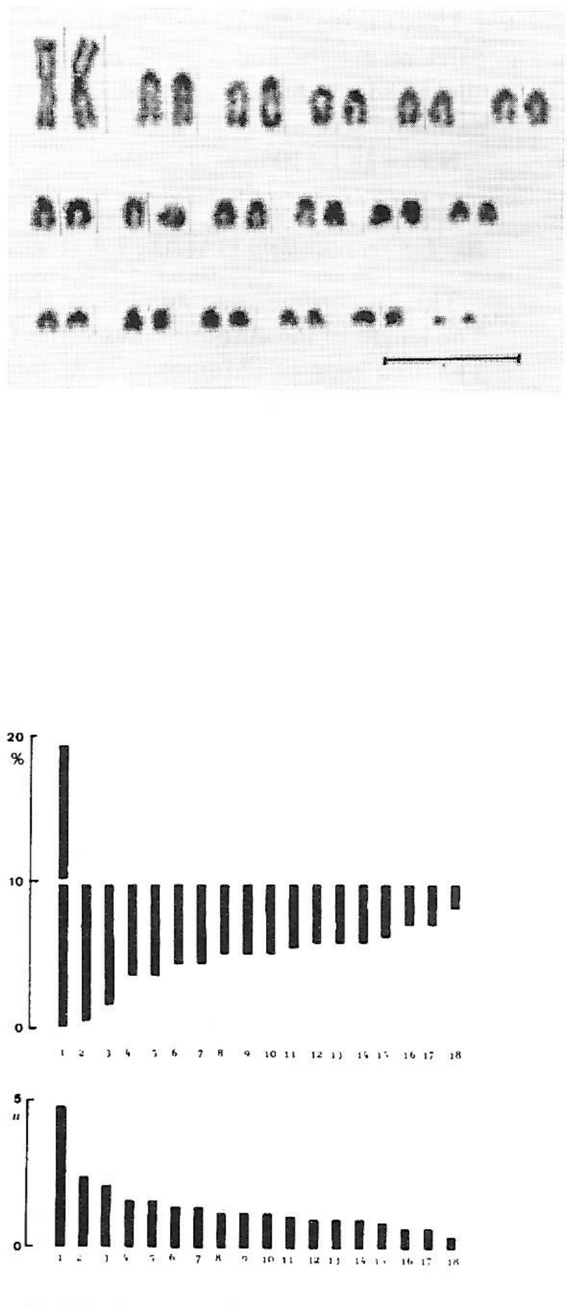

Fig. 22 – *Lacerta ocellata*

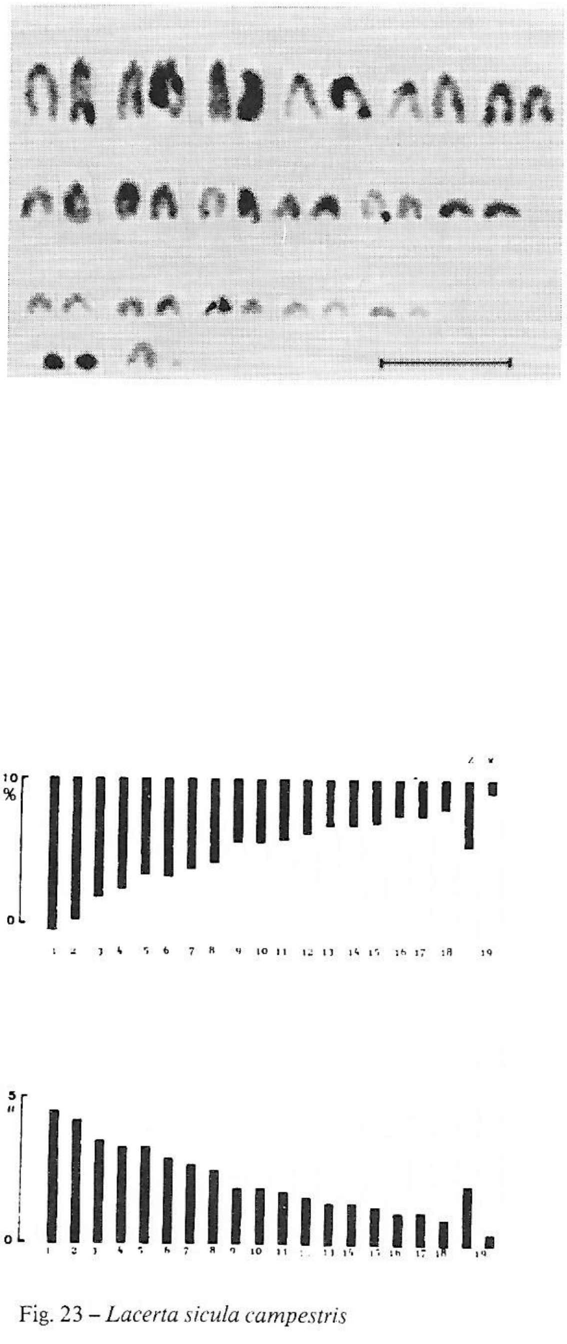

Fig. 23 – *Lacerta sicula campestris*

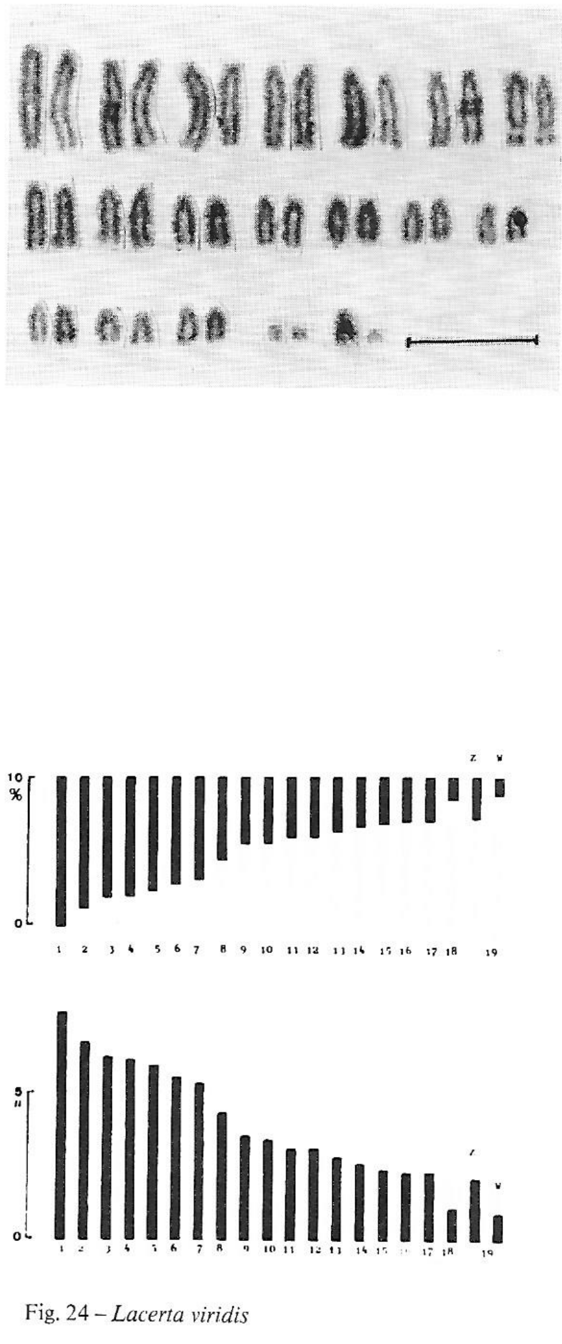

Fig. 24 – *Lacerta viridis*

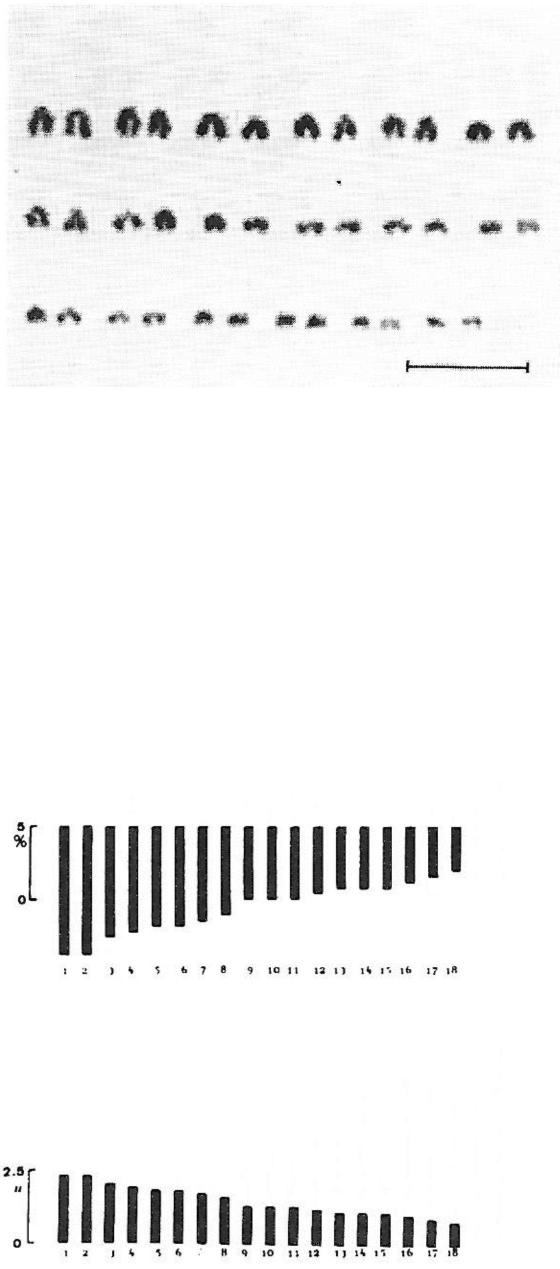

Fig. 25 – *Lacerta vivipara*

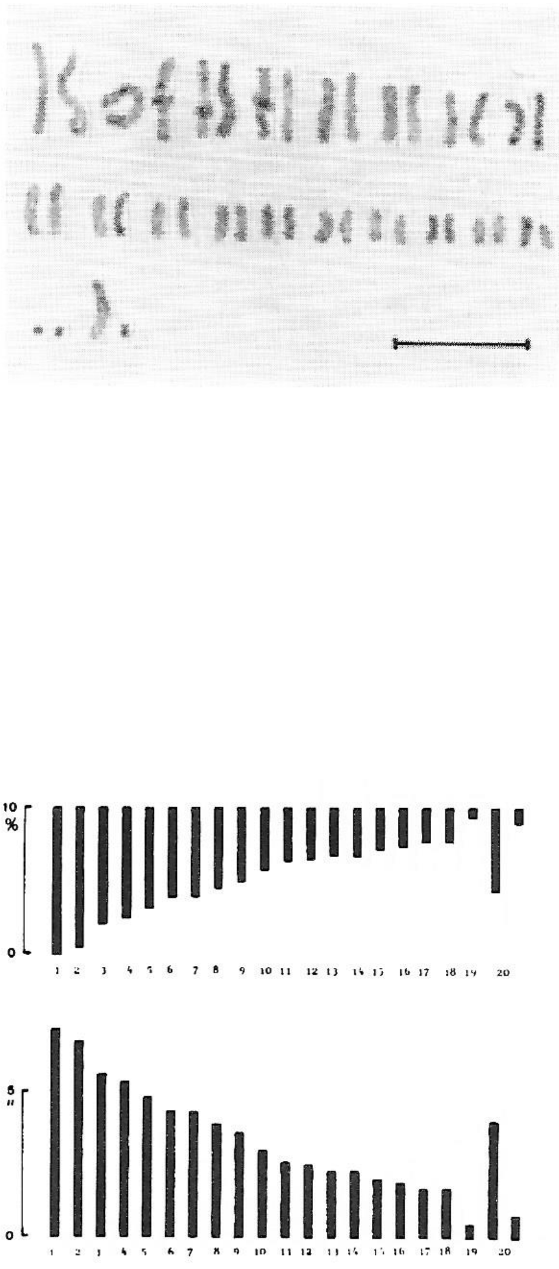

Fig. 26 – *Psammodromus algirus*

23. Lacerta vivipara JACQ., 1 ♂. (Fig. 25)

The 2n chromosome number is 36. The total chromosome length is 26.5 μ. The length of the chromosomes progressively decreases from 2.3 μ or 8.7 % to $\pm$ 0.8 μ or 3.0 %. According to the accepted 1 μ limit, 12 pairs of macro- and 6 pairs of microchromosomes can be distinguished. All chromosomes are acrocentric. Diakinesis (fig. 2b) shows half of the diploid number.

