QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 492

CHROMOSOME NUMBERS OF THE EXOTIC PASSIFLORA SPECIES IN AUSTRALIA

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SUMMARY

The chromosome numbers of three previously uncounted species in the genus *Passiflora*—*P. alata* Dryand., *P. antioquiensis* Karst. and *P. filamentosa* Cav.—are reported, all three species being 2n = 18. Several confirmatory counts of other exotic *Passiflora* species occurring in Australia are also listed. The cytology of the exotic *Passiflora* species is discussed in relation to evolution in the genus and in regard to a breeding programme involving the commercial passion fruit, *P. edulis*.

I. INTRODUCTION

The genus *Passiflora* comprises some 400 species of perennial vines, all but about 40 being native to the Americas (Killip 1938). Many *Passiflora* species bear highly coloured ornamental flowers or possess edible fruit, and these have been significant factors in their being dispersed throughout the tropics and subtropics.

Several species of *Passiflora* which produce edible fruit have achieved commercial significance both in Australia and overseas. The purple passion-fruit (*P. edulis*) is widely grown in Queensland and New South Wales. Commercial fruit production in this cultivar has limitations because of susceptibility to common pests and diseases and intolerance of cold. Disease resistance (Purss 1958) and cold tolerance (Bowden 1940) are known within the genus and several species have been used as protective rootstocks for *P. edulis* (Groszmann and Purss 1958).

Improvement in the purple passion-fruit could also be accomplished by a programme of breeding and selection using the available species. The *Passiflora* species cultivated in Australia (as ornamentals or for their edible fruit) represent a source of valuable characters. Further variability of potential value is available in the indigenous species and those exotic species now naturalized in Australia.

"Queensland Journal of Agricultural and Animal Sciences", Vol. 26, 1969

A knowledge of chromosome numbers in these species would indicate species relationships and possible compatibilities. A collection of species was made throughout Australia and a cytological study was undertaken.

II. REVIEW OF LITERATURE

Moore (1893, p. 253) recognized three native Australian species—*P. aurantia, P. herbertiana* and *P. cinnabarina*. *Passiflora* species of exotic origin also occur in Australia. Bailey (1900, p. 687) has recorded *P. subpeltata,* the purple passion-fruit and the granadilla (*P. quadrangularis*) as naturalized in Queensland. Undoubtedly the last two species are escapes from cultivation. *P. edulis, P. caerulea* and *P. subpeltata* are naturalized and quite common in the Sydney district and Blue Mountains (Beadle, Evans, and Carolin 1962, p. 198) of New South Wales. Two other common weeds—*P. suberosa* and *P. foetida*—are widely distributed in tropical and subtropical Queensland.

Indications are that more than these nine recorded species are to be found in Australia. In South-East Asia and the Pacific Islands the exotic species are numerically more significant than the indigenous species. Neal (1965) mentioned 22 species of *Passiflora,* all introduced, as occurring in Hawaii and most are cultivated for their ornamental value. Many exotic species are probably grown as ornamentals in plant nurseries or private collections in Australia.

Only some 28 species, species hybrids and species forms in the genus *Passiflora* have been studied cytologically. A summary of published chromosome number determinations is presented in Table 1. The total of species studied represents only a meagre sample from the genus.

Storey (1950) has published the most extensive work on the cytology of the genus, establishing and confirming numbers of some 20 species and species hybrids. All the more common horticultural forms (including *P. edulis*) have the same chromosome number, 2n = 18. Four species have previously been reported with 2n = 12 and the three native Australian *Passiflora* species also have this number (Table 1; Beal unpublished). The species *P. suberosa,* with its wide distribution, has three numbers (2n = 12, 24, 36) ascribed to it (Table 1). The common weed species *P. foetida* is known to possess various forms, and various numbers (2n = 18, 20, 22) have been ascribed to it by different workers (Table 1). The cytological work carried out by Storey (1950) in the genus *Passiflora* was confined to species occurring in Hawaii, and considering the few species investigated, it is always possible that other numbers will be found elsewhere.

