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Karyomorphological studies of some 80 taxa of *Dendrobium*, Orchidaceae*

Kiyoshi Hashimoto**

ラン科デンドロビウム属80余 taxa の核形態学的研究*

橋 本 清 美**

Introduction

The genus *Dendrobium,* which is known as one of the largest genera of the Orchidaceae with 1,000 or more species, is widely distributed in southeast and east Asia from Japan to the Himalayas and down to Indonesia and Australasia from New Guinea down to New Zealand. Only two species occur in Japan (Ohwi 1978).

This genus is known to be highly variable in external morphology and growth habit; *e.g.* the stems are wiry or thick and fleshy either throughout or in part. The leaves are herbaceous or coriaceous. Thus, taxonomic treatment of the genus could be highly complex and some different treatments have been made by various researchers (Lindley 1830, Bentham and Hooker 1883, Kränzlin 1910, Schlechter 1912, 1919, 1926, 1927). Especially, the excessive treatment is of Brieger (1981) which proposed many genera after changed in combination among the sectional ranks treated by certain previous researchers.

Chromosome numbers of 250 species and 50 varieties of *Dendrobium* have been reported by a number of workers (Hoffman 1929, 1930, Miduno 1940, Eftimiu-Heim 1941, Ito & Mutsuura 1957, Kosaki 1958, Tanaka 1962, 1964, 1965, Mutsuura & Nakahira 1958, 1959, Vajrabhaya & Randolph 1960, Kamemoto *et al.* 1961, Jones 1963, Chardard 1963, Shindo & Kamemoto 1963, Pancho 1965, Kamemoto & Sagarik 1967, Kamemoto *et al.* 1967, Kamemoto & Tara 1968, Mehra & Sehgal 1975, 1976, Mehra & Kashyap 1976, 1978, Hashimoto 1981, 1982, Jones *et al.* 1982, and Tanaka & Kamemoto 1982). However, morphological study of the somatic chromosome is poorly made in most standard references, except for Wilfret & Kamemoto (1971) examined and described in 23 species in 11 sections following Schlechter's classification.

In the present investigation morphology of chromosomes at resting stage, mitotic prophase and metaphase in 82 taxa in 24 sections in four subgenera is studied in order to elucidate interrelationships and speciation within the taxa.

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Materials and Methods

Localities and numbers of plants studied were listed in Table 1. These materials were cultivated in the Hiroshima Botanical Garden, Hiroshima City, Japan. Taxonomic treatment of the materials followed mostly Schlechter (1912, 1919, 1926, 1927) and some Kränzlin (1910), Ames (1912), Seidenfaden & Smitinand (1960) and Dockrill (1969).

Validating specimens and cytological data of the plants studied were deposited in the Herbarium of the Hiroshima Botanical Garden.

Chromosomes were observed by an aceto-orcein squash method modified by Tanaka & Kamemoto (1960): Growing root tips were cut into small pieces of 1.0–2.0 mm long and were immersed in 0.002M 8-hydroxyquinoline for four hours at 16°C. They were then transferred to a modified Carnoy's solution (99% ethanol: chloroform: gracial acetic acid=2:1:1) for 15 minutes at 16°C, hydrolyzed in 1N HCl at 60°C for two minutes, transferred to 45% acetic acid for three minutes, squashed and stained in 1% aceto-orcein.

Chromosomes at resting stage were studied morphologically by their condensed figures. Those figures given were classified into the types defined and proposed by Tanaka (1980).

The chromosomes at mitotic metaphase were measured by lengths of the long and short arms. Arm ratio was calculated by the long arm length / the short arm length, and expressed by the value of arm ratio of 1.0 to 1.7 as "median", 1.8 to 3.0 as "submedian", 3.1 to 7.0 as "subterminal" and over 7.1 as "terminal" according to Levan *et al.* (1964). The chromosomes were basically aligned in descending order from the longest to the shortest chromosomes and were given numbers 1, 2, 3, … , respectively.

Observation

Mitotic cell divisions were observed in root tips of the plants studied. Observations on chromosome morphology were made in the chromosomes at resting, prophase and metaphase stages of mitosis.

The results of the observations in 82 taxa representing 24 sections in four subgenera of the genus *Dendrobium* were as follows:

I Subgenus Athecebium

1. Section Desmotrichum

1) *Dendrobium macraei* Lindl., 2n=38, Tables 1 and 2, Fig. 1.

