

A SURVEY OF CHROMOSOME NUMBERS IN THE GESNERIACEAE OF THE OLD WORLD

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ABSTRACT. Chromosome numbers of about 200 species of Old World Gesneriaceae are tabulated. These cover most of the species in cultivation but represent only a fraction of an estimated total of 1300 species. Great differences occur in the patterns of cytological variation in the larger genera. In *Chirita* and *Didymocarpus* there is much dysploidy and polyploidy, whereas *Cyrtandra* and *Streptocarpus* show great stability of number. A fair amount of polyploidy occurs in *Aeschynanthus* and there also seems to be a recurring trend to dysploid reduction of the diploid number by one pair. It is probable that the ancestral basic number of the subfamily Cyrtandroideae, comprising all but a few species of Old World Gesneriaceae, was $x = 8$ or 9 , as found today in species of *Boea*, *Chirita* and *Didymocarpus*, and that the numbers $n = 15-18$ are of tetraploid origin. If this is correct the diversification and speciation of a number of important genera such as *Cyrtandra*, *Streptocarpus* and *Saintpaulia* has occurred at the tetraploid level.

Chromosome studies of the Gesneriaceae of the Old World have been carried out over a number of years at the Royal Botanic Garden, Edinburgh, to provide a cytological background to the taxonomic study of the group. The results have been published in a series of short papers (Ratter, 1963; Ratter & Prentice, 1964 and 1967; Ratter & Milne, 1970; Milne, 1975). The present communication brings these published results and those of other workers together and discusses the accumulated data.

Limitation of the study to the Old World does not imply a purely geographical criterion, since, as discussed by Burtt (1963), the Old World Gesneriaceae form a natural group distinct from the Gesneriaceae of the New World. Following the subfamilial circumscriptions used by Burtt (1963), almost all the Old World Gesneriaceae belong to the subfamily Cyrtandroideae and almost all the New World species to the Gesnerioideae. The only exceptions are three species of *Rhynchoglossum* (Cyrtandroideae) native to Central America and northern South America and a very few species of Gesnerioideae found in the Old World: *Fieldia*, a monotypic genus belonging to the tribe *Mitrarieae*, occurs in New South Wales, and the three or four genera of the tribe *Coronanthereae* are found in New Caledonia, New Zealand and Lord Howe Island. Rather than divide a natural tribe on a purely regional basis, data on the two South American representatives of the *Mitrarieae* for which cytological information is available, *Mitraria coccinea* and *Sarmienta repens*, are included in this paper. Apart from these species no other data are given for New World Gesneriaceae and readers are referred to Lee, 1962 and 1967, for a summary of chromosome counts.

Table 1 includes all counts of Old World Gesneriaceae known to me and it is hoped that it is a complete compilation of the published work. In all, counts are available for only about 200 out of an estimated 1300 species of Cyrtandroideae, and, although these represent most of the species in cultivation, knowledge of the cytology of the subfamily is obviously extremely incomplete.

The great majority of the material examined at Edinburgh is of known wild origin, as noted in the original publications, and this is also the case for much of the other material, e.g. Storey's *Cyrtandra* from Hawaii. Identifications of all material worked on at Edinburgh have been made by Mr B. L. Burt, apart from *Aeschynanthus* which has been determined by Mr P. J. B. Woods. Most of the other chromosome counts are from pieces of specialist work in which careful attention was paid to accuracy of identification, e.g. Lawrence et al. (1939), Fussell (1958), Storey (1966), etc.

Chromosomes in the Cyrtandroideae are generally rather small and this has precluded any work on morphology. In our studies the smallest chromosomes were found in some species of *Aeschynanthus* and *Cyrtandra* where all of the complement were less than $1\text{ }\mu\text{m}$ in length, and the largest chromosomes in *Agalmyla* (*Dichrotrichum amabile*)* where the longer members of the complement were over $3\text{ }\mu\text{m}$. Chromosomes in the Gesnerioid tribes *Coronanthereae* and *Mitrarieae* are very tiny with none of the complement exceeding $1\text{ }\mu\text{m}$ in length. All these measurements are from mitotic metaphase in root-tip material not subjected to any pretreatment.

TRIBAL DISCUSSION

Tribe *Cyrtandreae* G. Don

Chromosome counts are available for twenty-four species of *Cyrtandra* and although this is only a tiny fraction of such a vast genus (500–700 spp., extending from Thailand to Hawaii), the greater part of the geographical range is covered (Malaya, Borneo, New Guinea, Solomon Is., Tahiti and Hawaii) and also a fair sample of the taxonomic diversity. Although Borgmann, 1964, recorded $2n = 32$ in three unidentified species from New Guinea, $2n = 34$ is clearly the normal number for the genus and occurs in all other species recorded, including two from New Guinea. A basic number of $n = 17$ is high and presumably has arisen by polyploidy, either representing a dibasic tetraploid from ancestors with $x = 8$ and 9 or the result of dysploid change from an even number such as $n = 16$ or 18 . It is highly improbable that this number has been continually produced *de novo* in so many parts of the geographical and taxonomic diversity of the genus, and so we must conclude that evolution in *Cyrtandra* has been from an originally tetraploid stock.

The chromosome number of *Hexatheca fulva* is $2n = 34$, as in *Cyrtandra*, but *Rhynchotechum discolor* has $2n = 20$.

Tribe *Trichosporeae* Nees

The basic number of the large, South-East Asian, epiphytic genus *Aeschynanthus* appears to be $n = 16$, which is found in all sections and also occurs in the related genera *Agalmyla* and *Lysionotus*; as will be discussed later (p. 533), this number is probably of tetraploid origin. The number $2n = 30$ occurs in species of sections *Haplotrichum* and *Polytrichum*, where $2n = 32$ species also occur, whilst in *A. radicans* of section *Aeschynanthus* stocks with both $2n = 30$ and 32 have been found. In addition Eberle, 1956, records $2n = 28$ in *A. marmoratus* (= *A. longicaulis*), section *Polytrichum*, for which there are two other counts of $2n = 30$. It seems therefore that

* Awaiting transfer from *Dichrotrichum* to *Agalmyla*.

dysploid reduction in chromosome number has become established in three different sections, presumably representing as many independent evolutionary lines.