REFERENCE TO TABLE 1 (page 409)

Distribution refers to native areas, data being from Darlington and Wylie (1955) or Killip (1938). The columns n and 2n indicate whether the author has worked on somatic tissue (RT) or on reproductive tissue (PMC). Only the most recent confirmation of a chromosome number is included.

TABLE 1

Chromosome Numbers of Various Species, Species Hybrids and Subspecific Forms in the Genus *Passiflora*

Species	Distribution	Author	n	2n
x = 6 group				
P. lutea L.	Southern U.S.A. and West Indies	Bowden (1945)	..	84
P. lutea L.	Southern U.S.A. and West Indies	Baldwin (1949)	..	24
P. bryonoides H.B.K.	Mexico	Bowden (1945)	..	12
P. capsularis L.	Tropical America	Bowden (1945)	..	12
P. pulchella H.B.K.	Venezuela	Storey (1950)	6	12
P. suberosa L.	Tropical South America	Storey (1950)	12	24
P. suberosa L.	Tropical South America	Storey (1950)	18	36
P. suberosa L.	Tropical South America	Diers (1961)	6	12
P. aurantia Forst.	Eastern Australia	Beal (Unpub.)	6	12
P. herbertiana Lindl.	Eastern Australia	Beal (Unpub.)	6	12
P. cinnabarina Lindl.	Eastern Australia	Beal (Unpub.)	6	12
x = 9 group				
P. caerulea L.	Brazil	Bowden (1945)	..	18
P. edulis Sims	Tropical South America	Storey (1950)	9	18
P. edulis Sims f. *flavicarpa* Degener	..	Storey (1950)	9	18
P. incarnata L.	South-eastern U.S.A.	Storey (1950)	..	18
P. incarnata L.	South-eastern U.S.A.	Lloyd (1963)	18	..
P. laurifolia L.	Tropical America	Storey (1950)	9	18
P. ligularis Juss.	Peru	Storey (1950)	9	18
P. maliformis L.	Tropical America	Storey (1950)	9	18
P. mollissima H.B.K.	Tropical America	Heiser (1963)	..	18
P. quadrangularis L.	Tropical America	Beckett (1960)	..	18
P. subpeltata Ortega	Mexico and Venezuela	Storey (1950)	9	18
P. seemanni Griseb.	Central America	Storey (1950)	9	18
P. racemosa Brot	Rio De Janeiro and Brazil	Beckett (1960)	..	18
P. mixta L.	Andes	La Cour (1952)	..	18
P. tripartita Juss.	Central Equador	Heiser (1963)	..	18
P. alato-caerulea	Horticultural	Storey (1950)	..	18
P. racemosa-coccinea	Horticultural	Storey (1950)	9	18
P. caerulea-quadrangularis	Horticultural	La Cour (1951)	9	..
P. caerulea hybrid	..	Storey (1950)	..	18
P. maliformis x *P. laurifolia*	Horticultural	Storey (1950)	..	18
P. quadrangularis x *P. racemosa*	Horticultural	Beckett (1960)	..	27
x = 9, 10 group				
P. gracilis Jacq.	Venezuela	La Cour (1952)	..	18
P. gracilis Jacq.	Venezuela	Bowden (1945)	..	20
P. foetida L.	Tropical America and naturalized over tropics	Darlington and Janaki Ammal (1945)	..	18
P. foetida L.	Tropical America and naturalized over tropics	Bowden (1945)	..	22
P. foetida L.	Tropical America and naturalized over tropics	Storey (1950)	10	20
P. foetida L. var. *gossypifolia* Desv.	Tropical America and naturalized over tropics	Storey (1950)	10	20

