The Chromosomes of the Hawaiian endemic dragonflies, *Megalagrion oahuense* (Blackburn) (Coenagrionidae: Pseudoagrioninae) and *Nesogonia blackburni* (McLachlan), (Libellulidae: Sympetrinae), with a note on the cytotaxonomic affinities between the genera *Nesogonia* Kirby, and *Sympetrum* Newman (Odonata)

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During his brief stay in Hawaii in September, 1968, Prof. J. W. Boyes (McGill University, Montreal) made a few lacto-acetic-orcein squash preparations of *Megalagrion* (*Oahuagrion*) *oahuense* (Blackb.) and *Nesogonia blackburni* (McLach.), both endemic to the islands and not previously studied cytologically. Since the chief purpose of his visit was to collect local Syrphidae (Diptera) for cytological research, the fact that he took the time to make these smears is greatly appreciated.

Due to the endemic character of the material and in view of the fact that not a single Hawaiian dragonfly has ever been studied cytologically, it seems worth while to report briefly on the results.

The Microphotographs were taken of fresh preparations (a fortnight after fixation) with a Zeiss automatic photomicroscope, with ordinary light (100 × oil immersion, 8 × oculars, n.a. 1.25, green filter, Agepan FF panchromatic film). The positives were printed originally at 2250 × and are reduced in this paper to 1500 ×.

For the identification of specimens thanks are due to Dr. M. A. Lieftinck (Leiden).

OBSERVATIONS

Megalagrion (**Oahuagrion**) **oahuense** (Blackburn, 1884)

The monotypic subgenus is endemic to the island of Oahu. Structurally, this species stands well apart from the other megalagrions (Williams, 1936) and appears generalised when compared to most of them (Kennedy, 1929).

Our preparations originate from a single male taken at the Wiliwilinui Ridge.

No mitotic figures are available, but there are some 50 photographs of various meiotic stages. The haploid chromosome number is 14. The biva-

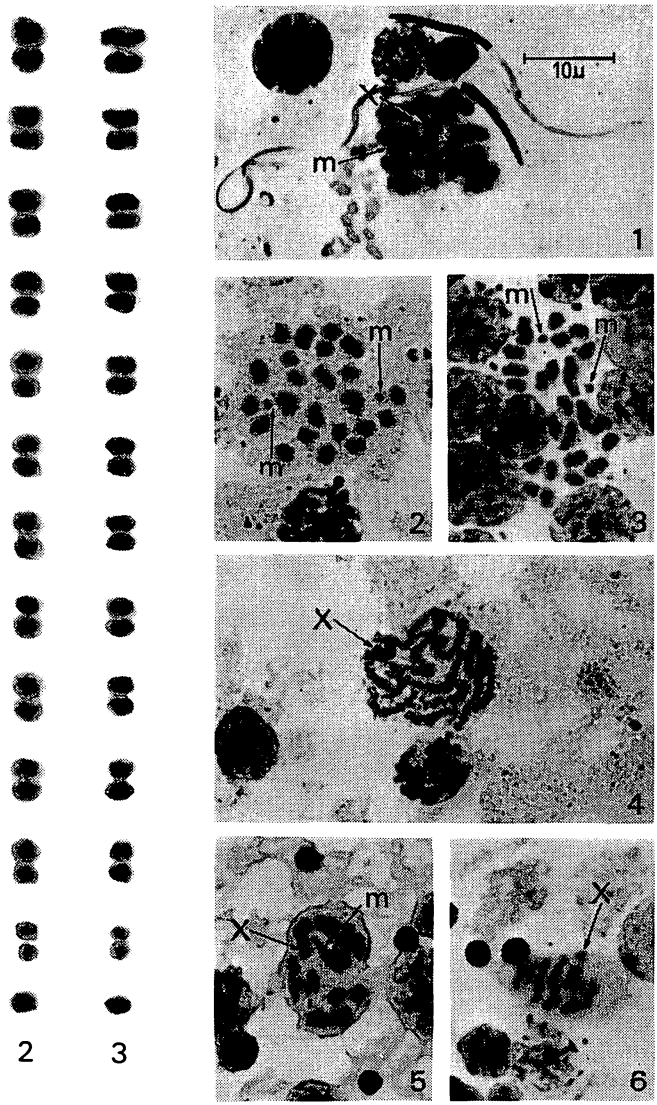

FIG. 1. *The Chromosomes of the hawaiian endemic Dragonflies* (X 1500).