N.F. = 24 I + 12 m = 36.

24. Psammodromus algirus (L.), 1 ♀. (Fig. 26)

The 2n chromosome number is 40. The total chromosome length is 70.1 μ. The length of the chromosomes progressively decreases from 7.1 μ or 10.1 % to $\pm$ 0.5 μ or 0.7 %. This species has 19 pairs of macro- and one pair of microchromosomes. All chromosomes are acrocentric. The Z chromosome measures 4.0 μ or 5.7 % of the length of the autosomes + Z. Its length is situated between the chromosomes n°s 10 and 11. The W chromosome (0.8 μ) is almost five times smaller than the Z or 1.1 % of the length of the autosomes + Z.

N.F. = 38 I + 2 m = 40.

2.4 Cordylidae

25. Gerrhosaurus flavigularis WIEGM., 1 ♀. (Fig. 27)

The 2n chromosome number is 34. The total chromosome length is 54.6 μ. The length of the chromosomes varies from 11.7 μ or 21.5 % to $\pm$ 0.6 μ or 1.1 %. This species has 6 pairs of macro- and 11 pairs of microchromosomes. The difference in size between macro- and microchromosomes is very clear. The macrochromosomes gradually decrease from 11.7 μ to 4.3 μ. They all are metacentric. The microchromosomes are probably meta- to subtelocentric. Pairs 1, 2 and 3 have a terminal secondary constriction on the longest arms.

N.F. = 24 (12 V) + 22 m = 46.

26. Gerrhosaurus major BLNGR., 1 ♀. (Fig. 1e, 28)

The 2n chromosome number is 34. The total chromosome length is 48.9 μ. The length of the chromosomes varies from 10.0 μ or 20.4 % to $\pm$ 0.5 μ or 1.0 %. There are 7 pairs of macro- and 10 pairs of microchromosomes. The macrochromosomes gradually decrease in length (10.0 - 1.3 μ) and are all metacentric.

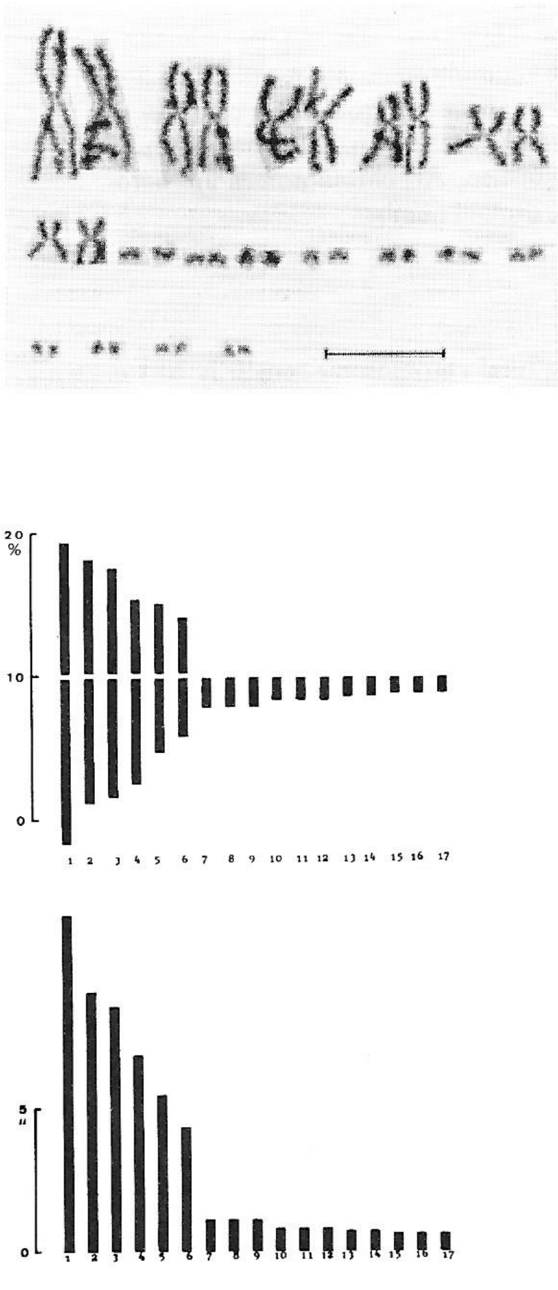

Fig. 27 – *Gerrhosaurus flavigularis*

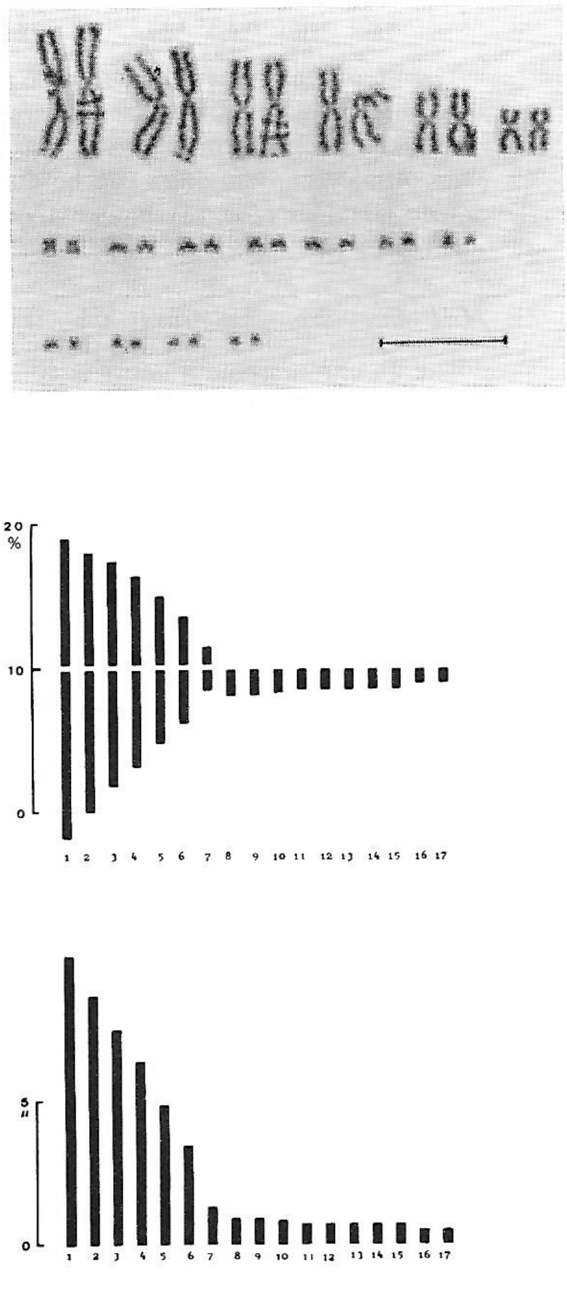

Fig. 28 – *Gerrhosaurus major*

Microchromosome pair 7 is clearly metacentric; the remaining are probably meta- to subtelocentric. The longest arms of the pairs n° 1 and 2 have satellites.

N.F. = 28 I (14 V) + 20 m = 48.

27. Cordylus giganteus A. SMITH, 1 ♂. (Fig. 29)

The 2n chromosome number is 42. The total chromosome length is 32.2 μ. This species has 9 pairs of macro- and 12 pairs of microchromosomes. The chromosome picture is characterized by a first large pair metacentric chromosomes (7.1 μ or 22.1 %) and 40 smaller telocentric chromosomes, which more or less progressively decrease in length (3.6 μ or 11.2 % to 0.1 μ or 0.3 %). Pair 1 has satellites on the longest arms.

N.F. = 4 (2 V) + 16 I + 24 m = 44.

28. Cordylus jonesii BLNGR., 1 ♀, 3 embryos. (Fig. 30)

The 2n chromosome number is 34. The total chromosome length is 70.9 μ. The length of the chromosomes varies from 13.5 μ or 19.1 % to ± 0.9 μ or 1.3 %. This species has 12 pairs of macro- and 5 pairs of microchromosomes. The macrochromosomes 1 to 6 are clearly larger (13.5 - 4.7 μ) than the pairs 7 to 12 (2.1 - 1.2 μ). The length of the larger macrochromosomes progressively decreases. All macrochromosomes are metacentric. The microchromosomes 13 and 14 are metacentric, while the centromere position was not clear in the microchromosomes 15 to 17.

N.F. = 48 (24 V) + 10 m = 58.

29. Cordylus vittifer (REICH.), 1 ♂. (Fig. 1f, 31)

The 2n chromosome number is 34. The total chromosome length is 63.3 μ. The length of the chromosomes varies from 11.9 μ or 18.8 % to ± 0.6 μ or 0.9 %. There are 12 pairs of macro- and 5 pairs of microchromosomes. The macrochromosomes 1 to 6 are clearly larger (11.9 - 4.4 μ) than the pairs 7 to 12 (1.5 - 1.2 μ). The length of the larger macrochromosomes progressively decreases. The centromere position of the pairs 13, 15 and 17 could not be exactly determined. The remaining chromosomes are metacentric.

N.F. = 48 (24 V) + 10 m = 58.