TABLE 2

Species of *Passiflora* in Australia

Species	Source*	Herbarium No.	Category
P. suberosa	1 R.H.R.S. Q.	BRI 065480	NAT
P. suberosa	2 Ormiston Q.	BRI 063596	NAT
P. suberosa	3 Brisbane Q.	BRI 063990	NAT
P. edulis	Ormiston Q.	BRI 064068	NAT. F.
P. edulis f. *flavicarpa*	Ormiston Q.	BRI 064069	NAT. R.
P. caerulea	Fingal N.S.W.	BRI 063594	NAT. R.
P. incarnata	Narara N.S.W.	BRI 053799	R
P. mollissima	Tamborine Q.	BRI 063789	F.O.
P. antioquiensis	Sydney N.S.W.	BRI 063806	O
P. alata	Toronto N.S.W.	BRI 057121	O
P. quadrangularis	1 Cairns Q. ..	BRI 054135	NAT. F.
P. quadrangularis	2 Ormiston Q.	BRI 055810	F
P. ligularis	Kuraby Q. ..	..	O
P. seemanni	Cairns Q. ..	BRI 064525	R
P. maliformis	Brisbane Q.	BRI 053954	O
P. subpeltata	Brisbane Q.	BRI 053952	NAT
P. filamentosa	Camden N.S.W.	BRI 063953	NAT
Passiflora sp. aff. *P. vitifolia*	Brisbane Q.	BRI 056106	O
P. foetida	Pialba Q. ..	BRI 053595	NAT
P. foetida var. *gossypifolia*	Brisbane Q.	BRI 066062	NAT

* R.H.R.S.—Redlands Horticultural Research Station, Ormiston.

III. MATERIALS AND METHODS

Species collection.—The 20 accessions of 15 species or species forms collected throughout Australia are listed (Table 2) together with the source of material. Each species is classified according to whether it is naturalized (NAT) or cultivated as an ornamental (O), for its edible fruit (F) or for its value as a rootstock (R).

The species were propagated from seeds, cuttings or entire plants at the Redlands Horticultural Research Station in south-eastern Queensland and grown in the glasshouse in 2 gal containers, or in the field over a commercial passion-fruit trellis.

Three forms of *P. suberosa* were examined and two forms of *P. quadrangularis* were studied. All species were identified by the Queensland Government Botanist and voucher specimens were numbered and lodged in the Queensland Herbarium (Table 2).

Cytological technique.—Chromosome number determinations were made where possible on both somatic tissue (root-tips) and at meiosis in PMC. Root-tips were taken from plants growing in the glasshouse or from the radicles of seed germinated in damp sand. Root-tips were pretreated for 2 hr in saturated aqueous para-dichlorobenzene at 7°C. This pretreatment allowed the accumulation of a large number of metaphase plates and facilitated subsequent chromosome counts (Darlington and La Cour 1962). The tissue was fixed in 3:1 alcohol-acetic solution for 24-48 hr and stored at 7°C in 70% ethyl alcohol.

Maceration and staining of root-tips were carried out in acid aceto-orcein (Darlington and La Cour 1962) and the root-tips were squashed between slide and coverslip under firm thumb pressure. Better stain contrasts in preparations were obtained by squashing the already macerated and stained root-tips in 45% acetic acid.

Flowers of *Passiflora* species are typically solitary and axillary and often when the PMC of one flower are in early prophase those of the following flower have reached the quartet stage. The difficulty of finding a suitable meiotic metaphase figure was largely overcome by relating meiotic stage to bud length. Flower buds were fixed in alcohol-acetic acid for 24–48 hr and stored in 70% alcohol at 7°C. Anthers from selected buds were placed in aceto-orcein on a slide and macerated with the flat end of a pair of forceps. All readily visible pieces of tissue were removed and the PMC were squashed after heating to 60°C.

For mitotic (RT) and meiotic (PMC) studies, drawings were made using a Zeiss drawing apparatus. Drawings of individual cells were each made at the highest possible magnification. These are presented at x 2700 for meiotic figures. Photographs were taken of favourable preparations and prints are at a magnification of x 3500 for mitotic figures and x 2500 and x 1250 for meiotic figures.

IV. RESULTS

The chromosome numbers of the 15 exotic species of *Passiflora* found in Australia are listed in Table 3 together with their native distribution. Numbers were confirmed for 12 species (Figures 1-6) and a number 2n = 18 has been

Fig. 1.—*P. foetida*. Ten bivalents at PMC meiosis. (x 2500).

