

General Introduction

The bisexual reproduction is common among most of the animal species. A haploid egg made in a female and a haploid sperm made in a male fuse into a diploid zygote, a fertilized egg, to develop into an embryo. In some of the animal species, however, females “parthenogenetically” produce embryos only from their eggs without male participation (Suomalainen, 1962). Three types of parthenogenesis have been known; *thelytoky*, in which unfertilized eggs develop into only females, *arrhenotoky*, in which unfertilized eggs develop into only males, and *deuterotoky*, in which unfertilized eggs develop into both sexes (Suomalainen, 1950).

The *thelytokous* parthenogenesis has been known in not a few animal species. It has been reported in different degrees of reliability based upon various bases, such as “absence” of males in some populations and reproduction by “virgin” females. However, these were not so easy to be proved. Only in a few cases, it has been described in some details on cellular processes and mechanisms of maleless start of the embryogenesis (Comrie, 1938; Barigozzi, 1944; Narbel-Hofstetter, 1950; Muldal, 1952; Cuellar, 1971; Marescalchi *et al.*, 1991; Pardo *et al.*, 1995).

The *thelytokous* parthenogenesis has been reported also in two scorpion families, the Buthidae, one of the ovoviviparous families, and the

Ischnuridae, one of the viviparous families. In some buthids, *Tityus* species, the thelytokous parthenogenesis was presumed based upon the absence of males in the populations examined (Lourenço, 1991; Lourenço and Cuellar, 1994) and upon the pregnancies repeated in isolated females (Lourenço, 1991). The thelytokous parthenogenesis was proposed also in another buthid, *Ananteris coineaui*, based on the all female neonates (Lourenço and Cuellar, 1999).

The virgin birth was confirmed by the separate rearing of specimens through the successive generations in two buthids, *Tityus serrulatus* (Matthiesen, 1962; San Martín and Gambardella, 1966) and *T. bolivianus uruguayensis* (Zolessi, 1985), and in an ischnurid, *Liocheles australasiae* (Makioka, 1993). The studies on the former two buthids, however, lacked histological examinations for the reproductive systems and left a doubt whether the virgin birth arose by the self-fertilization in the hermaphroditism. In the histological study on the latter species, *L. australasiae*, the absence of sperms and any other male gonadal elements was described through the reproductive systems to make the thelytokous parthenogenesis more reliable. In all these studies, however, the processes and mechanisms of the egg maturation and parthenogenetic start of the embryogenesis have not yet been studied, mainly because a sufficient number of specimens in the proper stage was difficult to be obtained.

In Part 1 of the present study, I have separately reared a number of specimens of *Liocheles australasiae* to make the virgin birth more certain and to obtain a sufficient number of specimens for the study in Part 2. In Part 2, I have studied the cellular processes and mechanisms of egg maturation and parthenogenetic start of embryogenesis using three different methods, histological, karyological, and DNA quantificational ones.