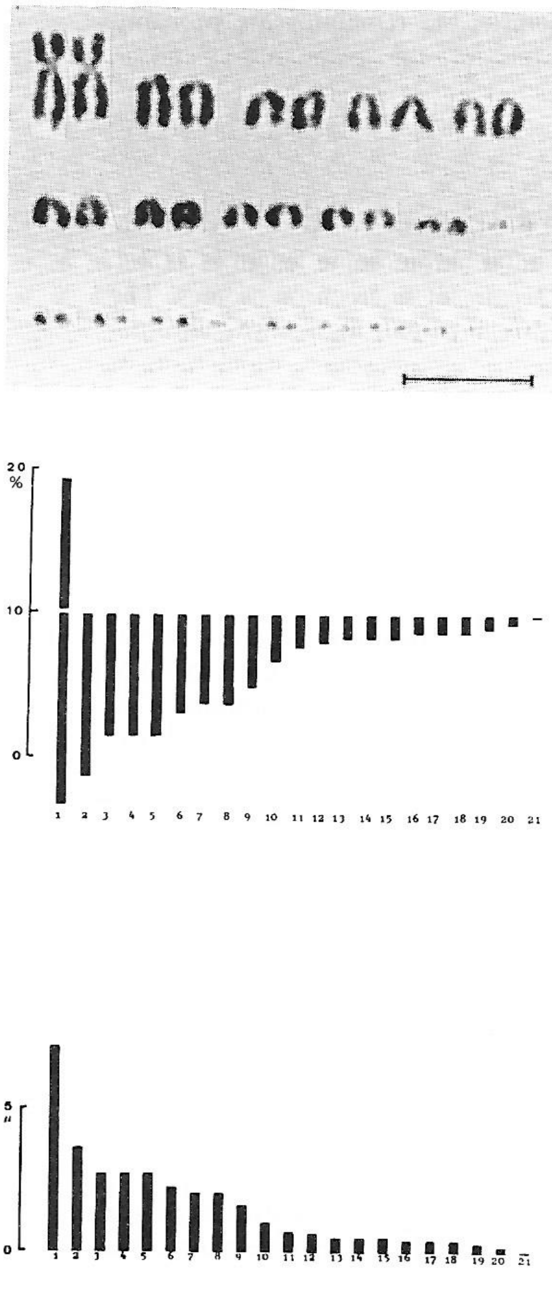

Fig. 29 – *Cordylus giganteus*

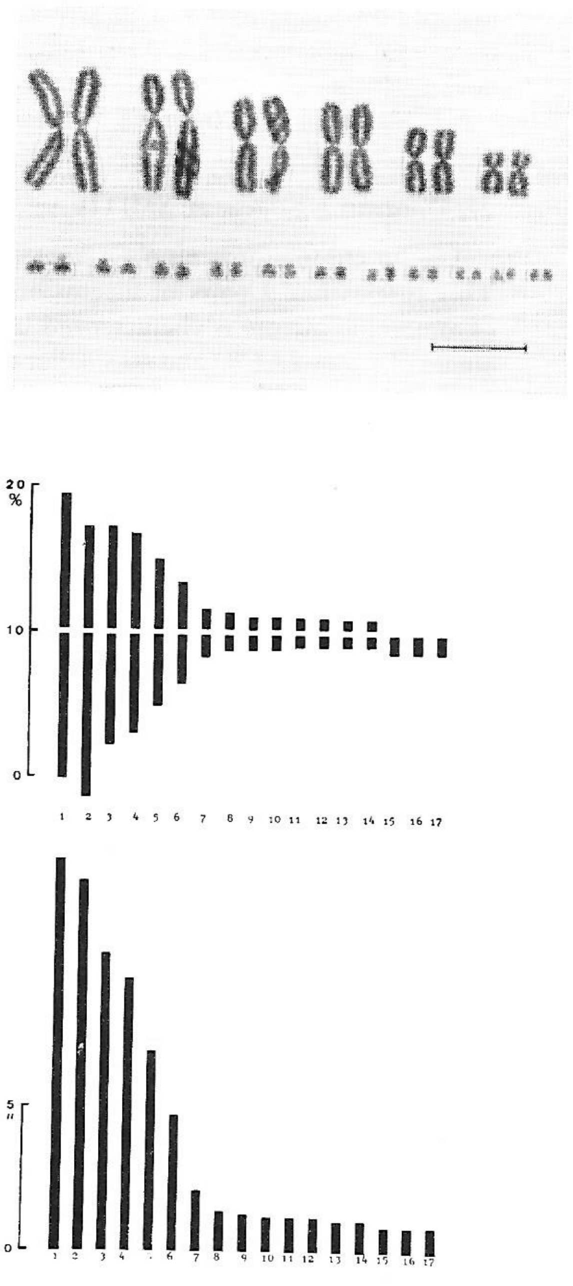

Fig. 30 – *Cordylus jonesii*

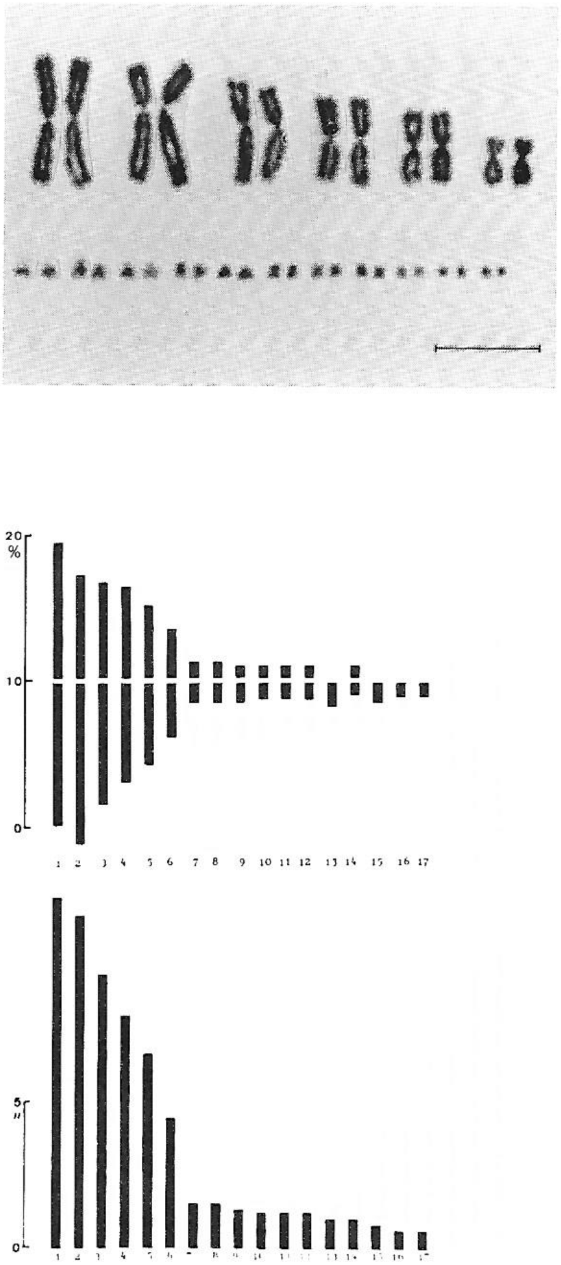

Fig. 31 – *Cordylus vittifer*

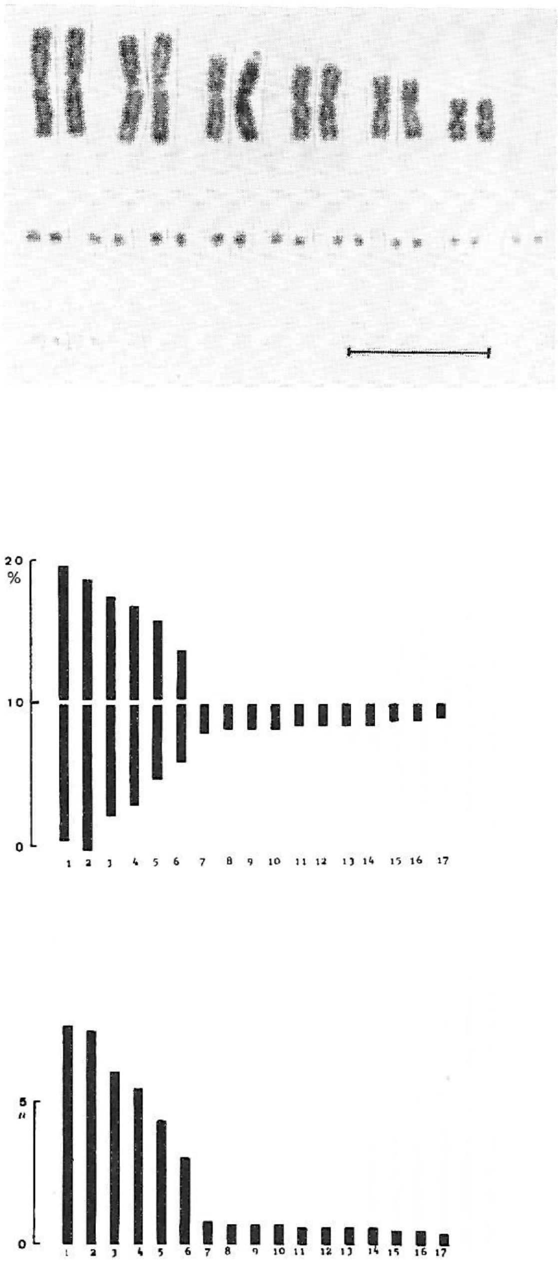

Fig. 32 – *Platysaurus guttatus*

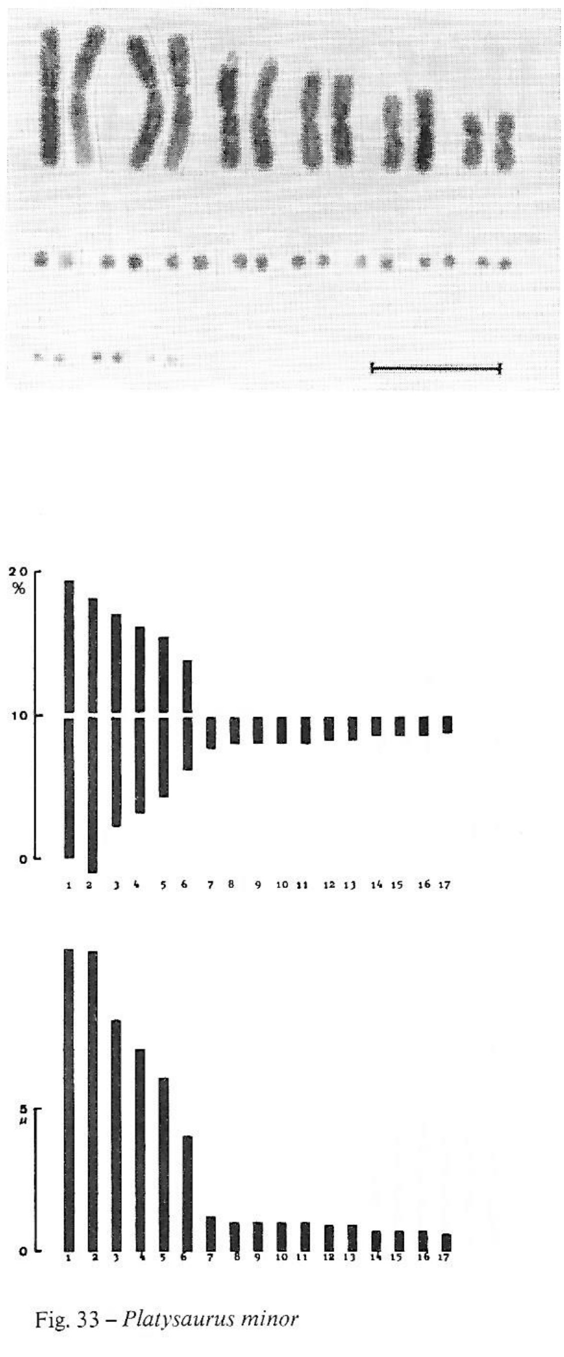

Fig. 33 – *Platysaurus minor*

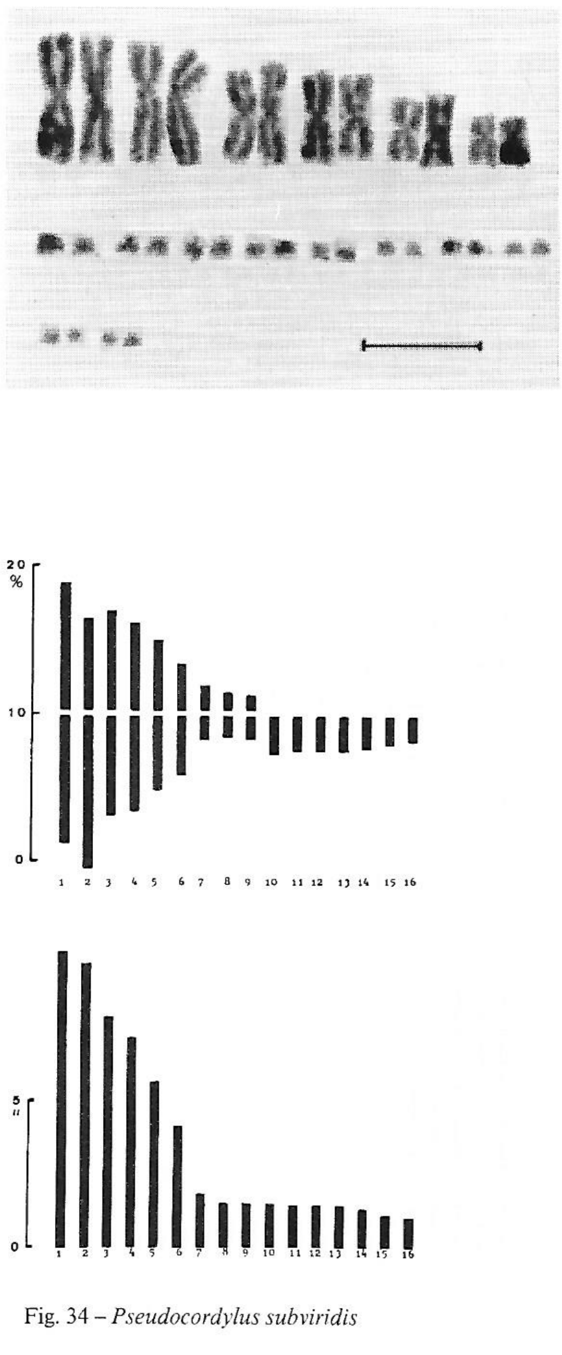

Fig. 34 – *Pseudocordylus subviridis*

30. Platysaurus guttatus A. SMITH, 1 ♂. (Fig. 1h, 32)

The 2n chromosome number is 34. The total chromosome length is 40.4 μ. The length of the chromosomes varies from 7.4 μ or 18.2 % to ± 0.4 μ or 1.0 %. This species has 6 pairs of macro- and 11 pairs of microchromosomes with clear differences of their length. All macrochromosomes and probably the microchromosomes too are metacentric. Pair n° 2 has satellites on the shortest arms.

N.F. = 24 (12 V) + 22 m = 46.

31. Platysaurus minor FITZS., 1 ♂. (Fig. 33)

The 2n chromosome number is 34. The total chromosome length is 55.5 μ. The length of the chromosomes varies from 10.4 μ or 18.6 % to ± 0.6 μ or 1.1 %. There are 6 pairs of macro- and 11 pairs of microchromosomes present. The macrochromosomes progressively decrease in length (10.4 - 4.0 μ). The limit between macro- and microchromosomes is very sharp. All macrochromosomes and probably all microchromosomes are metacentric. Pair 2 shows satellites on the shortest arms.

N.F. = 24 (12 V) + 22 m = 46.

32. Pseudocordylus subviridis A. SMITH, 1 ♀. (Fig. 34)

The 2n chromosome number is 32. The total chromosome length is 58.1 μ. The length of the chromosomes varies from 10.0 μ or 17.2 % to ± 1.0 μ or 1.7 %. This species has 14 pairs of macro- and 2 pairs of microchromosomes. The macrochromosomes 1 to 6 are clearly larger (10.0 - 7.1 μ) and clearly different from the remaining ones (3.1 - 1.3 μ). All large macrochromosomes are metacentric, with the exception of n° 2, which is meta- to submetacentric. The remaining chromosomes are probably meta- to submetacentric.

N.F. = 56 (28 V) + 4 m = 60.

2.5. Varanidae

33. Varanus bengalensis L., 2 ♂, 1 ♀. (Fig. 35)

The 2n chromosome number is 40. The total chromosome length is 43.8 μ. The length of the chromosomes varies from 9.6 μ or 21.9 % to ± 0.4 μ or 0.9 %. There are 8 pairs of macro- and 12 pairs of microchromosomes, which are distinctly different. Within the macrochromosomes 2 large pairs (9.6 - 9.5 μ) and