TABLE 3

CHROMOSOME NUMBERS OF *Passiflora* SPECIES IN AUSTRALIA

Species	Distribution	Chromosome Number n	2n	Herbarium Number
Sub-genus Granadilla				
P. quadrangularis L.	Tropical America	9	18	BRI 065810
P. quadrangularis L.	Tropical America	9	..	BRI 064135
P. edulis Sims	Tropical America	9	..	BRI 064068
P. edulis Sims f. *flavicarpa* Degener	..	9	..	BRI 064069
P. caerulea L.	Brazil	9	..	BRI 063594
P. incarnata L.	S.E. U.S.A.	9	..	BRI 063799
P. alata Dryand	Peru	9	..	BRI 067121
P. ligularis Juss.	Peru	9	18	..
P. seemanni Griseb.	Central America	9	18	BRI 064525
P. maliformis L.	Tropical America	9	18	BRI 063954
P. subpeltata Ortega	Mexico, Venezuela	9	18	BRI 063952
P. filamentosa Cav.	Central America	9	18	BRI 063953
Sub-genus Distephana				
Passiflora sp. aff. *P. vitifolia* ..	..	9	..	BRI 066106
Sub-genus Tacsonia				
P. mollissima H.B.K.	Tropical America	9	..	BRI 063789
Sub-genus Granadillastrum				
P. antioquiensis Karst. ..	Colombia	9	..	BRI 063806
Sub-genus Plectostemma				
P. suberosa L.	Tropical South America ..	12	24	BRI 063596
P. suberosa L.	Tropical South America ..	12	..	BRI 065480
P. suberosa L.	Tropical South America ..	12	..	BRI 063990
Sub-genus Dysosnia				
P. foetida L.	Tropical America and naturalized in tropics	10	..	BRI 063595
P. foetida L. var. *gossypifolia* Desv.	Tropical America	10	..	BRI 066062

established for *P. antioquiensis* (Figure 7), *P. alata* (Figure 8) and *P. filamentosa* (Figure 9). The three forms of *P. suberosa* all had the same chromosome number, 2n = 24, and the two forms of *P. quadrangularis* were both 2n = 18.

Meiosis was normal in all species with the exception of the single entry of *P. filamentosa*. Pairing behaviour was determined in only nine cells of this species (Table 4), as clumping of chromosomes made analysis difficult. Only 1-3 bivalents were observed at meiosis (Figure 9) and the irregular chromosome segregation resulted in micronuclei in the pollen quartet (Figure 10 and Table 5).

TABLE 4

MEIOTIC PAIRING IN *P. filamentosa*

No. of bivalents	0	1	2	3	4	5	6	7	8	9
No. of cells observed ..	4	1	1	3	0	0	0	0	0	0

Fig. 2.—*P. subpeltata.* Nine bivalents at PMC meiosis. (x 1250).

Fig. 3.—*P. edulis.* Nine bivalents at PMC meiosis. (x 1250).

TABLE 5

FREQUENCY OF OCCURRENCE OF NUCLEI PER PMC IN *P. filamentosa*

Nuclei per PMC	10	9	8	7	6	5	4	3	2	1
No. of cells observed ..	8	16	44	36	111	76	105	5	0	0

TABLE 6

FREQUENCY OF OCCURRENCE OF NUCLEI PER PMC IN *P. foetida* AND *P. foetida* VAR. *gossypifolia*

Nuclei per PMC	7	6	5	4	3	2	1
No. of cells in *P. foetida*	0	16	0	364	0	0	1
No. of cells in *P. foetida* var. *gossypifolia*	0	4	13	236	12	3	0

Fig. 4.—*P. caerulea.* Nine bivalents at PMC meiosis. (x 1250).