Polyploidy is of frequent occurrence in *Aeschynanthus*. Tetraploid species ($2n = 64$ and 60) occur in four of the five sections, and one stock of *A. ellipticus* is hexaploid. However, no correlations of ploidy with morphology or distribution can be made on the information so far available.

Tribe *Klugieae* K. Fritsch

Five counts are available for this small tribe. *Monophyllaea horsfieldii*, a unifoliolate species from Malaya, was counted as $2n = 32$ by Oehlkers (1923) and as $2n = 20$ by Ratter & Prentice (1967). The latter number is the same as occurs in species of the related genus *Rhynchoglossum*. The existence of two such different and unrelated counts in the same species is very remarkable.

The chromosome number ($2n = 20$) of *Rhynchoglossum gardneri* and *R. notonianum* shows no obvious relationship to those of the other two species of the genus for which data are available, *R. obliquum* ($2n = 42$) and *R. papuae* ($2n = 54$), both of which are polyploid.

Tribe *Didymocarpeae* Endl.

The Didymocarpeae is the cytologically best-known tribe of Cyrtandroideae and fair numbers of chromosome counts are available for the three largest genera. These exhibit very different cytological patterns: the Indo-Malaysian *Chirita* and *Didymocarpus* have a wide range of numbers, indicating that both dysploidy and polyploidy have been active in their evolution, whereas the African *Streptocarpus* shows great stability in chromosome number.

Seventeen of the seventy-seven species of *Chirita* recognised by Wood (1974) and one as yet unidentified species have been counted and the following numbers recorded: $2n = 8, 18, 20, 28, 32, 34$ and 36 . In the annual section *Microchirita*, where eight of the eighteen species have been studied, four species have $2n = 18$ and four $2n = 34$.* The eight cytologically-known species of the thirty-six belonging to the section *Chirita*, which includes both perennials and annuals, have the following numbers: $2n = 8$ (1 sp.), 18 (4 spp.), 20 (1 sp.), 28 and 32 (1 sp. for which both numbers were recorded), and 34 (1 sp.); whilst only one of the twenty-three species of section *Gibbosaccus* has been counted and has $2n = 36$. If, considering the genus as a whole, $2n = 8, 18$ and 20 are taken as diploid numbers and the higher numbers (28, 32, 34 and 36) as tetraploid, then of the eighteen species known cytologically eleven are diploid and seven tetraploid. Wood in his revision of the genus (1974) concluded that the counts available at the time he wrote, covering twelve species, could not be related to distribution or habitat preference.

The occurrence of $2n = 8$ in *Chirita pumila* requires some comment. Nowhere else in the Cyrtandroideae has such a remarkably low number been recorded, and it is perhaps significant that it occurs in a particularly widespread and abundant annual species. The species is found from north India to west China and Viet Nam and possibly owes its success to the

* Sugiura (1938, 1940b), however, records $2n = 36$ in *C. lavandulacea* where Rogers (1954) and Ratter & Prentice (1964) have counted $2n = 34$.

protection of a highly successful adaptive complex by a low recombination index consequent on the small number of chromosomes. The count, however, comes from a single stock of botanic garden origin and it is desirable to confirm that this number occurs throughout the range of the species.

In *Didymocarpus* seventeen out of approximately one hundred species have been examined cytologically. The following numbers occur: $2n = 18$ (4 spp.), 22 (1 sp.), 24 (1 sp.), 28 (2 spp.), 32 (3 spp.), 36 (1 sp.), 38 (1 sp.), 44 (1 sp.), 54 (2 spp.), 56 (1 sp.), ± 90 (1 sp.). If $2n = 18$, 22 and 24 are accepted as diploid numbers, 28, 32, 36, 38 and 44 as tetraploid, 54 as hexaploid, 56 as octoploid and ± 90 as decaploid, then there are six diploid, eight tetraploid, one hexaploid and one octoploid species amongst those counted, whilst *D. tomentosus* Wight has hexaploid and decaploid races. Clearly, if the species counted are a representative sample, polyploidy has been very active in the evolution of the genus. Table 1 shows the distribution of chromosome numbers amongst the sections.

In *Boea* the four members of the Australia/New Guinea assemblage of species counted belong to an $x = 8$ series, with $2n = 16$ in *B. hygroskopica*, *B. lawesii* and *B. magellanica* (the type of the genus) and $2n = 32$ in *B. hemsleyana*. $2n = 32$ also occurs in *B. speluncarum*, a Bornean species representing the group with purple flat-limbed corollas and bright yellow anthers. The three other species for which information is available, *B. reticulata*, $2n = 18$, *B. kerrii*, $2n = 34$, and *B. herbacea*, $2n = 36$, belong to the white, more campanulate-flowered assemblage of species from Thailand.

The occurrence of a common base number of 17 in *Ancylostemon*, *Briggsia*, *Petrocosmea* and *Opithandra* gives further evidence of the relationship of these Asiatic genera.

The existence of two recent counts of different chromosome numbers, $2n = 38$ and 44, for *Haberlea rhodopensis* is interesting in the light of some observations recorded in Milne (1975). When root-tips of a stock of *H. rhodopensis* grown at Edinburgh were examined it was found that they were highly polysomatic. Numbers from $2n = c. 30$ to $c. 50$ were recorded but the commonest number was $2n = 44$: the same number given by Lepper (1970) from meiotic material. As Borhidi's (1968) count of $2n = 38$ was made from root-tip material it seems possible that the difference from Lepper's count might well be the result of somatic instability in chromosome number of the type found in the Edinburgh stock.

