

Three Probable Cases of Parthenogenesis in Lizards (Agamidae, Chamaeleontidae, Gekkonidae)

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Neither parthenogenesis nor triploidy has previously been reported in the infraorder Iguania, comprising the families Iguanidae, Agamidae, and Chamaeleontidae. During a study of agamid karyotypes certain butterfly lizards, *Leiolepis belliana* Gray, possibly from northern Malaysia, were found to be apparently triploid parthenogenones while others from Thailand were diploid and bisexual. Literature surveys revealed two other previously unsuspected cases of lizard parthenogenesis; one in the Chamaeleontidae and the other, which probably involves triploidy as well, in the Gekkonidae.

The *Leiolepis* examined were imported from animal dealers in Bangkok (Thailand) and Singapore by Richard R. Ross. The Singapore dealer told Dr. Ross that his *Leiolepis* came from near the Malaysia-Thailand border. These will subsequently be called the 'Singapore' *Leiolepis*. The 'Bangkok' specimens probably came from Tak province in northern Thailand, according to the dealer who supplied them.

Karyotypes were made from testis, spleen, or bone marrow by air- or flame-drying hypotonically pretreated, 3:1 methanol-acetic acid fixed cell suspensions[[1](#), [2](#), [3](#)]. The lizards were injected with Velban or colchicine to arrest mitoses 2-8 h before preparation. Slides were stained with 1% or 2% aceto-orcein. The 'Singapore' *Leiolepis* were in poor condition when karyotyped and provided about 20 mitotic figures each, while many figures were examined from each 'Bangkok' specimen.

The 5 'Bangkok' *Leiolepis* karyotyped (2 ♂♂, 3 ♀♀) all had the probably primitive 36 chromosome pattern typical of many lizards (Figures [1](#), a and [2](#)), including at least some members of each of the 3 iguanian families (Iguanidae [[4](#), [5](#), [6](#), [7](#), [8](#)], Agamidae [[4](#), [8](#)], Chamaeleontidae [[4](#), [9](#), [10](#)]). Each of the 13 'Singapore' females examined had karyotypes of about 54 chromosomes (Figure [1](#), b) readily interpreted as triploid. 18 macrochromosomes were present in all cells examined from each 'Singapore' specimen, and at least some cells in most had the expected 36 micro-chromosomes, although these were difficult to count because of their large number and small size. Usually 1 chromosome of the largest trio (I in Figure [1](#), b) in most of the triploid figures is differentiated by very conspicuous secondary constriction, which may be the nucleolus organizer (n in Figure [1](#)). This differentiation is probably a developmental

phenomenon, reported for some mammals [11], but it might result from a clonal chromosomal polymorphism. There were no indications of sex chromosomal heteromorphism in any of the karyotypes.

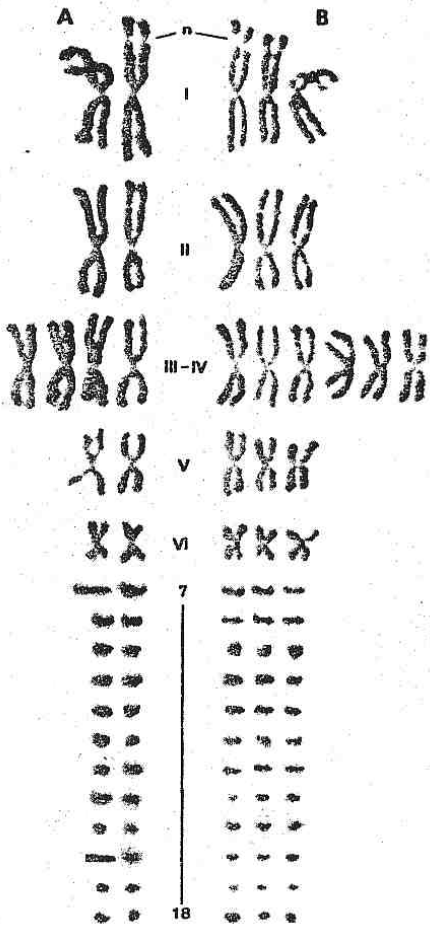


Fig. 1, a (left). Somatic karyotype of ♀ *Leiolepis belliana* from Bangkok, $2n = 36$.