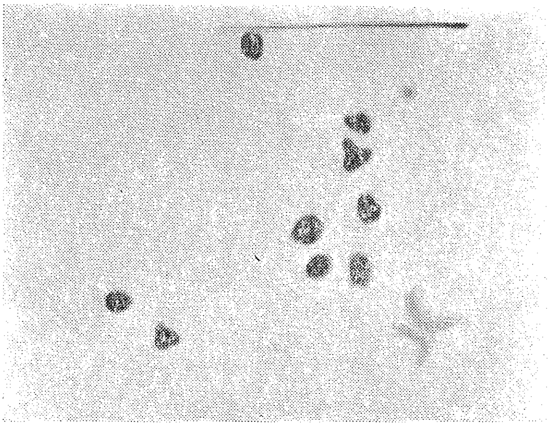

Fig. 5.—*P. quadrangularis* (BRI 065810). Nine bivalents at PMC meiosis. (x 1250).

Fig. 6.—*P. maliformis.* Eighteen chromosomes at mitotic metaphase. (x 3500).

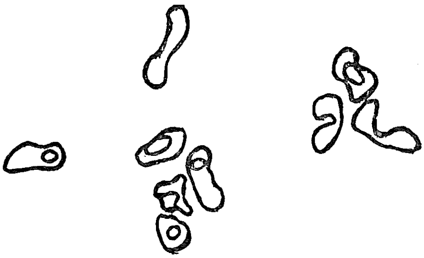

Fig. 7.—*P. antioquiensis.* Nine bivalents at PMC meiosis. (x 2700).

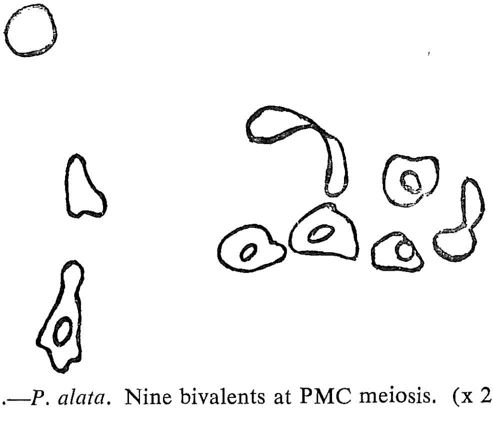

Fig. 8.—*P. alata.* Nine bivalents at PMC meiosis. (x 2700).

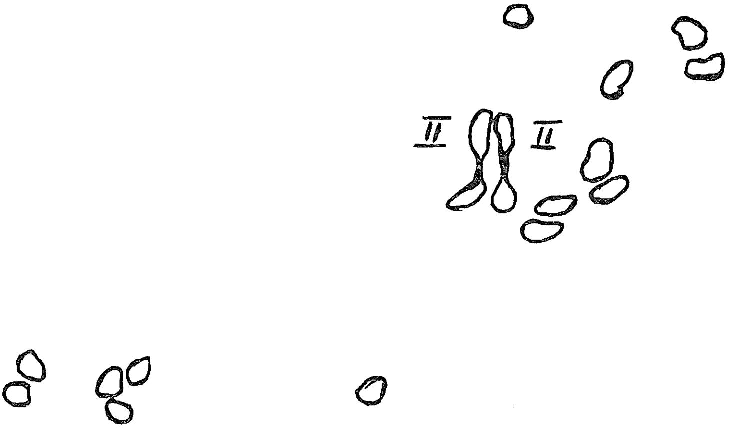

Fig. 9.—*P. filamentosa.* Two bivalents and 14 univalents at PMC meiosis. (x 2700).