The cytology of *Streptocarpus* is better known than that of any other large genus of Cyrtandroid Gesneriaceae, with chromosome numbers available for fifty-one* of the hundred and twenty-eight species recognised by Hilliard & Burt (1971). The two subgenera, *Streptocarpus*, made up of all the unifoliate and rosulate species, and *Streptocarpella*, which contains the caulescent species, are differentiated on chromosome number: $2n = 32$ (or a multiple thereof) in *Streptocarpus* and $2n = 30$, apart from one record of $2n = 28$, in *Streptocarpella*. The difference in chromosome number has provided a useful character in assigning some difficult species to subgenera (see Hilliard

* 48 species counted + numbers of 3 others deducible from counts of interspecific hybrids. In addition, Darlington & Janaki Ammal (1945) erroneously attributed to Lawrence et al. (1939) counts for the following species: *S. luteus*, *S. parviflorus*, *S. woodii* (syn. *fanninae*), *S. mahoni*, *S. denticulatus* and *S. orientalis*. With the exception of *S. orientalis*, the list was corrected in Darlington & Wylie (1955) so that these records no longer appear

& Burt, 1971, p. 119). As $2n = 30$ and 32 are high for diploid ($2x$) numbers it seems probable that they are of tetraploid origin. In support of this can be cited the occurrence of secondary associations amongst the bivalents, originally commented upon by Lawrence et al. (1939) and clearly shown in a photograph of a pollen mother cell of *S. grandis* in Ratter & Prentice (1967). Diploidization, however, must be very complete as not a single multivalent has been observed in the hundreds of pollen mother cells examined. It is interesting that $2n = 30$ should be found in the morphologically orthodox *Streptocarpella*, whereas in the highly specialized, acaulescent subgenus *Streptocarpus* $2n = 32$ occurs. If one accepts that $2n = 30$ represents a dysploid reduction from a eutetraploid $2n (= 4x) = 32$ condition (see p. 532), it follows that the morphologically specialized subgenus has the primitive chromosome number and the less specialized subgenus the derived.

The only polyploid species of *Streptocarpus* reported from nature, the closely related *S. variabilis* and *S. hildebrandtii*, are both from Madagascar. *S. variabilis* is a hexaploid ($2n = 96^*$) and *S. hildebrandtii* is an octoploid ($2n = 128$). Meiosis in both species is regular with all chromosomes associating as bivalents, indicating that the species are either 'true' allopolyploids, or if they are autopolyploids or segmental allopolyploids that some mechanism producing cytologically diploid behaviour has become established. Hilliard & Burt (l.c., Chapter 9), point out the fascinating features of Madagascan *Streptocarpus*, and judging from the evidence of *S. variabilis* and *S. hildebrandtii*, these also extend into the field of cytology.

Lawrence (1940) records the only other polyploid known in *Streptocarpus*, a fertile tetraploid cultivar called 'Merton Giant', produced from seed borne by the normally sterile hybrid of *S. grandis* and *S. x hybridus* (the latter itself a complex hybrid of *S. rexii*).

Hilliard & Burt have assembled a great deal of information germane to this discussion showing that interspecific hybridization, followed by introgression or stabilization of hybrid derivatives at the homoploid level, has been an important speciation mechanism in subgenus *Streptocarpus*. They consider, taking into account evidence from the extensive hybridization carried out in cultivation as well as their own field observations, that the whole of the subgenus represents a single gene pool. They point out in support of this hypothesis that wherever meiotic studies of interspecific hybrids have been made meiosis appears normal and that even in rather wide crosses there is some fertility of the F_1 (see Hilliard & Burt, Chapter 7).

The number $2n = 30$ characterises all taxa of *Saintpaulia* for which counts are available, apart from $2n = 28$, stocks of *S. ionantha* and two autotetraploid cultivars of the same species. Altogether there are sixteen species, sixteen cultivars and an interspecific hybrid which have been examined cytologically. Evidence demonstrating relationship of *Saintpaulia* and *Streptocarpus* is accumulating from morphological and embryological sources (see Hilliard & Burt, 1971, pp. 114-115) and the existence of a common chromosome number in *Saintpaulia* and the caulescent species of *Streptocarpus* accords with such a relationship. Presumably the number $2n = 30$ was already established in the common ancestor before the divergence of *Saintpaulia* and the caulescent species of *Streptocarpus*. The only interspecific

* Unfortunately erroneously reported as $2n = 48$ in Hilliard & Burt (1971) due to a mistake on the part of the writer.

hybrid of *Saintpaulia* for which cytological information is available, *S. confusa* x *orbicularis*, shows normal meiosis, and all interspecific hybrids show good fertility, indicating that there are probably few barriers to interspecific gene exchange. Ehrlich (1956, 58) reported a tetraploid, $2n = 60$, cultivar of *S. ionantha*, 'Ionantha Amazon', with meiosis showing all the characters of a raw autopolyploid

Subfamily *Gesnerioideae*. Tribes MITRARIEAE B. L. Burtt and CORONANTHEREAE K. Fritsch.

Species of five isolated monotypic genera belonging to these tribes have been studied: the Chilean *Mitraria coccinea* and *Sarmienta repens*, the Australian *Fieldia australis*, *Rhabdothamnus solandri* from New Zealand and *Negria rhabdothamnoides* from Lord Howe Island. All species are high polyploids and this is possibly associated with their occurrence as isolated relicts.

GENERA ANOMALA

Three genera which do not readily fit into the classification of the Gesneriaceae are included here.

The affinities of *Rehmannia* seem to lie with the Scrophulariaceae and it is only because of the presence of a unilocular ovary that it has sometimes been placed in the Gesneriaceae, although its inflorescence and other characters are clearly not in accord with the family. Mr B. L. Burtt considers that the monotypic genus *Jerdonia* probably also belongs to the Scrophulariaceae, although it has greater similarities to Gesneriaceae than *Rehmannia*. Both *Rehmannia* and *Jerdonia* have chromosome numbers probably based on $x = 7$, with $2n = 28$ in *R. angulata* and *J. indica* and $2n = 56$ in *R. glutinosa*.