Five plants were obtained from India. External morphological characteristics were as follows: Tip of each branched rhizome formed a pseudobulb consisted of an internode. Leaves were solitary and coriaceous and the leaf sheath was lacking. Flowers were about 3.0 cm across and creamy white in color. Thus, these materials must be classified as the

Table 1. Localities, numbers of plants and chromosome numbers of the species of *Dendrobium* studied

Species	Locality	No. of plant	Chromosome number (2n)
Subgenus Athecebium			
Section Desmotrichum			
macraei	India	5	38
scopa	Malaysia	2	38
Section Rhizobium			
beckleri	Australia	2	38
cucumerinum	Australia	2	38
linguiforme	Australia	2	38
pugioniforme	Australia	1	38
rigidum	Australia	1	38
wassellii	Australia	1	38
Section Sarcopodium			
acuminatum	Philippines	2	40
coelogyne	Thailand	4	40
cymbidioides	Indonesia	4	40
nakaharaei	Formosa	3	40
Section Dendrocoryne			
aemulum	Australia	1	38
monophyllum	Australia	2	38
ruppianum	Australia	1	38
schneiderae	Australia	1	38
Section Latourea			
engae	Papua New Guinea	2	36
finisterrae	Papua New Guinea	2	40
macrophyllum	Philippines	2	38
Section Callista			
aggregatum var. *majus*	India	5	38
chrysotoxum	Thailand	3	38
densiflorum	India	1	40 + 1f
dixanthum	Thailand	1	40 + 2f
palpebrae	India	1	40
sulcatum	India	2	40
Subgenus Eu-Dendrobium			
Section Eugenanthe			
albo-sanguineum	Thailand	4	40
brymerianum	Thailand	3	38
candidum	India	3	38
crassinode	Thailand	5	38
falconeri	India	4	38
findleyanum	Thailand	4	38
friedricksianum	Thailand	7	38
heterocarpum	India	6	38

Table 1. (continued)

monile	Japan(Gifu Pref.)	1	38
moschatum	India	5	38
nobile	Thailand	1	38
parishii	Thailand	3	38
pierardii	India	3	38
superbum var. *album*	Malaysia	1	38
tortile	Thailand	5	38
wardianum	India	2	38
Section Platycaulon			
platygastrium	Papua New Guinea	1	40
Section Pedilonum			
amethystoglossum	Philippines	3	40
bullenianum	Philippines	1	38
capituliflorum	Papua New Guinea	2	38
miyakei	Formosa	5	38
ramosii	Philippines	1	40
secundum	Thailand	4	40
smilliae	Australia	3	38
Section Calyptochilus			
phlox	Papua New Guinea	1	38
Section Cuthbertsonia			
sophronites	Papua New Guinea	1	38
Section Oxyglossum			
quinquecostatum	Papua New Guinea	1	38
Section Brachyanthe			
aduncum	India	3	38
stuposum	India	6	38
Section Stachyobium			
ciliatum	Thailand	9	40
compactum	China	1	40
denudans	India	3	40
Section Phalaenanthe			
bigibbum var. *compactum*	Australia	3	38
dicuphum	Australia	1	39
phalaenopsis	Australia	1	38
superbiens	Australia	3	38
williamsianum	Papua New Guinea	3	38
Section Eleutheroglossum			
canaliculatum	Australia	4	38
Section Ceratobium			
gouldii	Papua New Guinea	2	38
lasianthera	Philippines	1	38
Section Distichophyllum			
uniflorum	Malaysia	2	40
Section Oxygenianthe			

Table 1. (continued)

formosum var. *giganteum*	Thailand	5	38
infundibulum	Thailand	2	38
sanderae	Philippines	1	40
scabrilingue	Thailand	3	38
sutepense	Thailand	3	38
Subgenus Rhopalobium			
Section Rhopalanthe			
clavator	Thailand	3	38
crumenatum	Philippines	2	38
equitans	Formosa	3	38
Subgenus Xerobium			
Section Aporum			
acinaciforme	Thailand	2	38
distichum	Philippines	2	38
leonis	Thailand	3	38
mannii	Malaysia	2	38
subulatum	Malaysia	2	38
Section Grastidium			
bambusiaefolium	Thailand	2	38
Section Dichopus			
insigne	Papua New Guinea	4	36 + 2f
Section Monanthos			
agrostophyllum	Australia	1	38