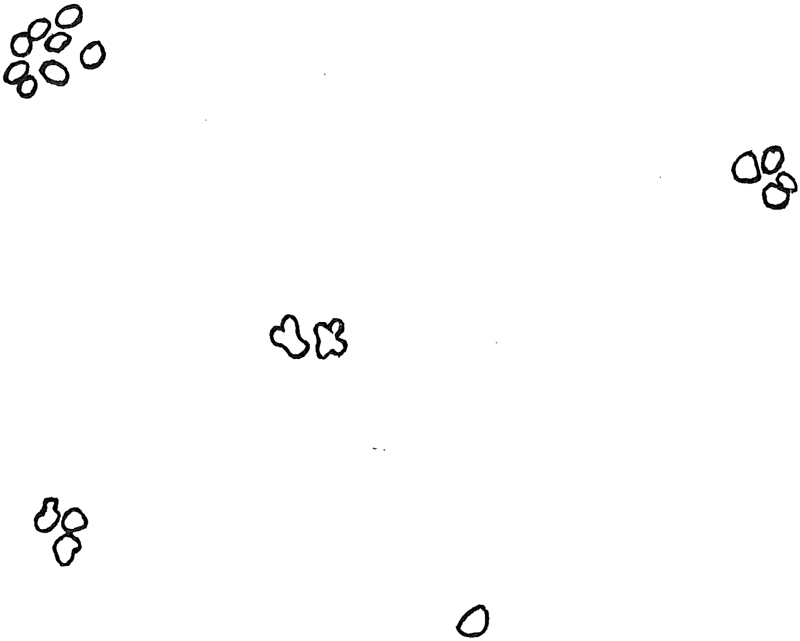

Fig 10.—*P. filamentosa.* Irregular segregation of 18 univalents at telophase I. (x 2700).

V. DISCUSSION

In Australia, 17 types of exotic *Passiflora* species are known, including 14 species, one form, one variety and one species form. Three indigenous species also occur but the genus is poorly represented in Australia. The status of the exotic species in Australia (Table 2) is largely determined by their edible or ornamental value, although several species are common weeds and others are cultivated for use as rootstocks. The native *Passiflora* species are not of edible or ornamental value and they are seldom cultivated in Australia.

Chromosome numbers are now recorded in 34 species and sub-specific types of *Passiflora*. Storey (1950) indicated the importance of interspecific polyploidy, as one species was known with $2n = 12$ and several with $2n = 18$. Seven $2n = 12$ species are now known and the Australian native species are found in this group. However, all the more common horticultural species, including *P. edulis,* are $2n = 18$. Other euploid numbers also occur, including $2n = 24$, $2n = 36$ and higher ploids. Aneuploid changes have also occurred, a species with $2n = 20$ chromosomes being known, a further indication that both new numbers and new series may be found in the numerous uncounted species.

The $2n = 12$ species with their low chromosome number may be regarded as the primitive or ancestral species in the genus (Stebbins 1950). These species do not have the development of flower and fruit inherent in the $2n = 18$ species and as a result have seldom been cultivated or investigated.

The $2n = 18$ group of species with one exception had a regular meiosis and high fertility. The low level of pairing in *P. filamentosa* (Figure 9 and Table 4) was associated with abnormal chromosome disjunction (Figure 10 and the occurrence of micronuclei in the pollen quartet (Table 5). Indications of complete sterility in *P. filamentosa* were confirmed by observations in this study and by the report (McBarron personal communication) that the single plant of this species at Camden had not been known to fruit in over 30 years. Only the plant's strong suckering habit allowed it to survive in nature.

The plant studied may be a rare asynaptic individual not characteristic of the species, although the meiotic irregularity and sterility observed in *P. filamentosa* suggest alternatively a possible hybrid origin as was previously suggested by Killip (1938) on morphological grounds. The plant may be of immediate hybrid origin and not *P. filamentosa* at all. However, the voucher specimen agrees with the description of the type specimen of this species (Killip 1938). It is also possible that *P. filamentosa* is not a valid species and plants ascribed to this name are hybrids of two synaptic species. A study of several plants representative of *P. filamentosa* or of hybrids of closely related species would be useful in testing these hypotheses.