Titanotrichum, another monotypic genus, has much closer affinities with the Gesneriaceae than the other two genera and is best included in the family. Its chromosome number of $2n = 40$ gives no clue as to its relationship within the family.

GENERAL DISCUSSION

Patterns of chromosomal variation are strikingly different in the larger genera of Cyrtandroideae. In *Chirita* and *Didymocarpus* there are dysploid and polyploid series, whereas in the African *Streptocarpus* and *Saintpaulia* speciation has proceeded almost entirely without change of chromosome number. *Aeschynanthus* shows polyploid series at three levels and there also seems to be a recurring trend to reduction of the normal diploid number, usually by one pair.

The simplest interpretation would suggest that the ancestral basic number of the Cyrtandroideae was probably $x = 8$ or 9, as found today in species of *Boea*, *Chirita* and *Didymocarpus*, and that the important numbers $n = 15$, 16, 17 and 18 are of tetraploid origin: $n = 15$ owing its origin to dysploid reduction, and $n = 17$ being either the product of dibasic polyploidy of $x = 8$ and 9 or the result of a dysploid alteration in number. If this interpretation is correct, diversification and speciation of *Cyrtandra*, *Saintpaulia*

and *Streptocarpus* has taken place entirely at the tetraploid level, with the two higher polyploid Madagascan species of *Streptocarpus* subgenus *Streptocarpus* as the only known exceptions. The basic number of 17 characteristic of the related genera *Ancylostemon*, *Briggsia*, *Petrocosmea* and *Opithandra* also indicates evolutionary diversification at the tetraploid level, since it is extremely unlikely the number would arise independently in each genus. The tetraploid level seems also to have been the basis for evolution in the tribe *Trichosporeae*: no numbers are known below $n = 16$ or 15 which are found in *Agalmyla*, *Lysionotus* and all sections of *Aeschynanthus*, and from which higher polyploids have been derived in a number of sections of *Aeschynanthus*.

A comparison of the chromosome numbers of the subfamily Cyrtandroideae with the New World subfamily Gesnerioideae shows no obvious relationship. In the Gesnerioideae the basic number $x = 9$ occurs throughout the tribe *Columnneae* (*Columnnea*, *Drymonia*, *Episcia*, etc.), whilst $n = 13$ is particularly widespread, occurring in no less than twelve genera, including the well-known *Reichsteineria*, *Sinningia* and *Kohleria*. Polyploidy is of rare occurrence in New World Gesnerioideae in contrast to the situation in Cyrtandroid genera such as *Chirita*, *Didymocarpus* and *Aeschynanthus*.

In conclusion, cytological studies of the Old World Gesneriaceae have provided interesting information on patterns of evolution within genera and in some cases, such as the group of genera with $x = 17$, have given further evidence of affinities already postulated from morphology. In *Streptocarpus* cytological evidence has been useful in clinching the subgeneric assignments of a number of difficult species made on morphological grounds. Chromosome studies have failed to give the type of spectacular aid to subfamilial classification which they have afforded in, for example, the Dipterocarpaceae (Jong & Lethbridge, 1967) or the Ranunculaceae, but this situation is shared with the great majority of plant families and particularly those predominantly herbaceous.

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TABLE I

	Distribution	n	2n	Reference
Subfamily Cyrtandroideae Endl.				
Tribe CYRTANDREAE G. Don				
<i>Cyrtandra</i> nr. <i>axillaris</i> C.B.Cl.	Borneo		34	R. & P., 1964
<i>C. cordifolia</i> Gaud.	Hawaii	17	34	Storey, 1966
<i>C. ferruginosa</i> St. J. & Storey	"		34	" "
<i>C. garnotiana</i> Gaud.	"		34	" "
<i>C. grandiflora</i> Gaud.	"	17	34	" "
<i>C. latebrosa</i> Hill.	"		34	" "
<i>C. mooreaensis</i> G.W. Gillett	S Pacific	17	34	R. & P., 1967, as near <i>C. biflora</i> J. R. & G. Forst. M., 1975
<i>C. aff. multibracteata</i> C.B.Cl.	Borneo	17		R. & P., 1967
<i>C. oblongifolia</i> (Blume) C.B.Cl.	" , Java	17		R. & P., 1964
<i>C. paludosa</i> Gaud.	Hawaii	17	34	R. & P., 1967 Storey, 1966
<i>C. pendula</i> Blume	Malaya, Java		34	R. & P., 1964, some cells with 2n = 35 and 36 also observed (polysomatic)
<i>C. propinqua</i> C.N. Forbes	Hawaii		34	Storey, 1966
<i>C. radiciflora</i> C.B.Cl.	Borneo		34	R. & P., 1967
<i>C. sandei</i> De Vries	Java		34	M., 1975
<i>C. sandwicensis</i> (Lév.) St. J. & Storey	Hawaii	17		Storey, 1966
<i>C. sororia</i> Schltr.	New Guinea	17		M., 1975
<i>C. splendens</i> C.B.Cl.	Borneo		34	R. & P., 1964, cells with 2n = 21 & \pm 24 also observed (polysomatic)
<i>C. nr. splendens</i> C.B.Cl.	Borneo		34	R. & P., 1964, cells with 2n = 27 & 36 also observed (polysomatic)
<i>C. stupantha</i> St. J. & Storey	Hawaii	17	34	Storey, 1966
<i>C. sp.</i> C.3782	Solomon Islands		34	R., 1963
<i>C. sp.</i> C.4376	New Guinea	17		R. & P., 1967
<i>C.</i> 3 spp.	" "		32	Borgmann, 1964
<i>Hexathea fulva</i> C.B.Cl.	Borneo	17		R. & M., 1970
<i>Rhynchochelym discolor</i> (Maxim.) B.L. Burt	New Guinea, Philippines, Taiwan, Japan		20	R., 1963
Tribe TRICHOSPOREAE Nees				
<i>Aeschynanthus</i> Sect.				
<i>Aeschynanthus</i>				
<i>A. javanicus</i> Hook.	Java		64	Eberle, 1956
<i>A. lamponga</i> Miq.	Sumatra		64	" "
<i>A. lobbianus</i> Hook.	Borneo	32	64	" "
<i>A. obconicus</i> C.B.Cl.	W Malesia	16		R. & P., 1967
<i>A. parvifolius</i> R.Br.	" "		64	R. & M., 1970 (5 stocks)
<i>A. praelongus</i> Kraenzl.	Borneo	16		R. & M., 1970
<i>A. pulcher</i> (Blume) G. Don	Java		60	Rogers, 1954
			64	Eberle, 1956; R., 1963
<i>A. radicans</i> Jack	W. Malesia	15		R. & M., 1970 (1 stock)
			32	R. & M., 1970 (2 stocks)
<i>A. tricolor</i> Hook. f.	Borneo	16		Eberle, 1956, 1957
			32	R. & M., 1970