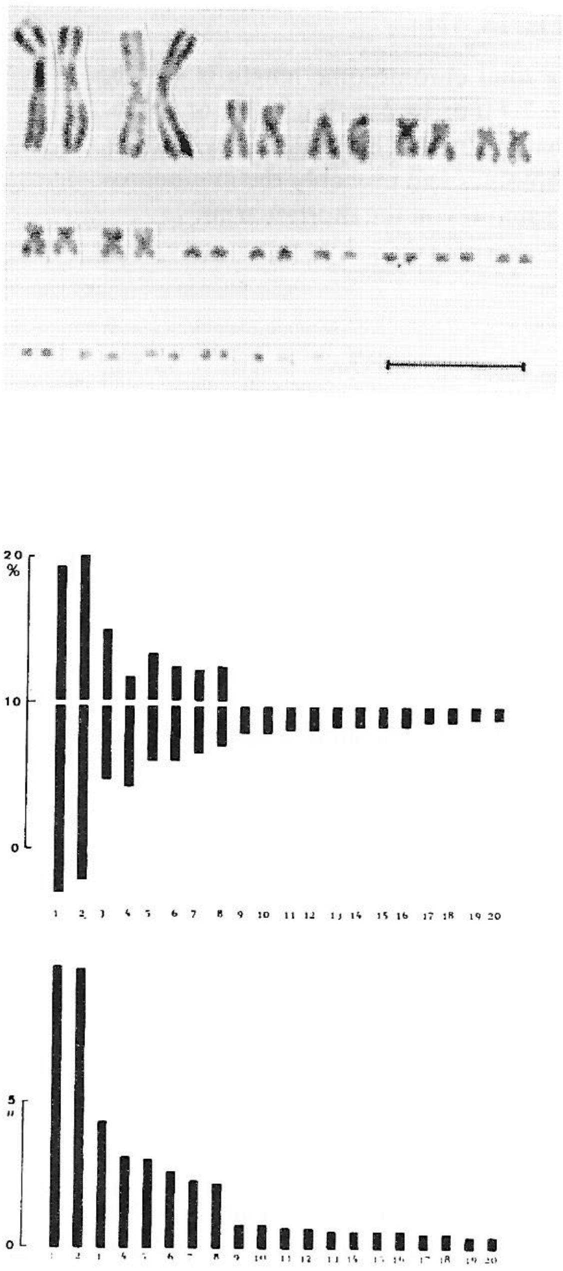

Fig. 35 – *Varanus bengalensis*

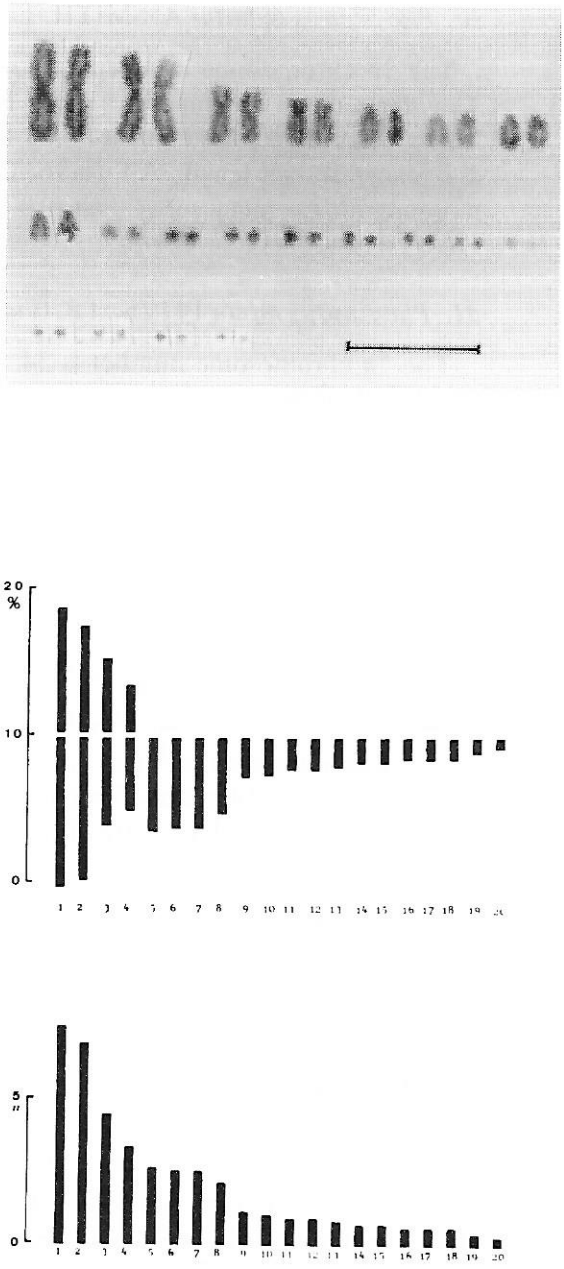

Fig. 36 – *Varanus exanthematicus*

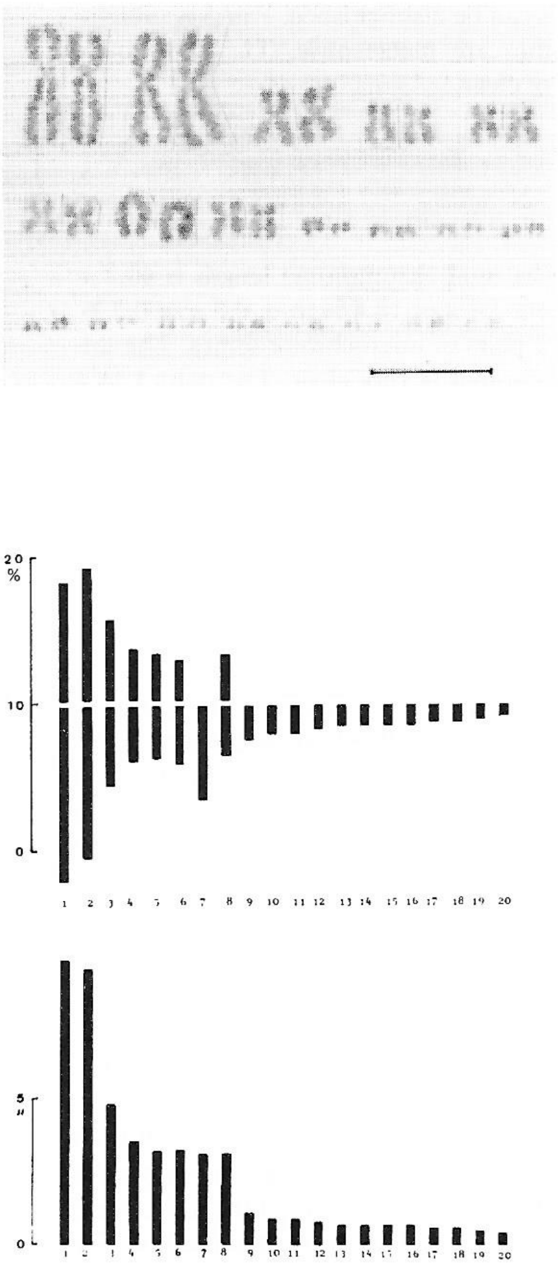

Fig. 37 – *Varanus griseus*

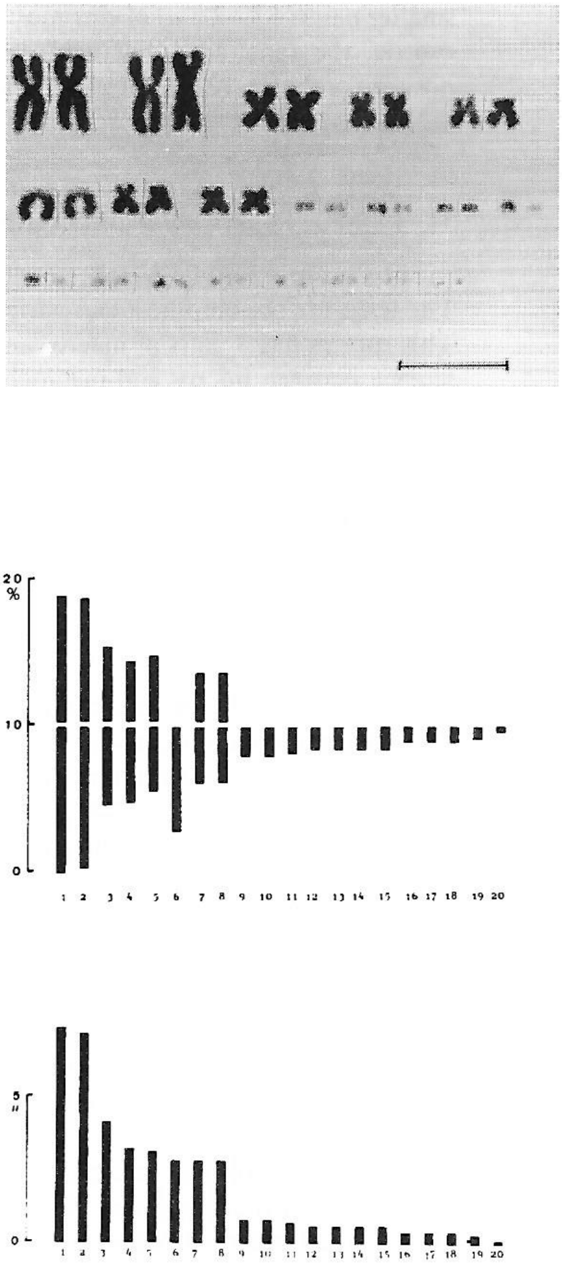

Fig. 38 – *Varanus salvator*

smaller pairs (4.3 - 2.2 μ) of chromosomes can be distinguished. Pair 5 is subtelocentric, the remaining macrochromosomes are metacentric. The centromere position of the microchromosomes was not clear.

N.F. = 32 (16 V) + 24 m = 56.

34. Varanus exanthematicus (DAUD.), 1 ♂. (Fig. 36)

The 2n chromosome number is 40. The total chromosome length is 40.2 μ. The length of the chromosomes varies from 7.4 μ or 18.4 % to $\pm$ 0.3 μ or 0.7 %. This species has 8 pairs of macro- and 12 pairs of microchromosomes. The difference between micro- and macrochromosomes is very clear. The pairs 1 to 4 are metacentric and progressively decrease in length (7.4 - 3.3 μ). The remaining macrochromosomes are acrocentric and of nearly equal size (2.6 - 2.1 μ). We failed to determine the centromere position of the microchromosomes. Diakinesis fig. 2a.

N.F. = 16 (8 V) + 8 I + 24 m = 48.

35. Varanus griseus (DAUD.), 1 ♀. (Fig. 1g, 37)

The 2n chromosome number is 40. The total chromosome length is 47.8 μ. The length of the chromosomes varies from 9.7 μ or 20.6 % to $\pm$ 0.4 μ or 0.8 %. There are 8 pairs of macro- and 12 pairs of microchromosomes present. The first two pairs are rather large (9,7 - 9,4 μ); the pairs 3 to 8 are nearly of equal size (4,8 - 3,1 μ). All macrochromosomes are metacentric, the acrocentric pair 7 excepted. The microchromosomes are probably meta- to submetacentric.

N.F. = 28 (14 V) + 2 I + 24 m = 54.

36. Varanus salvator (LAUR.), 1♂. (Fig. 38)

The 2n chromosome number is 40. The total chromosome length is 39.5 μ. The length of the chromosomes varies from 7.3 μ or 18.5 % to $\pm$ 0.1 μ or 0.3 %. This species has 8 pairs of macro- and 12 pairs of microchromosomes. Within the macrochromosomes two pairs are large (7.3 - 7.1 μ) and 6 pairs are smaller and more or less of equal size (4.1 - 2.8 μ). With the exception of the acrocentric pair n° 6, all macrochromosomes are metacentric. The microchromosomes are probably submetacentric to acrocentric.

N.F. = 28 (14 V) + 2 I + 24 m = 54.

TABLE 1
CHROMOSOME MEASUREMENTS IN TEIIDAE

Chromosome pairs		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*n*
Ameiva chrysolaema	r.l.	15,7	10,7	10,0	7,8	6,8	6,2	5,8	4,9	4,9	4,5	0,3
2n = 50	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
Tupinambis nigropunctatus	r.l.	16,3	15,9	13,7	12,9	10,6	4,1	3,0	2,8	2,6	2,3	1,2
2n = 38	a.r.	1,1	1,6	1,1	1,1	1,1	1,3	1,3	1,0	—	2,3	—
T. teguixin	r.l.	19,9	19,2	14,3	13,1	11,8	4,7	3,1	2,2	2,2	1,7	0,7
2n = 36	a.r.	1,3	1,5	1,1	1,1	1,1	2,0	1,3	1,2	—	—	—