Fig. 1, b (right). Somatic karyotype of ♀ from Singapore, $3n = 54$. The probable homologs are arrayed opposite one another for purposes of comparison, 'n' indicates the conspicuous secondary constriction, usually well developed in only a single chromosome of each cell.

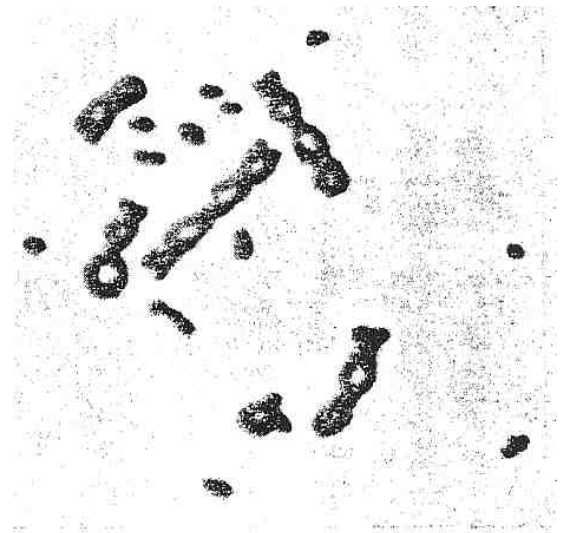


Fig. 2. Diakinesis in a male *Leiolepis belliana* from 'Bangkok'.

Constant triploidy almost always requires parthenogenetic reproduction [12] and is usually taken as presumptive evidence for it. In support of this conclusion, all 33 'Singapore' *Leiolepis* obtained were female. The probability of randomly collecting 33 females and no males from a bisexual population is about 1 in 1010, assuming an equal ratio and random distribution of the sexes.

Although no theory requires parthenogenesis to have a hybrid origin [12, 13], most lineages of

parthenogenetic vertebrates are thought to have originated as interspecific hybrids, with triploid clones deriving from back-crosses between diploid parthenogenones and males of related bisexual species (see Maslin [14] and Schultz [15] for references). One possible exception to the hybrid origin scheme is the parthenogenesis of certain Amazonian populations of *Cnemidophorus lemniscatus*, where there appears to be only one potential source species [16, 17]. Gunther Peters of the Humboldt Museum, Berlin, who has seen my specimens, is reviewing *Leiolepis* and any speculations on the origin of parthenogenesis in this group must be deferred until his review is complete.

During a literature search, 2 other probable cases of lizard parthenogenesis, 1 apparently involving triploidy, were brought to light. These merit verification and further study. The gecko, *Gehyra variegata ogasawarisimae* Okada (1930) [18], from Chichijima, one of the Bonin Islands, Japan [US Admin., Treaty of San Francisco], has 63 chromosomes (Makino and Momma [19]), the highest $2n$ of any gecko except the clearly triploid *Hemidactylus garnotii* [20]. Makino and Momma made karyotypes from embryonic ovaries only because they found no males and then cited the odd number of chromosomes as evidence for female sex chromosomal heteromorphism, still unconfirmed in lizards [4, 21]. However, particularly in view of the seeming lack of males, these *Gehyra* might be parthenogenetic triploid derivatives of a 42 chromosome diploid ancestral stock. The geckos, *Tarentola mauritanica* [22], *Bunops tuberculatus*, and *Cyrtodactylus koischyi* [23] all have $2n$'s of 42, which may thus be common in the Gekkonidae.