TABLE I (contd.)

	Distribution	n	2n	Reference
A. tricolor Hook. f. x parviflorus R. Br. Sect. <i>Diplotrichium</i> Benth.	Synthetic hybrid		48	R. & M., 1970
A (grandiflorus Spreng.) = parasiticus (Roxb.) Wall.	E India		32	Eberle, 1956 ¹
A. parviflorus (D. Don) Spreng.	NE India- SW China		32	R., 1963
A. sikkimensis Stapf	NE India		32	R., 1963; R. & M., 1970 (2 stocks)
Section <i>Haplotrichium</i> Benth.				
A. hosseusii Pellegrin	Vietnam		32	R., 1963
A. longiflorus DC	W Malesia		30	Fussell, 1958; R., 1963
A. perakensis Ridl.	Malaya		30	R. & P., 1964, polysomatic, 2n=21 & 28 also observed
A. speciosus Hook.	W Malesia		64	Eberle, 1956
Section <i>Microtrichium</i> C.B.Cl.				
A. ellipticus Lauterb. & K. Sch.	New Guinea		32	M., 1975
			64	R., 1963
			96	R. & P., 1964
A. horsfieldii R. Br.	Java		32	M., 1975
A. longicalyx Ridl.	Malaya		32	" "
A. nummularius (Burk. & S. Moore) K. Sch.	New Guinea		64	R., 1963; R. & M., 1970 (2 stocks)
A. papuanus (Schltr.) B.L. Burt	" "		32	M., 1975
A. sp. nov. C.4600	" "		32	" "
Section <i>Polytrichium</i> Benth.				
A. albidus (Bl.) Steud.	W Malesia		30	M., 1975
A. fecundus P. Woods	Thailand	16		R. & M., 1970, as sp. nov. sect. <i>Polytrichium</i>
A. marmoratus T. Moore	Burma, Malaya		28	Eberle, 1956
			30	Rogers, 1954; R. & P., 1964
A. myrmecophilus P. Woods	Malaya		64	M., 1975
Section <i>Diplotrichium</i> x <i>Haplotrichium</i>				
A.x splendidus T. Moore	Synthetic hybrid		32	R., 1963, as <i>A. parasiticus</i> (Wall.) Spreng; R. & P., 1964
Not assigned to sections				
A. lineatus Craib	Thailand		30	M., 1975
A. sp. G. 260	—	15		Lee, 1962
A. sp.	New Guinea		60	Borgmann, 1964
Agalmyla borneensis (Schlecht.) B.L. Burt	Borneo	16		R. & P., 1967 } as R. & P., 1964 } <i>Dichrotri-</i> chum sp. C.4045
A. parasitica (Lam.) Kuntze	W Malesia	16		Fussell, 1958
			32	R., 1963
A. (<i>Dichrotrichium</i> amabile S. Moore) ²	New Guinea		32	R. & P., 1964, as <i>Dichrotrichium</i> ? Sp. 60-811
Lysionotus serratus D. Don	N India, Burma, Thailand		32	Fussell, 1958; R. & P. 1964

TABLE I (contd.)

	Distribution	n	2n	Reference
Tribe KLUGIEAE K. Fritsch <i>Rhynchoglossum gardneri</i> Theobald & Grupe	Ceylon	10		R. & P. 1967, as <i>R. notonianum</i> (Wall.) B. L. Burt
<i>R. notonianum</i> (Wall.) B.L. Burt	S India, Ceylon	10	20	Eberle, 1956, 1957, as <i>Klugia notoniana</i> A.DC.
<i>R. obliquum</i> Bl.	India to Indonesia	21		R. & P., 1967, as sp. from Thailand
<i>R. papuae</i> Schlecht.	New Guinea	27		R. & P., 1967
<i>Monophyllaea horsfieldii</i> R. Br.	W Malesia	16 10	32	Oehlkers, 1923 R. & P., 1967
Tribe DIDYMOCARPEAE Endl. <i>Conandron ramondoides</i> Sieb. & Zucc.	Japan Taiwan	16	32	R. & P., 1964
<i>Ramonda myconii</i> (L.) Reichenb.	Pyrenees	48 24	48	R., 1963; R. & P. 1964 (2 stocks) R. & P. (1964); Lepper, 1970
<i>R. nathaliae</i> Panciĉ & Petroviĉ	N Macedonia & Serbia	18	48	Glišić, 1924 (cited by Tischler, 1927)
<i>R. serbica</i> Panciĉ	N Macedonia, Serbia, Albania	36		R., 1963 Glišić 1924 (cited by Tischler, 1927)
<i>Haberlea rhodopensis</i> Friv.	Bulgaria	22	38 44 (ca.30 -ca.50)	Lepper, 1970 Borhidi, 1968 M., 1975
<i>Beccarinda cordifolia</i> (Anthony) B.L. Burt	Burma		20	R. & P., 1964
<i>Briggsia aurantiaca</i> B.L. Burt <i>B. muscicola</i> (Diels) Craib	S Tibet NE Himalayas, SW China		34 68	R., 1963 R. & P., 1964
<i>Ancylostemon convexus</i> Craib	SW China	17	34	R. & P., 1964
<i>Opithandra primuloides</i> (Miq.) B.L. Burt	Japan		34	Fussell, 1958; R., 1963
<i>Petrocosmea kerrii</i> Craib <i>P. parryorum</i> C.E.C. Fisch.	Thailand India (Assam)	17	34 34	Fussell, 1958; R., 1963 R. & P., 1967 Fussell, 1958
<i>Hemiboea bicornuta</i> (Hay.) Ohwi	Taiwan	18		Hsu, 1968, as <i>Chirita</i> <i>bicornuta</i> Hay.