r.l. = relative length; a.r. = arm ratio.

TABLE 2
CHROMOSOME MEASUREMENTS IN SCINCIDAE

Chromosome pairs		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*n*
Chalcides chalcides	r.l.	19,8	16,2	15,5	13,6	6,5	4,5	4,2	3,6	3,6	2,9	2,3
2n = 28	a.r.	1,2	1,3	1,1	1,1	1,2	∞	∞	—	—	—	—
C. ocellatus polylepis	r.l.	19,8	16,7	14,0	13,1	6,7	5,9	4,4	4,4	4,0	2,4	2,0
2n = 28	a.r.	1,0	1,4	1,1	1,1	1,3	1,2	2,3	1,2	1,6	1,2	1,3
Eumeces schneideri	r.l.	17,9	15,7	8,8	7,0	6,8	6,6	6,4	6,0	4,8	4,4	1,6
2n = 32	a.r.	1,1	1,1	1,0	∞	∞	1,2	∞	∞	∞	∞	∞
Mabuya capensis	r.l.	20,6	16,6	14,4	13,0	7,3	5,5	5,0	4,0	2,1	2,1	0,9
2n = 32	a.r.	1,1	1,2	1,2	1,0	1,6	2,3	2,0	1,8	—	—	—
M. carinata	r.l.	19,1	16,8	13,9	12,8	7,1	4,7	4,7	4,0	3,8	2,4	1,2
2n = 32	a.r.	1,5	1,6	1,3	1,1	1,3	1,6	1,6	1,3	1,1	—	—
M. multifasciata	r.l.	17,4	16,1	12,2	11,1	6,9	5,2	4,7	3,9	3,5	3,0	2,2
2n = 32	a.r.	1,3	1,6	1,1	1,1	1,3	1,2	1,4	∞	∞	1,8	—
M. quinquetaeniata	r.l.	18,5	16,2	12,2	11,2	7,2	5,9	5,0	4,5	4,0	2,8	1,7
2n = 32-34	a.r.	1,2	1,3	1,0	1,1	1,2	1,9	2,0	1,7	1,2	—	—
M. varia	r.l.	22,4	20,0	15,4	12,0	7,4	5,0	4,3	3,7	2,0	1,7	0,3
2n = 32	a.r.	1,1	1,5	1,0	1,0	1,0	1,1	1,2	1,1	—	—	—
Riopa sundevallii	r.l.	17,1	16,8	13,2	13,2	8,7	5,5	5,2	3,6	3,4	2,6	2,1
2n = 30	a.r.	1,4	1,0	1,0	1,0	1,1	1,1	1,0	1,0	1,2	—	—
Tiliqua scincoides	r.l.	17,5	15,9	13,0	12,5	8,4	5,4	5,1	4,1	3,5	2,8	1,6
2n = 32	a.r.	1,4	1,3	1,0	1,1	1,1	2,3	1,2	1,3	∞	1,1	—

r.l. = relative length; a.r. = arm ratio.

3. GENERAL SURVEY

3.1 Teiidae (table 1)

Of the family Teiidae 3 species were studied: *Ameiva chrysolaema, Tupinambis nigropunctatus* and *Tupinambis teguixin. Ameiva chrysolaema* has 50 acrocentric chromosomes (22 I + 28 m). The macrochromosomes gradually shade off into the microchromosomes. The same picture was found for another, not identified, *Ameiva* species. The specimens identified as *Tupinambis nigropunctatus* have 2n = 38. *Tupinambis teguixin* has a diploid number of 36. There are 8 to 9 pairs of macrochromosomes present. For both species the first five pairs are metacentric and their size is clearly distinct from the microchromosomes. The pairs n° 2 have satellites on the longest arms. Comparing the relative chromosome lengths and the arm ratios of the two *Tupinambis* species, a very good agreement results with the exception of the pairs 1 and 2 which are 3 to 4 % larger for *Tupinambis teguixin.* GORMAN (1970) found for *Tupinambis nigropunctatus* 2n = 36. In his systematic review of the genus *Tupinambis,* PRESCH (1973) includes the species *nigropunctatus* in the synonymy of *Tupinambis teguixin,* as the variation of *T. nigropunctatus* falls within the range of *T. teguixin.* If the above conclusions of PRESCH are accepted, *Tupinambis teguixin* would display a variation in the 2n chromosome number and in the chromosome morphology of the pairs 1 and 2.