The third possible case of parthenogenesis was brought to my attention by A. Ross Kiester. Schmidt [24] found only females in a collection of 63 '*Rhampholeon boulengeri*' (Chameleontidae) [= *Brookesia spectrum affinis*, sensu Loveridge, 1951 [25]] from the Ituri Forest (Congo). 61 were from Medje and 2 were from Poko. I examined *Brookesia spectrum* in the Museum of Comparative Zoology collection: 4 additional *B. s. affinis* from Mayala, Ituri Forest, were female. However, males were found in small collections of *B. s. spectrum* from Ja River and Kribi, both in Cameroun, and of *B. s. boulengeri* from Upper Mulinga, Idjwi Id., Congo. I diagnosed the sexes by exposing gonads in the MCZ specimens, but errors in sex determination by Schmidt [24] would seem to be precluded by the males' greatly enlarged hemipenal swellings and much longer tails. Matthey [9] karyotyped 2 species of *Brookesia*, including *spectrum*: *B. stumpffi* (Madagascar) has the common and probably primitive lizard karyotype of 36 chromosomes. *B. [Rhampholeon, sensu Matthey] spectrum*, from an unspecified locality has a $2n$ of 20, the lowest number reported for any lizard. Since the *spectrum* locality is unspecified, the karyotypic data may provide little information on the possible parthenogenesis of the Ituri Forest population. However, since the genus *Chamaeleo* shows several species with $2n$'s of 22 from which the *B. spectrum* karyotype might be more directly derived than it can be from the $2n = 36$ karyotype of *B. stumpffi* [9, 10], karyotypic analysis of the remaining *Brookesia* species might indicate separate origins of the mainland and Madagascar dwarf chameleons, and might thereby support the older classification of *Rhampholeon* for the mainland forms and *Brookesia* for the Madagascar species [26].

Zusammenfassung. Nachweis von Triploidie und Parthenogenese bei Reptilien (Agamidae, Chamaleontidae und Gekkonidae).

REFERENCES AND NOTES

- [1] E. P. EVANS, G. BRECKON and C. E. FORD, *Cytogenetics J*, 289 (1964).
- [2] J. L. PATTON, *J. Mammal.* 48, 27 (1967).
- [3] L. A. PENNOCK, D. W. TRINKLE and M. W. SHAW, *Chromosoma* 24, 467 (1968).
- [4] R. MATTHEY, *Lcs Chromosomes des Vertebres* (F. Rouge, Lausanne 1949).
- [5] G. C. GORMAN, L. ATKINS and T. HOLZINGER, *Cytogenetics* 6, 286 (1967).
- [6] G. C. GORMAN, Thesis, Harvard University (1968).
- [7] W. P. HALL, paper read at the 1966 annual meetings of the Am. Soc. Ichthyologists and Herpetologists, Lawrence, Kansas.
- [8] W. P. HALL, unpublished.
- [9] R. MATTHEY, *Rev. Suisse Zool.* 64, 709 (1957).
- [10] R. MATTHEY and J. VAN BRINK, *Bull. Soc. vaud. Sci. Nat.* 67, 333 (1960).
- [11] T. C. Hsu, B. R. BRINKLEY and F. E. ARRIGHI, *Chromosoma* 23, 137 (1967).
- [12] E. SOUMALAINEN, *Adv. Genet.* 3, 193 (1950).
- [13] R. A. BEATTY, *Parthenogenesis and Polyploidy in Mammalian Development* (Cambridge University Press, London 1957).
- [14] T. P. MASLIN, *Syst. Zool.* 77, 219 (1968).
- [15] R. J. SCHULTZ, *Am. Naturalist* 103, 605 (1969).
- [16] D. M. V. M. PECCININI, Thesis, Univ. Sao Paulo (1969).
- [17] P. E. VANZOLINI, Abstract for Latin American Congress Zoology (Caracas, 1968).

- [18] Y. OKADA, Bull. biogeogr. Soc. Japan 7, 187 (1930).
- [19] S. MAKINO and P.: MOMMA, Cytologia 75, 96 (1949).
- [20] A. G. KLUGE and M. J. ECKARDT, Copeia 1969, 651 (1969).
- [21] R. MATTHEY and J. M. VAN BRINK, Evolution 77, 163 (1957).
- [22] R. MATTHEY, Rev. Suisse Zool. J5, 118 (1931).
- [23] Y. L. WERNER, Bull. Res. Council Israel 5 B, 319 (1956).
- [24] K. P. SCHMIDT, Bull. Am. Mus. Nat. Hist. 39, 385 (1919).
- [25] A. LOVERIDGE, Bull. Mus. Comp. Zool. Harvard 706, 177 (1951).
- [26] I thank E. E. WILLIAMS for his many suggestions, A. R. KIESTER, W. B. NEAVES and G. C. GORMAN for their comments and R. R. Ross for obtaining *Leiolepis*. This study was aided by N.S.F. Grant No. GB 6944 to E. E. WILLIAMS.