TABLE 1 (contd.)

	Distribution	n	2n	Reference
Chirita Sect. <i>Gibbosaccus</i> C.B. Cl.				
C. sinensis Lindl.	China		36	R. & P., 1964
Sect. <i>Chirita</i>				
C. pumila D. Don	N India- W China- Vietnam	4		R., 1963
C. anachoreta Hance	Burma-Thailand- Vietnam- Taiwan		18	R., 1963
C. macrophylla Wall.	India-Burma- W China- Thailand	9	18	R. & P., 1967
C. zeylanica Hook.	Ceylon	10		R. & P., 1967
C. walkeri Gardn.	"	9		M., 1975
C. urticifolia Buch.-Ham. ex D. Don	India- W China		34	R. & P., 1964
C. speciosa Kurz	India- W China- Vietnam		18	Fussell, 1958; R., 1963, (reported in both refer- ences under the synonym <i>C. trailliana</i> Forrest & W.W. Sm.)
C. asperifolia (Bl.) B.L. Burt	Sumatra, Java	14		Lee, 1962, as <i>C. blumei</i> C.B.Cl.
Sect. <i>Microchirita</i> C.B.Cl.		16	32	R. & P., 1967
C. caliginosa C.B.Cl.	Malaya, Sarawak	9		R. & P., 1967
C. sericea Ridl.	Malaya		18	R., 1963
C. hamosa R. Br.	India-W China- Malaya	17		M., 1975
C. micromusa B.L. Burt	Thailand	17		R. & M., 1970
C. bimaculata D. Wood	"	17		M., 1975
C. lavandulacea Stapf	Vietnam	18		Sugiura, 1938, 1940b (in the latter under <i>Didymo- carpus lavandulacea</i>)
			34	Rogers, 1954; R. & P., 1964
C. involucrata Craib	Thailand, Cambodia, Malaya	9		M., 1975
C. caerulea R. Br.	Thailand, Java, Lesser Sunda Is	9		M., 1975
Not assigned to a section				
C. sp. C.8246	Thailand	9		M., 1975
Didymocarpus Sect. <i>Didymanthus</i> C.B.Cl.				
D. alternans Ridl.	Malaya	18		R. & M., 1970
D. flavescens Ridl.	"	9		R. & M., 1970
D. malayanus Hook. f.	"	9		R. & M., 1970
Sect. <i>Heteroboea</i> Benth.				
D. aff. bombycinus Ridl.	"		18	R. & M., 1970
D. reticulosus C.B.Cl.	Borneo	9		R. & M., 1970

TABLE I (contd.)

	Distribution	n	2n	Reference
Sect. <i>Orthoboea</i> Benth.				
<i>D. floccusus</i> Thw.	Ceylon	16		M., 1975
<i>D. innominatus</i> B.L. Burt	S India	16	32	R. & P., 1967
<i>D. tomentosus</i> Wight	"	27		Thathachar, 1942
		±45	±90	R. & P., 1967
Sect. <i>Didymocarpus</i>				
<i>D. biserratus</i> Barnett	Thailand	28		M., 1975
<i>D. praeteritus</i> Burt & Davidson	Burma	12		R. & P., 1964
<i>D. purpureus</i> Ridl.	Malaya	16		R. & P., 1967
<i>D. rodgeri</i> var. <i>siamensis</i> W.W.Sm.	Thailand	14		R. & M., 1970
<i>D. siamensis</i> Barnett	"		54	R. & P., 1964
<i>D. sp. nov.</i> C.4304	"		28	R. & P., 1967
Sect. <i>Elati</i> Ridl.				
<i>D. citrinus</i> Ridl.	Malaya	11		R. & M., 1970
<i>D. corchorifolius</i> R. Br.	"	22		R. & M., 1970
Sect. <i>Boeopsis</i> Ridl.				
<i>D. pumilus</i> Ridl.	Malaya	19		R. & M., 1970
<i>Loxocarpus conicapsularis</i> (C.B.Cl.) B.L. Burt				
	Sarawak	9		M., 1975
<i>Paraboea capitata</i> Ridl.				
<i>P. vulpina</i> Ridl.	Malaya	18		R. & P., 1967
	"		±36	R. & P., 1967
			36	R. & M., 1970
<i>Ornithoboea wildeana</i> Craib	Thailand	±16		R. & P., 1967
<i>Boea hemsleyana</i> B.L. Burt				
	Solomon Islands	16		R. & M., 1970 (published as sp. from Solomon Islands)
<i>B. hygroskopica</i> F. Muell.	Australia	8		Lee, 1962; R., 1963
<i>B. lawesii</i> (F.Muell.) H.O. Forbes	New Guinea	8	16	R. & P., 1967 (2 stocks)
<i>B. magellanica</i> Lam.	New Guinea-Solomon Islands	8	16	R. & P., 1964; R. & M., 1970 (2 stocks)
<i>B. herbacea</i> C.B. Cl.	Thailand		36	R. & M., 1970
<i>B. kerrii</i> Craib	"	17		M., 1975
<i>B. reticulata</i> Barnett	"	9		M., 1975
<i>B. speluncarum</i> B.L. Burt	Borneo	16		R. & P., 1967 (published as sp. from Sarawak)
<i>Dichiloboea speciosa</i> (Ridl.) Stapf				
	Thailand-Malaya	18		R. & P., 1967
Streptocarpus subgenus <i>Streptocarpus</i>				
<i>S. baudertii</i> L.L. Britten	Southern Africa	16		R. & M., 1970
<i>S. caeruleus</i> Hilliard & Burt	" "	16		R. & M., 1970
<i>S. confusus</i> Hilliard	" "	16		R. & P., 1967
<i>S. cooksonii</i> B.L. Burt	" "	16		R. & P., 1967
<i>S. cyanandrus</i> B.L. Burt	" "	16		R. & P., 1967
<i>S. cyaneus</i> S. Moore	" "	16		R. & P., 1967
			32	L. et al., 1939;
				L. 1945, under the synonym <i>S. polackii</i> B.L. Burt (no indication of whether a meiotic or a somatic count)