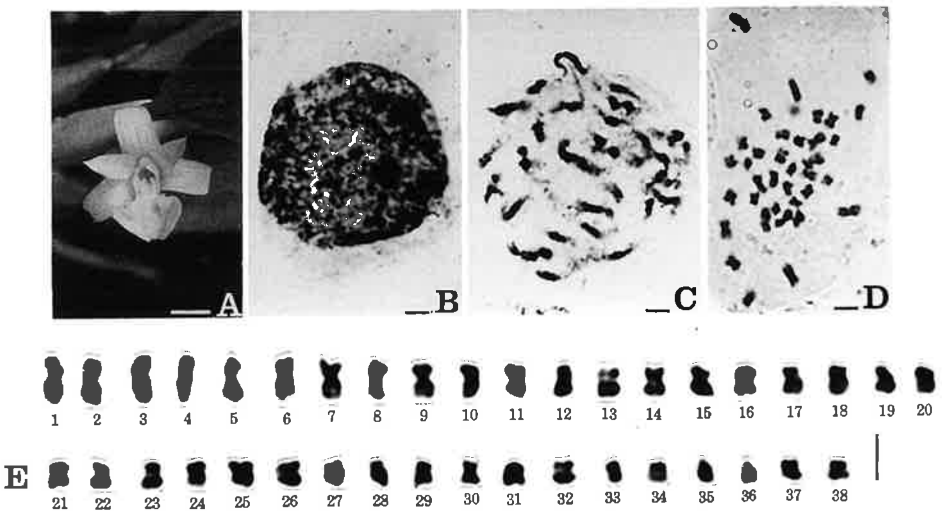

Fig. 1. *Dendrobium macraei*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

species *D. macraei* described by Schlechter (1912).

The chromosome number of the five plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage were observed as chromomeric granules and fibrous threads scattered throughout the nucleus. Many small chromatin blocks which varied in number from 100 to 130 per nucleus were observed in the resting nuclei. They varied from 0.4–1.0 μm in diameter and showed irregular shape with rough surface. Some of the blocks aggregated into large blocks as the chromocentral aggregation. At prophase the chromosomes formed early condensed segments located in the proximal as well as in the interstitial and distal regions. Thus, the description of the karyotype at resting stage was considered to belong to the category of the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.0 μm to the shortest one of 0.8 μm. The positions of their centromeres were mostly median, except for four (Nos. 27, 28, 35, 36) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium scopa* Lindl., 2n=38, Tables 1 and 3, Fig. 2

Two plants were obtained from Malaysia. External morphological characteristics were as follows: Vegetative characters were similar to those of *D. macraei* but a little larger in flower size and branched. Flowers lasted only one day, and midlobe of the lip was fringed with long yellow hairs. Thus, this description of the materials follows Schlechter (1912).

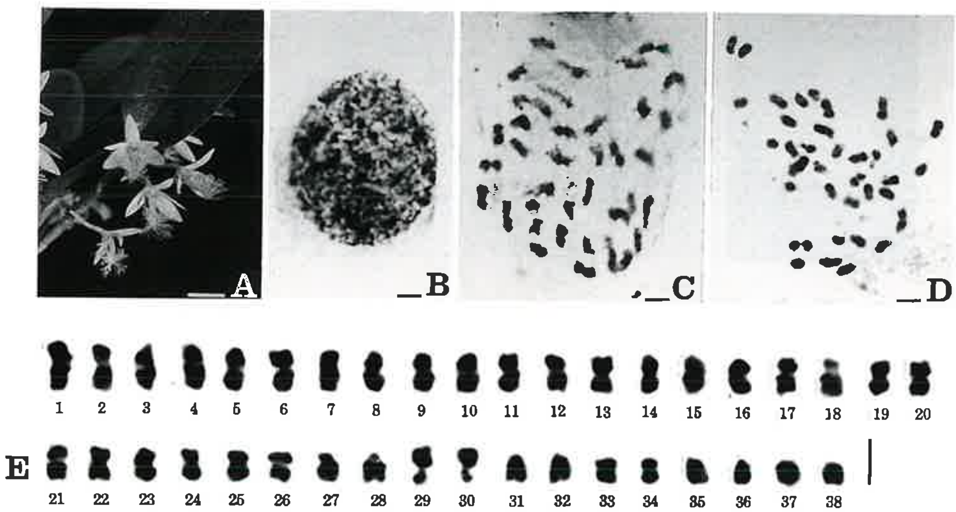

Fig. 2. *Dendrobium scopa*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

The chromosome number of the two plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. macraei* described above (p. 2). That is, the karyotype at resting stage could be classified into that of the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.1 μm to the shortest one of 1.0 μm, and the positions of the centromeres were either median or submedian. Among the 38 chromosomes about 32 were median, while the other six (Nos. 27–32) were submedian. Two chromosomes (Nos. 29, 30) had secondary constrictions in their long arms, and four (Nos. 17, 18, 27, 28) had small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2. Section Rhizobium