Further karyological information for the Teiidae is to be found in COLE et al. (1969), FRITTS (1969), GORMAN (1969), LOWE & WRIGHT (1966), LOWE et al. (1970 a, b), MATTHEY (1949), PENNOCK (1965) a.o.

3.2 Scincidae (table 2)

The karyotypes of 10 species of Scincidae, belonging to 5 genera were investigated: *Chalcides chalcides, Chalcides ocellatus polylepis, Eumeces schneideri, Mabuya capensis, Mabuya carinata, Mabuya multifasciata, Mabuya quinquetaeniata, Mabuya varia, Riopa sundevallii* and *Tiliqua scincoides.* Diploid chromosome numbers of 24 to 32/34 were found. *Chalcides chalcides* and *C. ocellatus polylepis* have 2n = 38; *Riopa sundevallii* has 2n = 30; *Eumeces schneideri, Tiliqua scincoides* and the *Mabuya* species have 2n = 32. *Mabuya quinquetaeniata* is characterized by the presence of a very small pair of microchromosomes, which is not found in all metaphase plates (modal 2n values of 32 and 34 were obtained). *Eumeces schneideri* has two large metacentric chromosomes, followed by a series of chromosomes progressively decreasing in length and which are mainly acrocentric. Only one pair of microchromosomes is present (12 V + 18 I + 2 m). Our results do not agree so far with the observations of GORMAN (1973 : 380) who mentions for this species « most elements two-armed ». *Chalcides chalcides* and *C. ocellatus polylepis* both have 4 pairs large metacentric macrochromosomes, which are clearly distinct in size from the remaining, mainly also metacentric macrochromosomes. The last ones gradually shade off into the microchromosomes. For *Riopa sundevallii, Tiliqua scincoides* and the different *Mabuya* species, the difference between the first four pairs of large macrochromosomes and the remaining chromosomes is not or less pronounced. The chromosomes are predominantly metacentric.

Generally speaking the karyotypes of the *Chalcides, Mabuya, Riopa* and *Tiliqua* species studied show a very pronounced obvious overall resemblance. The chromosomes are mainly metacentric, *Eumeces schneideri* excepted which has numerous acrocentric chromosomes. The 2n values are relatively low and vary from 24 to 32/34. The number of microchromosomes is also relatively low (2 to 16). The N.F. values are found between 38 and 60. The *Mabuya* species studied showed secondary constrictions above and under the centromeres of the chromosomes n° 1 and 2.

ASANA & MAHABELE (1941), BEÇAK et al. (1972), BHATNAGAR (1962), DALLAI & TALLURI (1969), DEWEESE & WRIGHT (1970 in GORMAN : 1973), DUTT (1969), MAKINO (1948), MAKINO & MOMMA (1949), NAKAMURA (1931) and MATTHEY (1931) investigated some 15 other species belonging to the genera *Cryptobrephalus, Eumeces, Mabuya, Riopa, Scincus* and *Sphenomorphus*. The 2n chromosome number can be 24, 26, 28, 30 or 32. The macrochromosomes are generally meta- to submetacentric.

3.3 **Lacertidae** (table 3)

The karyotypes of 11 species representing three genera were studied: *Acanthodactylus pardalis, Acanthodactylus scutellatus, Lacerta agilis, Lacerta hispanica, Lacerta mellisellensis, Lacerta muralis brueggemanni, Lacerta ocellata, Lacerta sicula campestris, Lacerta viridis, Lacerta vivipara* and *Psammodromus algirus*.

The 2n chromosome number is 36 for *Lacerta ocellata* and *L. vivipara*. The other species of the genus *Lacerta* and the two *Acanthodactylus* species have 2n = 38. A female specimen of *Lacerta galloti* also had 2n = 38, all chromosomes acrocentric (this species was not included here as further study is necessary). *Psammodromus algirus* has 2n = 40. This disagrees with MATTHEY (1931) who found for *Tropidosaurus (= Psammodromus) algirus* 2n = 38 and acrocen-

TABLE 3
CHROMOSOME MEASUREMENTS IN LACERTIDAE

Chromosome pairs		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*n*
Acanthodactylus pardalis	r.l.	9,4	8,3	8,1	7,2	6,8	6,6	6,3	5,5	5,0	4,6	1,8
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
A. scutellatus	r.l.	10,3	9,1	8,3	7,2	6,9	6,6	6,3	6,0	5,3	4,7	1,3
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	—
Lacerta agilis	r.l.	10,0	8,7	8,0	7,4	6,9	6,5	6,2	6,2	5,3	5,1	1,6
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L. melisellensis	r.l.	10,9	8,4	8,0	7,0	6,6	6,6	6,4	6,0	5,6	4,8	1,2
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L. hispanica	r.l.	9,2	8,8	8,1	7,3	6,9	6,5	6,2	5,0	5,0	5,0	1,5
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L. muralis brueggemanni	r.l.	10,6	8,5	8,5	7,5	6,9	6,9	6,3	6,0	5,4	4,8	1,2
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L. ocellata	r.l.	18,6	9,3	8,2	6,2	6,2	5,4	5,4	4,7	4,7	4,7	1,6
2n = 36	a.r.	1,1	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L. sicula campestris	r.l.	10,4	9,7	8,1	7,6	7,6	6,7	6,2	5,8	4,4	4,4	2,1
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L. viridis	r.l.	10,1	8,8	8,1	8,0	7,7	7,2	6,9	5,6	4,6	4,5	1,4
2n = 38	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
L. vivipara	r.l.	8,7	8,7	7,5	7,2	6,8	6,8	6,4	6,0	4,9	4,9	3,0
2n = 36	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
Psammodromus algirus	r.l.	10,1	9,6	8,0	7,6	6,9	6,1	6,1	5,6	5,1	4,3	0,7
2n = 40	a.r.	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞

r.l. = relative length; a.r. = arm ratio.

tric. *Lacerta ocellata* has one pair metacentric and 16 pairs acrocentric chromosomes. The remaining species have exclusively acrocentric chromosomes. In consequence all species have a N.F. value of 38 with the exception of *Lacerta vivipara,* N.F. = 36 and *Psammodromus algirus,* N.F. = 40. The metacentric macrochromosome pair n° 1 of *Lacerta ocellata* is probably the result of a centric fusion.

Characteristic for the family are the low numbers of microchromosomes (generally 2) and the acrocentric macrochromosomes which show a progressive decrease in size.

Lacerta agilis and *L. viridis* have satellites on pair 8, respectively pair 7. The literature provides data for some 25 other species (GORMAN: 1973; KUPRIYANOVA: 1969; MATTHEY: 1949; NAKAMURA: 1935; NOGUSA: 1953), belonging to the genera *Acanthodactylus, Eremias, Ophisops, Psammodromus, Takydromus* and *Lacerta.* With the exception of *Lacerta parva,* 2n = 24 (14 V + 10 I) (GORMAN: 1973); *Lacerta ocellata,* 2n = 36 (2 V + 34 I); *Lacerta vivipara,* 2n = 36 (36 I) and the *Psammodromus algirus* of the present study with 2n = 40 (40 I), all Lacertidae have a diploid number of 38 acrocentric chromosomes.

A female heterogamety could be demonstrated for *Lacerta agilis, L. melisellensis, L. sicula campestris, L. viridis* and *Psammodromus algirus.* The females have a pair of heteromorphic chromosomes: an acrocentric macro- and an acrocentric microchromosome. In contrast with our findings DALLAI & URBANI (1967) could not demonstrate female heterogamety for *Lacerta sicula campestris.* GORMAN (1973) also suggests heterogamety for *Lacerta trilineata* and *Eremias olivieri* with a heteromorphic pair of acrocentric chromosomes for the females. OGUMA (1934) found for *Lacerta vivipara* acrocentric chromosomes with 2n = 36 male and 2n = 35 female. Although those figures might be exact, it seems possible to us that a female heterogamety as described above was present, but that the author was unable to demonstrate the smaller microchromosomes with the techniques used at that time. MARGOT (1946) and MATTHEY & VAN BRINK (1956) found for *Lacerta vivipara* 2n = 38, all chromosomes acrocentric, and denied the existence of heterochromosomes. CHEVALIER (1969) on the contrary demonstrated a heterogamic system for *Lacerta vivipara*: male all chromosomes acrocentric and 2n = 36, female 2n = 35 with one unpaired metacentric macrochromosome. IVANOV & FEDOROVA (1970) mention for *Lacerta strigata* a heterogamy of the $Z_1Z_1Z_2Z_2$-Z_1Z_2W type.

From the preceding facts it is clear that female heterogamety frequently occurs in the Lacertidae. The controversial data in the literature for one and the same species, points towards interspecific morphological variation of the sex chromosomes.

3.4 Cordylidae (table 4)

Eight species of the family Cordylidae were examined : subfamily Gerrhosaurinae : *Gerrhosaurus flavigularis* and *Gerrhosaurus major;* subfamily Cordylinae : *Cordylus giganteus, Cordylus jonesii, Cordylus vittifer, Platysaurus guttatus, Platysaurus minor* and *Pseudocordylus subviridis.* The 2n chromosome number is 42 for *Cordylus giganteus,* 32 for *Pseudocordylus subviridis* and 34 for the other species studied.

MATTHEY (1949) found for *Gerrhosaurus flavigularis* 2n = 36 (12 V + 24 m). With the exception of *Cordylus giganteus,* all species show a very strong similarity. There are 6 pairs large metacentric macrochromosomes, which are clearly distinct from the microchromosomes. The relative lengths and the armratios of these chromosomes are nearly identical for the different species. Another species, *Platysaurus intermedius,* not included in this study as too few metaphases could be examined, showed 2n = 34 with a karyogram almost identical with that of *P. guttatus* and *P. minor. Cordylus giganteus* has one pair metacentric and 20 pairs telocentric chromosomes (2 V + 16 I + 24 m). The length of the chromosomes is decreasing progressively.

MATTHEY (1931) found for *Zonurus cataphractus* (syn. *Cordylus cataphractus)* 2n = 46 with 11 pairs of acrocentric macrochromosomes and 12 pairs of microchromosomes (22 I + 24 m). The karyotypes of the Cordylidae we studied can be constructed from the karyotype of *Cordylus cataphractus* by fusions of telocentric chromosomes to metacentric chromosomes with the participation of the microchromosomes. For *Cordylus giganteus* and *Pseudocordylus subviridis* a loss of one pair telocentric chromosomes must be supposed. Satellites were present on the longest arms of the chromosomes pairs n°s 1, 2 and 3 for *Gerrhosaurus flavigularis;* on n°s 1 and 2 for *G. major* and on n° 1 for *Cordylus giganteus, Platysaurus guttatus* and *P. minor* had satellites on the shortest arms of the chromosome pair n° 2. The calculated N.F. values vary from 44 to 60.