TABLE 1 (contd.)

	Distribution	n	2n	Reference
<i>S. davyi</i> S. Moore	" "	16		R. & P., 1967
<i>S. decipiens</i> Hilliard & Burt	" "	16		R. & M., 1970
<i>S. denticulatus</i> Turrill	" "	16		R. & P., 1967
<i>S. dunnii</i> Mast.	" "	16		L. et al., 1939
<i>S. erubescens</i> Hilliard & Burt	E Central Africa	16		R. & M., 1970
<i>S. eylesii</i> S. Moore	Southern & E Central Africa	16		R. & P., 1967
<i>S. eylesii</i> subsp. <i>brevistylus</i> Hilliard & Burt	E Central Africa	16		R. & M., 1970
<i>S. galpinii</i> Hook. f.	Southern Africa	16		L. et al., 1939
<i>S. gardenii</i> Hook.	" "	16	32	L. et al., 1939
<i>S. goetzei</i> Engl.	E Central Africa	16		R. & M., 1970
<i>S. grandis</i> N.E. Br.	Southern Africa	16		Sugiura, 1941; R. & P., 1967
<i>S. haygarthii</i> N.E. Br.	" "	16	32	L. et al., 1939
				L. et al., 1939; Sugiura, 1941; R. & P., 1967
<i>S. hildebrandtii</i> Vatke	Madagascar	64		M., 1975
<i>S. hirtinervis</i> C.B. Cl.	E Central Africa	16		R. & M., 1970
<i>S. johannis</i> L.L. Britten	Southern Africa	16		R. & M., 1970
<i>S. kentaniensis</i> Britten & Story	" "	16	32	R. & M., 1970
<i>S. kungwensis</i> Hilliard & Burt	E Central Africa	16		M., 1975 (2 stocks)
<i>S. michelmorei</i> B.L. Burt	Southern Africa	16		L. et al., 1939
<i>S. micranthus</i> C.B. Cl.	" "	16		R. & P., 1967
<i>S. molweniensis</i> Hilliard	" "	16		R. & P., 1967
<i>S. montanus</i> Oliver	E Central Africa	16		R. & M., 1970
<i>S. polyanthus</i> Hook.	Southern Africa	16		L. et al., 1939
<i>S. polyanthus</i> forma	" "	16		M., 1975
<i>S. polyanthus</i> subsp. <i>comptonii</i> (Mansf.) Hilliard	" "	16		L. et al., 1939, as <i>S. comptonii</i>
			33*	R. & P., 1967
<i>S. primulifolius</i> Gand.	" "	16		R. & P., 1967, as sp. nr. <i>primulifolius</i>
			32	L., 1945, under the synonym <i>S. insignis</i> (no indication of whether a meiotic or a somatic count)
<i>S. prolixus</i> C.B. Cl.	" "	16		R. & P., 1967. L. et al., 1939, & R., 1963, as <i>S.</i> <i>gracilis</i> B.L. Burt
<i>S. rexii</i> (Hook.) Lindl.	" "	16		L. et al., 1939; M., 1975
<i>S. rimicola</i> Story	" "	16		R. & P., 1967
<i>S. saundersii</i> Hook.	" "	16		Sugiura 1940b. R. & P., 1967; R. & M., 1970 (2 stocks)
<i>S. schliebenii</i> Mansf.	E Central Africa	16		M., 1975 (Addendum)
<i>S. solenanthus</i> Mansf.	" "	16		R. & M., 1970
<i>S. umtaliensis</i> B.L. Burt	Southern Africa	16		R. & P., 1967
<i>S. variabilis</i> Humbert	Madagascar, Comoro Is	48 ^a		M., 1975
<i>S. wendlandii</i> Spreng. ex Damman	Southern Africa	16		Sugiura 1936a, b.; L. et al., 1939; R. & M., 1970
<i>S. cyaneus</i> S. Moore x <i>wilmsii</i> Engl.	Natural hybrids	16	32	R. & P., 1967
<i>S. fannini</i> (Harvey ex) C.B. Cl. x <i>gardenii</i> Hook.			32	R. & P., 1967

TABLE I (contd.)