1) *Dendrobium beckleri* F. Muell., 2n=38, Tables 1 and 4, Fig. 3

Two plants were obtained from Australia. External morphological characteristics were as follows: Sympodial branches consisted of a length of rhizome terminated by a solitary leaf. The leaf was erect and terete, lacking leaf sheath. Flowers were white in color with purple lines on the base and about 3 cm in width. Thus, this description of the materials

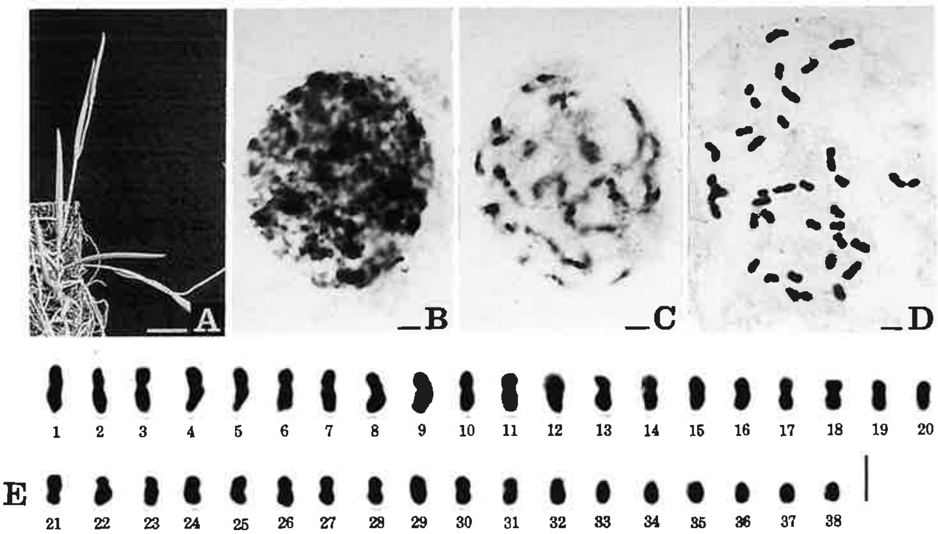

Fig. 3. *Dendrobium beckleri*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 4.0 cm in A and 2.0μm in B–E).

follows Kränzlin (1910).

The chromosome number of the two plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage were shown as chromomeric granules and fibrous threads scattered throughout the nucleus. Numerous small chromatin blocks which varied in number from 80 to 100 per nucleus were observed in the resting nuclei. They varied from 0.4–2.0 μm in diameter and showed irregular shape with rough surface. Some blocks aggregated into large blocks as the chromocentral aggregation. At prophase the chromosomes formed early condensed segments located in the proximal as well as in the distal and interstitial regions. Thus, the karyotype at resting stage was considered to belong to the category of the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.0 μm to the shortest one of 0.8 μm. The positions of the centromeres were mostly median, except for two (Nos. 22, 23) submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium cucumerinum* Macleay ex Lindl., 2n=38, Tables 1 and 5, Fig. 4.

Two plants were obtained from Australia. External morphological characteristics were as follows: Leaves were about 2.0 cm long and similar to small gherkin fruits. Flowers did not open widely and their perianths were all narrow. Flower color was creamy. Thus, this description of the materials follows Kränzlin (1910).