The general resemblance between the karyotypes of the Gerrhosaurinae and the Cordylinae on the one hand, and the difference with the karyotypes of the Scincidae, the Lacertidae (this study) and the Anguidae (BURY et al. : 1969; MARGOT : 1946; MATTHEY : 1931, 49; OHNO : 1967) on the other hand, favours the view of ROMER (1968 : 552) who unites the families « Gerrhosauridae, generally considered related to the skinks and lizards, and the Cordylidae

TABLE 4
CHROMOSOME MEASUREMENTS IN CORDYLIDAE

Chromosome pairs		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*n*
Gerrhosaurus flavigularis	r.l.	21,5	16,5	15,5	12,4	9,9	7,8	2,0	2,0	2,0	1,5	1,1
2n = 34	a.r.	1,1	1,1	1,1	1,4	1,4	1,0	—	—	—	—	—
G. major	r.l.	20,4	17,6	15,1	12,8	9,8	7,0	2,6	1,8	1,8	1,6	1,0
2n = 34	a.r.	1,3	1,3	1,1	1,1	1,1	1,1	1,2	—	—	—	—
Cordylus giganteus	r.l.	22,1	11,2	8,4	8,4	8,4	6,8	6,2	6,2	5,0	3,1	0,3
2n = 42	a.r.	1,4	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
C. jonesii	r.l.	19,1	18,0	14,5	13,3	9,7	6,9	2,4	2,4	2,1	1,9	0,9
2n = 34	a.r.	1,1	1,6	1,1	1,0	1,0	1,1	1,1	1,1	1,6	1,4	—
C. vittifer	r.l.	18,8	17,9	14,7	12,5	10,4	6,6	2,9	2,0	1,8	1,7	1,3
2n = 34	a.r.	1,1	1,6	1,3	1,0	1,1	1,0	1,0	1,0	1,2	1,4	—
Platysaurus guttatus	r.l.	18,8	18,2	14,8	13,5	10,7	7,3	2,0	1,7	1,7	1,7	1,0
2n = 34	a.r.	1,0	1,2	1,1	1,1	1,0	11	—	—	—	—	—
P. minor	r.l.	18,8	18,6	14,3	12,5	10,7	7,2	2,1	1,8	1,8	1,8	1,1
2n = 34	a.r.	1,1	1,4	1,1	1,1	1,1	1,0	—	—	—	—	—
Pseudocordylus subviridis	r.l.	17,2	16,5	13,4	12,3	9,7	7,1	3,1	2,6	2,6	2,6	1,7
2n = 32	a.r.	1,0	1,7	1,0	1,1	1,1	1,3	1,1	1,1	1,5	—	—

r.l. = relative length; a.r. = arm ratio.

TABLE 5
CHROMOSOME MEASUREMENTS IN VARANIDAE

Chromosome pairs		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*n*
Varanus bengalensis	r.l.	21,9	21,7	9,8	7,1	6,9	6,0	5,3	5,0	1,8	1,8	0,9
2n = 40	a.r.	1,4	1,2	1,0	3,4	1,1	1,6	1,6	1,2	—	—	—
V. exanthematicus	r.l.	18,4	16,9	11,0	8,2	6,4	6,2	6,2	5,2	2,7	2,5	0,7
2n = 40	a.r.	1,2	1,3	1,2	1,5	∞	∞	∞	∞	—	—	—
V. griseus	r.l.	19,9	19,3	9,9	7,2	6,6	6,6	6,4	6,4	2,3	1,9	0,8
2n = 40	a.r.	1,5	1,1	1,2	1,1	1,1	1,5	∞	1,1	—	—	—
V. salvator	r.l.	18,5	18,0	10,4	8,2	7,8	7,1	7,1	7,1	2,0	2,0	0,3
2n = 40	a.r.	1,1	1,2	1,1	1,0	1,2	∞	1,2	1,2	—	—	—

r.l. = relative length; a.r. = arm ratio.

(Zonuridae), usually placed in the neighborhood of the anguids » in one and the same family.

3.5. Varanidae (table 5)

Four species of the family Varanidae were studied: *Varanus bengalensis, Varanus exanthematicus, Varanus griseus* and *Varanus salvator.* The 2n chromosome number is 40 for all species examined.

There are always 8 pairs of macro- and 12 pairs of microchromosomes present. The pairs 1 and 2 are distinctly larger than the other macrochromosomes. The idiograms of the lengths of the chromosomes are nearly identical for the different species. However the species can be recognized by means of the centromere position of the chromosome pairs 3 to 8. For *Varanus bengalensis* pair n° 4 is subtelocentric, the remaining pairs are metacentric; for *V. exanthematicus* the pairs n° 3 and 4 are metacentric, 5 to 8 are acrocentric; *V. griseus* and *V. salvator* have one pair acrocentric chromosomes (n° 6 or 7), the other macrochromosomes are metacentric. In view of the identical 2n values and the similar relative chromosome lengths, the morphological differences of the pairs 3 to 8 can be explained by pericentric inversions. This however disturbs the calculation of the N.F. values whereby they vary from 48 to 56. *Varanus bengalensis, V. exanthematicus* and *V. griseus* have secondary constrictions near the centromere on the two arms of the chromosomes n°s 1 and 2.

From the literature karyological data are known for *Varanus gouldi*: 2n = 40, 8 V + 8 I + 24 m (MATTHEY: 1931), *V. monitor* (syn. *V. bengalensis)*: 2n = 40, 8 V + 8 I +24 m (DUTT: 1968) and 12 V + 2 sV + 2 I (SINGH et al.; 1970 in GORMAN: 1973), *V. flavescens*: 2n = 40, 10 V + 4 sV + 2 I + 24 m (SINGH et al.: 1970) and *V. rudicollis*: 2n = 40, 8 V + 8 I (with 6 subtelocentrics) + 24 m (GORMAN & GRESS: 1970). The seven Varanidae studied so far, all have an identical diploid chromosome number of 40 with constant 16 macro- and 24 microchromosomes. The armratios of the macrochromosome pairs 3 to 8 are generally different for the various species from which we may conclude that the phenomenon of pericentric inversion played a major role in the speciation of the Varanidae.

SUMMARY

The present contribution describes the karyotypes of 36 species and 15 genera of Lacertilia, belonging to the families Teiidae, Scincidae, Lacertidae, Cordylidae and Varanidae. A general survey of the 2n number, the N.F. values, the number of macro- and microchromosomes as well as some chromosome ratios, are presented in table 6.

The diploid chromosome number varies from 28 to 50. The N.F. values are found between 36 and 60. The general aspect of the karyograms is rather specific for the different families.

All families display microchromosomes, although in different numbers. High numbers of microchromosomes, which are clearly separated of the macrochromosomes are found for the Teiidae, Cordylidae and Varanidae. The number of microchromosomes is low, and the transition from macro- to microchromosomes is indistinct for the Scincidae and Lacertidae.

The karyotype of the Lacertidae is characterized by chromosomes with a terminal centromere. The other families studied generally have two-armed chromosomes.

Robertsonian fusions probably occured in the genera *Cordylus* and *Lacerta*. The genus *Varanus* is characterized by pericentric inversions. With the exception of female heterogamety of the ZW type for 5 species of Lacertidae, sex chromosome heterogamety could not be demonstrated for the other families.

SAMENVATTING

In deze studie worden chromosoomgegevens verstrekt voor 36 soorten en 15 genera van Lacertilia (Autarchoglossa), behorende tot de families Teiidae, Scincidae, Lacertidae, Cordylidae en Varanidae. Een algemeen overzicht van de 2n en de N.F. waarden, het aantal macro- en microchromosomen, evenals sommige chromosoomverhoudingen is te vinden in tabel 6. Het diploïde chromosomenaantal varieert van 28 tot 50. De N.F. waarden zijn begrepen tussen 36 en 60.

Het algemene aspect van de karyogrammen is vrij specifiek voor de verschillende families. Alle families vertonen microchromosomen, zij het in verschillende aantallen. Hoge aantallen microchromosomen, die scherp gescheiden zijn van de macrochromosomen, zijn typisch voor de Teiidae, Cordylidae en Varanidae. Bij de Scincidae en de Lacertidae is het aantal microchromosomen laag en de overgang micro-macrochromosomen is onduidelijk. Lacertidae hebben een karyotype dat overwegend opgebouwd is uit chromosomen met een terminaal gelegen centromeer. Bij de overige families overwegen de chromosomen met twee armen. Binnen het genus *Cordylus* en *Lacerta* werden soorten gevonden waar mogelijke Robertsoniaanse fusies hebben plaatsgegrepen. Het genus *Varanus* is gekenmerkt door pericentrische inversies. Met uitzondering van een vrouwelijk heterogamie van het type ZW bij 5 soorten Lacertidae, kon geen geslachtschromosoom heterogamie aangetoond worden bij de overige onderzochte families.

TABLE 6

	2n	M	V	I	m	N.F.	T.L.	V/M	M/I	N.F./2n
Lacertilia										
Teiidae										
Ameiva chrysolaema	50	22	—	22	28	50	30,9	0	1,0	1,0
Tupinambis nigropunctatus	38	16	32	—	22	54	43,2	2,0	∞	1,4
T. teguixin	36	18	36	—	18	54	57,7	2,0	∞	1,5
Scincidae										
Chalcides chalcides	28	14	20	4	14	38	30,8	1,4	3,5	1,4
C. ocellatus	28	20	40	—	8	48	44,7	2,0	∞	1,7
Eumeces schneideri	32	30	24	18	2	44	56,2	0,8	1,7	1,4
Mabuya capensis	32	16	32	—	16	48	42,4	2,0	∞	1,5
M. carinata	32	18	36	—	14	50	45,2	2,0	∞	1,6
M. multifasciata	32	28	48	4	4	56	46,0	1,7	7,0	1,8
M. quinquetaeniata	32-34	26	52	—	6-8	58-60	54,5	2,0	∞	1,8
M. varia	32	16	32	—	16	48	30,0	2,0	∞	1,5
Riopa sundevallii	30	18	36	—	12	48	38,0	2,0	∞	1,6
Tiliqua scincoides	32	24	48	2	6	56	60,6	2,0	12,0	1,8
Lacertidae										
Acanthodactylus pardalis	38	36	—	36	2	38	45,7	0	1,0	1,0
A. scutellatus	38	36	—	36	2	38	85,2	0	1,0	1,0
Lacerta agilis	38	36	—	36	2	38	55,4	0	1,0	1,0
L. melisellensis	38	36	—	36	2	38	50,3	0	1,0	1,0
L. hispanica	38	22	—	22	16	38	26,0	0	1,0	1,0
L. muralis	38	28	—	28	10	38	33,1	0	1,0	1,0
L. ocellata	36	20	4	18	16	38	25,7	0,2	1,1	1,1
L. sicula campestris	38	36	—	38	2	38	43,3	0	1,0	1,0
L. viridis	38	36	—	36	2	38	76,4	0	1,0	1,0
L. vivipara	36	24	—	24	12	36	26,5	0	1,0	1,0
Psammodromus algirus	40	38	—	38	2	40	70,1	0	1,0	1,0
Cordylidae										
Gerrhosaurus flavigularis	34	12	24	—	22	46	54,6	2,0	∞	1,4
G. major	34	14	28	—	20	48	48,9	2,0	∞	1,4
Cordylus giganteus	42	18	4	16	24	44	32,2	0,2	1,1	1,1
C. jonesii	34	24	48	—	10	58	70,9	2,0	∞	1,7
C. vittifer	34	24	48	—	10	58	63,3	2,0	∞	1,7
Platysaurus guttatus	34	12	24	—	22	46	40,4	2,0	∞	1,4
P. minor	34	12	24	—	22	46	55,5	2,0	∞	1,4
Pseudocordylus subviridis	32	28	56	—	4	60	58,1	2,0	∞	1,9

	2n	*M*	*V*	*I*	*m*	*N.F.*	*T.L.*	$\frac{V}{M}$	$\frac{M}{I}$	$\frac{N.F.}{2n}$
Varanidae										
Varanus bengalensis	40	16	32	—	24	56	43,8	2,0	∞	1,4
V. exanthematicus	40	16	16	8	24	48	40,2	1,0	2,0	1,2
V. griseus	40	16	28	2	24	54	47,8	1,8	8,0	1,4
V. salvator	40	16	28	2	24	54	39,5	1,8	8,0	1,4

2n = diploid chromosome number; M = number of macrochromosomes; V = number of arms of two armed chromosomes; I = number of one armed chromosomes; m = number of microchromosomes; N.F. = nombre fondamental; T.L. = total chromosome length (μ);
$\frac{V}{M}$ index of two arms; $\frac{M}{I}$ index of symmetry; $\frac{N.F.}{2n}$ relative N.F. value.