1. *Megalagrion* (*Oahuagrion*) *oahuense* (Blackburn), *primary spermatocyte metaphase. Polar view. The univalent sex element and the m-bivalent area indicated by arrows.*
2–3. *Nesogonia blackburni* (McLachlan), *spermatogonial metaphase and karyograms. Note a pair of long autosomes and a pair of f m-chromosomes.*
4. *Nesogonia blackburni, spermatocyte pachytene. Note the heteropycnotic sex element and the bouquet orientation of the autosomes.*
5. *Nesogonia blackburni, primary spermatocyte metaphase. Polar view. Note a large bivalent and the negatively heterochromatic m-bivalent.*
6. *Nesogonia blackburni, secondary spermatocyte anaphase. Lateral view. Note the heterokinesis of the sex element.*

lents are of gradually decreasing magnitude. Their length at primary spermatocyte metaphase ranges from 4.6 to 2.0 μ. An m-bivalent is present and is slightly bigger than the unpaired sex chromosome (1.8 μ) (Fig. 1). In all bivalents presumably a single chiasma occurs.

Since no other *Megalagrion* species has ever been studied cytologically, nothing can be said at present on the cytotaxonomic affinities between *Oahuagrion* and the other subgenera proposed by Kennedy (1920).

The genus is considered as a direct derivative from *Pseudagrion* (Fraser, 1957) of which five species, all of them from India (Dasgupta, 1957), have so far been studied cytologically. The only cytotaxonomic feature in which the representatives of *Pseudagrion* differ essentially from the *Megalagrion* species studied is the relative size of the m-bivalent in primary spermatocytes. In all pseudagrions the m-bivalent is essentially smaller than it is in *Megalagrion oahuense*. The ratio of the volume of the m and X in the representatives of the former genus ranges between 0.66 and 0.37 (Dasgupta, 1957) whereas it is well above 1.0 in *Megalagrion*.

Ceriagrion is the only other genus of the subfamily so far studied cytologically. The cytological conditions in four Indian species were reported by Asana & Makino (1935), Makino (1935), Ray Chaudhuri & Das Gupta 1949), Srivastava & Das (1953) and Dasgupta (1957). No essential cytotaxonomic difference was found between this and the former genus.

Cytotaxonomically, *Megalagrion oahuense* thus stands well apart from all other Pseudagrioninae hitherto studied cytologically.

Nesogonia blackburni (MacLachlan, 1883)

The species is endemic to the Hawaiian archipelago, but did not develop distinct infraspecific forms within the islands (Kennedy, 1929).

Two males were collected at Wiliwilinui Ridge on the island of Oahu. More than 200 figures of most spermatogonial and spermatocyte stages are present in this material. The mitotic figures greatly outnumber those of meiotic stages.

The chromosome number is $2n = 25$, $n = 13$. The size of the mitotic elements ranges from 3.1 to 0.9 μ. The first autosomal pair in most figures is clearly longer than the others. The second and third pairs both are approximately 2.9 μ long, the others are of gradually decreasing magnitude, save for a pair of minute m-chromosomes. The sex chromosome is one of the medium sized elements (Figs. 2, 3).

The autosomes form a bouquet at pachytene (Fig. 4). The sex element is positively heteropycnotic at the usual stages and divides in the postreductional way (Fig. 6). At primary spermatocyte metaphase the m-bivalent is negatively heterochromatic (Fig. 5).

The karyotype of *Nesogonia* is similar to that of the allied genus *Sympetrum*. The cytotaxonomic comparison of the two genera is outlined below.

DISCUSSION ON THE CYTOTAXONOMIC AFFINITIES BETWEEN THE GENERA *NESOGONIA* AND *SYMPETRUM*

The genus *Nesogonia* was erected by Kirby (1898) to house the single known species, *Lepthemis blackburni* McLachl. Its generic distinction has been regarded by some authors as questionable (Kennedy, 1929) since *Nesogonia* is so close to the holarctic *Sympetrum* that it could be put in that genus with little argument. Obviously it is a relatively recent immigrant to Hawaii. For this reason it seems worth while to review the cytotaxonomic affinities between the two genera.

So far 15 species of the genus *Sympetrum* (from North America, Europe, Japan and Jamaica) were studied cytologically. This figure represents more than 25% of species described. A review of the cytological situation within the genus was given by Kiauta (1969). In Table I a comparison of the main cytological data on *Nesogonia* and *Sympetrum* is given.

TABLE 1. *Cytological comparison of the genera Nesogonia and Sympetrum*

Cytological characters		*Nesogonia*	*Sympetrum*
type number		13	13
haploid chromosomes number	*actually recorded*	13	11,12,13
	primary complement	13	12,13
secondary fusions		no	yes
extra large autosomes in primary complement		yes	no
m in primary complement		yes	yes or no
bouquet in male		yes	yes

From Table 1 it is apparent that the cytotaxonomic differences between the two genera are bigger than usual in a single genus, though, it should be stressed, in several anisopterous genera even greater cytological differences occur within a single genus.

The most striking difference between *Nesogonia* and *Sympetrum* lies in the presence of an extra large autosomal pair in the former genus, whereas such a pair is lacking in the primary complements of the latter. In view of the relatively large number of *Sympetrum* species studied, this character is probably to be regarded as a generic character. Thus from a cytological point of view the two genera appear distinct, though closely related.

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