	Distribution	n	2n	Reference
<i>S. michelmerei</i> B.L. Burtt x <i>candidus</i> Hilliard	Synthetic hybrids	16	32, 64	R. & M., 1970
<i>S. x kewensis</i> (= <i>rexii</i> x <i>dunnii</i>) x <i>grandis</i>				L. 1945 (no indication of whether meiotic or mitotic counts). 64 count probably refers to 'Merton Giant', see below
<i>S. 'Merton Giant'</i> = x <i>hybridus</i> x <i>grandis</i>	"	16	64	L., 1940 (no indication whether a meiotic or a mitotic count)
<i>S. x veitchii</i>				Sugiura 1938, 1940a
Subgenus <i>Streptocarpella</i> K. Fritsch				
<i>S. caulescens</i> Vatke	E Central Africa	15		L. et al., 1939; R., 1963
<i>S. caulescens</i> var. <i>pallenscens</i> Engl.	" " "	15		M., 1975
<i>S. glandulosissimus</i> Engl.	" " "	15		M., 1975 (erroneously recorded as n = 16 in R. & M., 1970)
<i>S. hilsenbergii</i> R. Br.	Madagascar	15		R. & P., 1967
<i>S. holstii</i> Engl.	E Central Africa	15		L. et al., 1939
<i>S. kirkii</i> Hook. f.	" " "	15		L. et al., 1939; R. & P., 1967; M., 1975
<i>S. nobilis</i> C.B. Cl.	W Tropical Africa	14		Mangenot & Mangenot, 1957 & 1962
<i>S. muscosus</i> C.B.Cl.	Madagascar	15		R. & M., 1970 (2 stocks)
<i>S. oliganthus</i> B.L. Burtt	"	15		R. & M., 1971, in Hilliard & Burtt, 1971; M., 1975
<i>S. stomandrus</i> B.L. Burtt	E Central Africa	15		M., 1975
<i>S. saxorum</i> Engl.	" " "	15	30	Lee, in Moore, 1955
<i>S. thompsonii</i> R. Br.				L. et al., 1939
var. <i>bojeri</i> (R.Br.) C.B.Cl.	Madagascar	15		M., 1975
<i>S. thysanotus</i> Hilliard & Burtt	E Central Africa	15		M., 1975
<i>Saintpaulia amaniensis</i> E. Roberts	E Central Africa	15		Fussell, 1958
<i>S. brevipilosa</i> B.L. Burtt	" " "		30	M., 1975
<i>S. confusa</i> B.L. Burtt	" " "	15		Fussell, 1958
<i>S. difficilis</i> B.L. Burtt	" " "	15		M., 1975
<i>S. diplotricha</i> B.L. Burtt	" " "		30	M., 1975
<i>S. grandifolia</i> B.L. Burtt	" " "	15		M., 1975
<i>S. grotei</i> Engl.	" " "		30	Cox & Roberts, 1950; Wilson, 1951, 1955; R., 1963
<i>S. intermedia</i> B.L. Burtt	" " "		30	R., 1963
<i>S. ionantha</i> Wendl.	" " "	14		Sugiura, 1931, 1936b
			28	Holzer, 1952, as <i>S. kewensis</i> C.B.Cl.
			30	Wilson, 1951, 1955; Ehrlich, 1956, 1958
<i>S. magungensis</i> E. Roberts	" " "	15		Fussell, 1958
<i>S. orbicularis</i> B.L. Burtt	" " "	15		Fussell, 1958; M., 1975
<i>S. pendula</i> B.L. Burtt	" " "		30	R., 1963
<i>S. shumensis</i> B.L. Burtt	" " "	15		Fussell, 1958
<i>S. teitensis</i> B.L. Burtt	" " "		30	R., 1963

TABLE 1 (contd.)

	Distribution	n	2n	Reference
<i>S. tongwensis</i> B.L. Burt	" " "		30	Wilson, 1951, 1955
<i>S. velutina</i> B.L. Burt	" " "	15		M., 1975
<i>S. sp.</i> (from Tanzania)	" " "	15		Fussell, 1958
<i>S. confusa</i> B.L. Burt x <i>orbicularis</i> B.L. Burt	Synthetic hybrid	15		M., 1975
14 cultivars			30	See Lee, 1962, for details
2 cultivars			60	Wilson, 1951, 1955; Ehrlich, 1956, 1958
Subfamily Gesnerioideae Endl.				
Tribe MITRARIACEAE B.L. Burt				
<i>Fieldia australis</i> F. Muell.	Australia		±80	R., 1963
<i>Mitraria coccinea</i> Cavan.	Chile		±74	R., 1963
<i>Sarmienta repens</i> Ruiz & Pavon	Chile		±74	R., 1963
Tribe CORONANTHEREAE K. Fritsch				
<i>Negria rhabdanthamnoideis</i> F. Muell.	Lord Howe Island	±45	±90	R. & P., 1967
<i>Rhabdanthamnus solandri</i> A. Cunn.	New Zealand	37	±74	Hair & Beuzenberg, 1960 R., 1963
Genera Anomala				
<i>Jerdonia indica</i> Wight	S India	14		M., 1975
<i>Rehmannia angulata</i> (Oliver) Hemsl.	China	14		Sugiura, 1936
			28	R., 1963; R. & P., 1964
<i>R. glutinosa</i> (Gaertn.) Libosch. ex Steud.	China		56	Suzuko & Koriba, 1949
<i>Titanotrichum oldhamii</i> (Hemsl.) Solereder	Taiwan		±40 40	Fussell, 1958 R., 1963

n denotes meiotic counts; 2n denotes mitotic counts.

In the references the following abbreviations have been used: L = Lawrence; M = Milne; P = Prentice; R = Ratter.

1 A count of 2n = 30 was attributed to Rogers (1954) by Lee (1962) but cannot be found in the original paper.

2 Awaiting formal transfer from *Dichrotrichum* to *Agalmyla*.

3 Erroneously reported by R. & M. in Hilliard & Burt (1971) as 2n = 48.

4 = *S. magungensis* E. Roberts.

* *S. polyanthus ssp. comptonii*. The plant was examined by R. & P., 1967, had an extra chromosome (2n = 33) and showed 16₁₁ 1, or 15₁₁ 3, at M1.

Repetitions of counts in previous compilations such as Rogers (1954) and Lee (1962) are not included in the references.