RÉSUMÉ

Des données chromosomiques de 36 espèces et 15 genres de Lacertidae (Autarchoglossa), appartenant aux familles des Teiidae, Scincidae, Lacertidae, Cordylidae et Varanidae sont présentées dans cette étude. Un résumé des valeurs 2n et N.F., le nombre de macro- en microchromosomes ainsi que certains rapports sont données dans le tableau 6. Le nombre diploide varie de 28 à 42. Le nombre fondamental est compris entre 36 et 60. L'aspect général des caryotypes est assez spécifique pour chaque famille. Toutes les familles montrent des microchromosomes, quoique dans des nombres différents. La configuration avec un grand nombre de microchromosomes, bien séparés des macrochromosomes, est typique pour les Teiidae, Cordylidae et Varanidae. Les Scincidae et les Lacertidae montrent un petit nombre de microchromosomes, qui passent graduellement en macrochromosomes. Le caryotype des Lacertidae est caractérisé par des chromosomes aux centromères terminales. Les autres familles examinées ont en général des chromosomes à deux bras. Les genres *Cordylus* et *Lacerta* montrent des fusions Robertsoniennes. Le genre *Varanus* est caractérisé par des inversions péricentriques. A l'exception de 5 espèces de Lacertidae, avec une hétérogamétie féminine du type ZW, des hétérochromosomes sexuels n'ont pas pu être démontrés chez les autres familles examinées.

ZUSAMMENFASSUNG

Die Karyotypen von 36 Arten und 15 Genera Lacertilia (Autarchoglossa), die gehören zu den Familien Teiidae, Scincidae, Lacertidae, Cordylidae und Varanidae, wurden untersucht.

Die Übersicht der 2n und N.F. Werte, die Anzahl Makro- und Mikrochromosomen, ebenso wie einige Chromosoom Verhältnisse sind zu finden in Tabelle 6. Die diploïde Chromosoom Zahl variiert von 28 bis 50. Die N.F. Werte betragen 36 bis 60. Der allgemeine Aspekt der Karyogrammen ist ziemlich spezifisch für die verschiedenen Familien. Alle Familien schauen Mikrochromosomen, obgleich in verschiedenen Anzahl. Die Teiidae, Cordylidae und Varanidae haben eine grosse Anzahl Mikrochromosomen, die deutlich zu unterscheiden sind von den Makrochromosomen. Die Scincidae und Lacertidae haben eine kleine Anzahl Mikrochromosomen die gleichmässig übergehen in die Makrochromosome. Die Karyotypen aller Lacertidae sind charakterisiert durch Chromosomen mit terminalem Zentromer; die übrigen untersuchten Familien haben im allgemeinen Zwei-armige Chromosomen. Robertsonian Fusion hat warscheinlich statt gefunden innerhalb der Genera *Cordylus* und *Lacerta*. Das Genus *Varanus* kennzeichnet zich durch perizentrische Fusionen. Ausser weiblicher Heterogametie von ZW Typ für 5 species Lacertidae, konnten morphologisch zu unterscheiden Geslechtschromosomen nicht nachgewiesen werden.

LITERATURE

ASANA, J.J., MAHABELE, T.S. (1941): Spermatogonial chromosomes of two Indian lizards, *Hemidactylus flaviviridis* RÜPPELL and *Mabuya macularia* BLYTH. Curr. Sci., 10 : 494-495.

BEÇAK, M.L., BEÇAK, W., DENARO, L. (1972): Chromosome polymorphism, geographical variation and karyotypes of Sauria. Caryologia, 25 : 313-326.

BHATNAGAR, A.N. (1958): Spermatogonial chromosomes of two lizards, *Hemidactylus brookii* GREY and *Varanus monitor* LINN. Curr. Sci., 27 : 504-505.

BURY, R.B., GORMAN, G.C., LYNCH, J.F. (1969): Karyotypic data for 5 species of anguid lizards. Experientia, 25 : 314-316.

CHEVALIER, M. (1969): Données nouvelles sur le caryotype du lézard vivipare (Reptiles, Lacertilia). Existe-t-il une hétérogamétie femelle du type Z_1Z_2W? C.R. Acad. Sc., D268 : 2098-2100.

COLE, C.J. (1969): Sex chromosomes in teiid whiptail lizards-genus *Cnemidophorus*. Am. Mus. Novit., N° 2395 : 1-14.

DALLAI, R., BARONI URBANI, C. (1967): Fine resolution of the karyogram of *Lacerta sicula campestris* (DE BETTA). Caryologia, 20 : 347-353.

DALLAI, R., VEGNI TALLURI, M. (1969): A karyological study of three species of Scincidae (Reptilia). Chromosoma, 27 : 86-94.

DAREVSKY, I.S. (1966): Natural parthenogenesis in a polymorphic group of Caucasian rock lizards related to *Lacerta saxicola* EVERSMANN. J. Ohio Herpet, Soc., 5 : 115-152.

DUTT, K. (1968): A karyotype study of *Varanus monitor* LINN. Caryologia, 21 : 1-10.

GORMAN, G.C. (1970): Chromosomes and the systematics of the family Teiidae (Sauria, Reptilia). Copeia, 1970 (2) : 230-245.

GORMAN, G.C., GRESS, F. (1970): Chromosome cytology for four boid snakes and a varanid lizard, with comments on the cytosystematics of primitive snakes. Herpetologica, 26 : 206-207.

IVANOV, V.G., FEDOROVA, V.G. (1970): Sex heteromorphism of chromosomes in *Lacerta strigata* EICHWALD. Tsitologia, 12 : 1582-1585.

KUPRIYANOVA, L.A. (1969): Karyological analysis of lizards of the subgenus *Archaeolacerta*, Tsitologia, 11 : 803-814.

LEVAN, A., FREDGA, K., SANDBERG, A.A. (1964): Nomenclature for centromeric position on chromosomes. Hereditas, 52 : 201-220.

LOWE, C.H., WRIGHT, J.W. (1966): Evolution of parthenogenetic species of *Cnemidophorus* (Whiptail lizards) in Western North America. J. Arizona Acad. Sci., 4 : 81-87.

LOWE, C.H., WRIGHT, J.W., COLE, C.J., BEZY, R.L. (1970a) : Natural hybridization between the teiid lizards *Cnemidophorus sonorae* (parthenogenetic) and *Cnemidophorus tigris* (bisexual) Syst. Zool., 1970 : 114-127.

LOWE, C.H., WRIGHT, J.W., COLE, C.J., BEZY, R.L. (1970b) : Chromosomes and evolution of the species groups of *Cnemidophorus* (Reptilia : Teiidae). Syst. Zool., 19 : 128-141.

MAKINO, S., An atlas of the chromosome numbers in animals. 2nd ed. 1948. Iowa State College Press. Ames.

MAKINO, S., MOMMA, E. (1949) : An idiogram study of the chromosomes in some species of reptiles. Cytologia, 15 : 96-108.

MARGOT, A. (1946) : Démonstration de l'absence d'hétérochromosomes morphologiquement différenciés chez deux espèces de sauriens : *Anguis fragilis L.* et *Lacerta vivipara* JACQUIN. Rev. Suisse Zool., 53 : 555-596.

MATTHEY, R. (1931) : Chromosomes de reptiles, Sauriens, Ophidiens, Chéloniens. L'évolution de la formule chromosomiale chez les Sauriens. Rev. Suisse Zool., 38 : 117-186.

MATTHEY, R., Les chromosomes des vertébrés. Librairie de l'Université, F. Rouge-Lausanne, 1949, 344 pp.

MATTHEY, R. (1951) : The chromosomes of the vertebrates. Adv. Genet., 4 : 159-180.

MATTHEY, R., VAN BRINK, J.M. (1956) : La question des hétérochromosomes chez les sauropsidés. Reptiles. Experientia, 12 : 53-55.

MATTHEY, R., Les chromosomes des reptiles. In : Traité de Zoologie. T.XIV (3), Reptiles (Masson et Cie, éd., Paris). 1970 : 829-858.

NAKAMURA, K. (1931) : Studies on reptilian chromosomes. II. On the chromosomes of *Eumeces latiscutatus* (HALLOWELL), a lizard. Cytologia, 2 : 385-401.

NAKAMURA, K. (1935) : Studies on reptilian chromosomes. IV. Chromosomes of *Takydromus* spp. (lizards). Mem. Coll. Sc., Kyoto Imp. Univ., Ser. B, 10 : 341-353.

NOGUSA, S. (1953) : A study of the chromosomes of some lizards, with special remarks on the m-chromosomes. Cytologia, 18 : 29-35.

OGUMA, K. (1934) : Studies on the sauropsid chromosomes. II. The cytological evidence proving female heterogamety in the lizard *(Lacerta vivipara)*. Arch. Biol., 45 : 27-46.

OHNO, S., Sex chromosomes and sex-linked genes. Monographs on Endocrinology. Springer-Verlag, Berlin-Heidelberg-New York. 1967, 192 pp.

OHNO, S., Evolution by gene duplication. Springer-Verlag. Berlin-Heidelberg-New York, 1970, 160 pp.

PRESCH, W. (1973) : A review of the tegus, lizard genus *Tupinambis* (Sauria : Teiidae) from South America. Copeia, 1973(4) : 740-746.

PENNOCK, L.A. (1965) : Triploidy in parthenogenetic species of the Teiid Lizard genus *Cnemidophorus*, Science, 149 : 539-540.

ROMER, A.S., Osteology of the reptiles. The University of Chicago Press. Chicago & London. 2nd ed., 1968, 722 pp.

VAN BRINK, J.M. (1959) : L'expression morphologique de la diagamétie chez les Sauropsidés et les Monotrèmes. Chromosoma, 10 : 1-72.