The lowest haploid number recorded in the genus *Passiflora* was $n = 6$, suggesting a possible triploid origin for the $2n = 18$ species. Irregular meiosis and sterility are normally associated with triploid origins but the normal meiosis and high fertility found in the $2n = 18$ group of species suggest a different mode of origin. Storey (1950) suggests that $x = 3$ rather than $x = 6$ is the basic number for the genus and that the $2n = 18$ species can be regarded as allohexaploids of ancient origin where diploidization is complete. However, no conclusive evidence is recorded which suggests that $x = 3$ is the basic number of the genus. The number $2n = 84$ recorded for *P. lutea* (Table 1) is an extremely high ploid if x = 3 is the basic number. Chromosome numbers of 2n = 24 and 2n = 48 recorded in species from the related genera of *Tetrapathea* (Hair and Beuzenberg 1959) and *Adenia* (Miège 1960) equally well support the suggestion of a probable basic number of x = 6 in the genus. Numbers are not recorded by Darlington and Wylie (1955) for species in related families in the order Passiflorales (aff. Hutchinson 1960). However, the lowest haploid number recorded in families from the related orders Loasales and Cucurbitales (aff. Hutchinson 1960) is n = 7. The 2n = 18 *Passiflora* species may well have evolved in successive steps as aneuploid derivatives of a 2n = 24 type. Support is lent to this hypothesis as the intermediate numbers of 2n = 22 and 2n = 20 are recorded in *P. foetida.* Evolution of 2n = 18 species of *Passiflora* from a 2n = 24 type by successive loss of a chromosome pair would still be commensurate with a basic number of x = 6 for the genus.

Interspecific compatibility is high in the 2n = 18 group (Bailey 1935, p. 2476), indicating the close relationship of these species. Meiotic studies of the numerous interspecific hybrids could possibly elucidate the problem of genomic relationships of the 2n = 18 species, yet only in one interspecific hybrid—*P. caerulea* x *P. quadrangularis* (La Cour 1951)—has a study of meiotic behaviour been recorded.

Intraspecific chromosome variation is recorded in *P. suberosa* and *P. foetida,* both of which occur in Australia. Three chromosome races (2n = 12, 24, 36) are recorded in *P. suberosa* and the well-documented morphological variability (Killip 1938) may be associated with differences in ploidy. The three forms of *P. suberosa* occurring in Australia varied in leaf shape and hairiness but had the same chromosome number, 2n = 24. The 2n = 24 race is the only one recorded in Australia and it is also dominant in Hawaii (Storey 1950), suggesting that this ploid level is significant in survival and dispersion of this species over the tropics.

Secondary pairing, which is indicative of polyploid origin, was recorded by Storey (1950) in *P. suberosa* (2n = 24) from Hawaii but it was not observed in *P. suberosa* in Queensland. There is further conclusive evidence for a polyploid origin for *P. suberosa* in the discovery of a 2n = 12 race in Peru (Diers 1961) and the occurrence of multivalence up to and including hexivalence in a 2n = 36 race in Hawaii (Storey 1950). The 2n = 36 race produces fertile seed and spreads under natural conditions, but is presumed of relatively recent origin as it has a limited distribution in Hawaii.

Various numbers (2n = 18, 20, 22) have been ascribed to *P. foetida.* In Hawaii (Storey 1950) and in Australia only the number 2n = 20 has been found in both *P. foetida* and *P. foetida* var. *gossypifolia.* It is possible that *P. foetida* (2n = 20) has evolved as an aneuploid variant of a 2n = 24 type and the other recorded numbers (2n = 18 and 2n = 22) are possible cytotypes.

Only bivalent behaviour has been observed in *P. foetida* (Figure 1) and its variety *gossypifolia* in Hawaii and Australia. However, in the Australian material a low frequency of abnormal micronuclei occurred in the pollen quartets

(Table 6). This is normally indicative of irregular segregation and lagging chromosomes at meiosis but no such cytological behaviour was observed. This species is worthy of further cytological investigation, as numerous varieties have been recognized (Killip 1938), of which several have become widely dispersed over the tropics and subtropics.

In any plant improvement programme, selection can be facilitated if a particular character occurs within the normal variation of the commercial species. There are large- and small-fruited forms within *P. quadrangularis* and both have the same chromosome number (Table 2). However, it may be necessary to search beyond the immediate commercial species to find the desired character and this can involve interspecific hybridization.

The distant cytological and taxonomic relationship of the $2n = 12$ species to *P. edulis* suggests that there is little or no chance of fertile hybrids being formed with this species. The native Australian *Passiflora* species have been precluded by the author from any hydridization programmes involving *P. edulis* for this reason.

Of the *Passiflora* species, in the sub-genus *Granadilla* (Killip 1938) *P. edulis* and nine other species (including *P. alata*) occur in Australia and they all have the same chromosome number, $2n = 18$. These nine species (Table 3) with their close taxonomic and chromosomal relationship to *P. edulis* are preferred as parents in any breeding programme involving this species, as fertile hybrids are more likely to be produced.

P. mollissima is an edible species of commercial value in several countries (Castaneda 1956) but it as well as *P. antioquiensis* and *P. vitifolia* is in a different sub-genus (Table 3) to *P. edulis,* although they all have the same chromosome number. *P. vitifolia,* however, was once included by Masters (1871) in the sub-genus *Granadilla.* The *Passiflora* sp. aff. *vitifolia* which was examined more closely resembled *P. vitifolia* than any of its related species—*P. speciosa, P. coccinea* and *P. quadraglandulosa*—and its normal meiosis (Figure 11) indicates its possible use as a parent in hybridization with *P. edulis.*

In a hybridization programme involving *P. edulis,* selection of species with the same chromosome number ($2n = 18$) and in the same sub-genus may not ensure production of fertile hybrids. Interspecific hybrids within the sub-genus *Granadilla* are almost invariably sterile (Storey 1950). Production of fertile alloploids by chromosome doubling of sterile hybrids could be a solution to the problem of sterility in breeding. A high degree of normal bivalent behaviour is essential in the induced alloploids to ensure high fertility. A knowledge of the cytological basis of sterility in the various hybrids is also needed, but meiotic studies of interspecific hybrids in *Passiflora* species are generally lacking.

Breeding problems in passion-fruit could be better understood with a more complete knowledge of the cytology of the genus. Few chromosome number determinations have been made in the genus *Passiflora* but it is apparent that considerable variation in chromosome number exists. Only a few species are familiar to fruit breeders and most of these species are in the 2n = 18 group. Several of these exotic species occur in Australia and they are a potential source of valuable characters for improvement of the edible species. Interspecific compatibility is high in the 2n = 18 group of species but hybrid sterility limits progress in fruit breeding. Further success in breeding depends largely on understanding the cytological basis of sterility of hybrids in the 2n = 18 group.

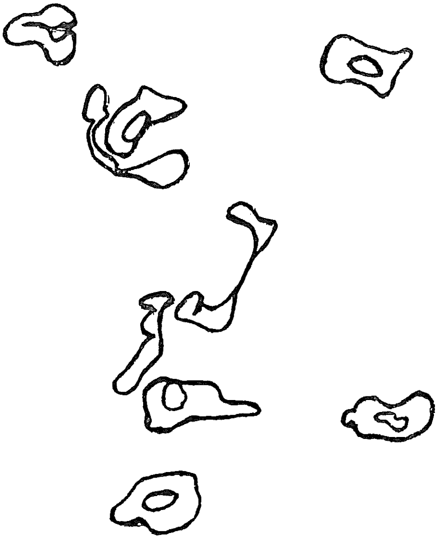

Fig. 11.—*Passiflora* sp. aff. *P. vitifolia*. Nine bivalents at PMC meiosis. (x 2700).

VI. ACKNOWLEDGEMENT

The assistance of Mr. W. W. Manly in the production of photo-micrographs is gratefully acknowledged.

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NOTE

In the paper "Cytology of the native Australian *Passiflora* species. 1. Chromosome number and horticultural value", which appeared in Vol. 26, No. 1, the reference on page 78 should read "Darlington and Wylie 1955", and the following additional reference should have appeared on page 81:

Storey, W.B. (1950).—Chromosome numbers of some species of *Passiflora* occurring in Hawaii. *Pacif. Sci.* 4:37-42.

(Received for publication August 28, 1968)

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CORRECTION: "Chromosome numbers of the exotic *Passiflora* species in Australia", by P. R. Beal. For "synaptic" in Vol. 26, p. 417, line 32 read "sympatric".