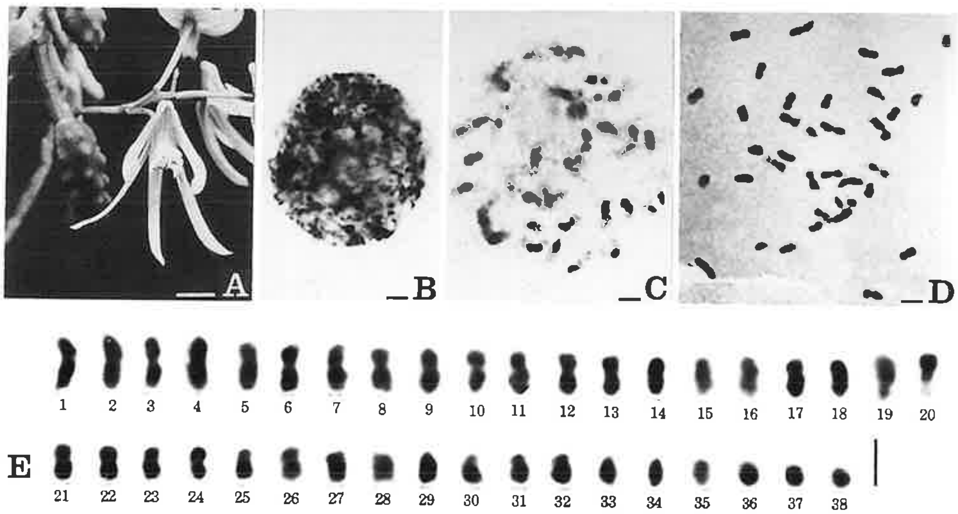

Fig. 4. *Dendrobium cucumerinum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

The chromosome number of the two plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Morphology of the resting nucleus and the chromosomes of mitotic prophase were similar to those of *D. beckleri* described above (p. 7). The karyotype at resting stage was considered to belong to the category of the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.3–0.9 μm in length. The four longest chromosomes (Nos. 1–4) were distinguishably long, average 2.3 μm in length. Arm ratios of these four longest chromosomes were all 1.3, and thus, the positions of their centromeres were median. Two chromosomes (Nos. 19, 20) had secondary constrictions in their long arms. Among the 38 chromosomes about 32 were median, and the other six (Nos. 25, 26, 33–36) were submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium linguiforme* Sw., 2n=38, Tables 1 and 6, Fig. 5

Two plants were obtained from Australia. External morphological characteristics were

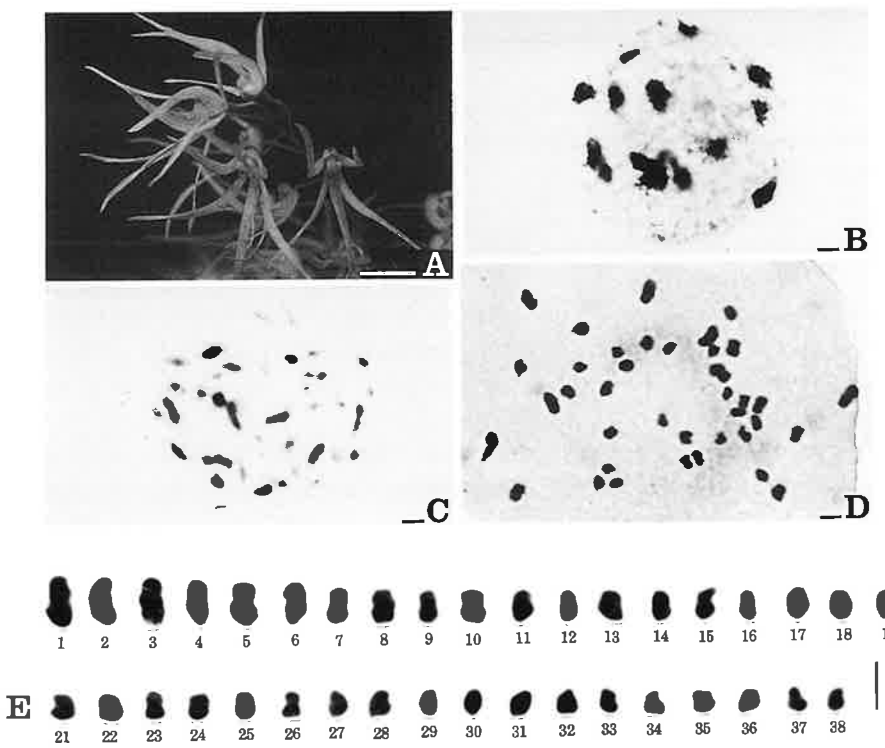

Fig. 5. *Dendrobium linguiforme*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

as follows: Leaves were ligulate, thick and longitudinally grooved. Flowers were usually inverted and about 2 cm across. Flower color was white. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the two plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage were conspicuous. They were observed as chromomeric granules and fibrous threads which stained lightly. At the same time about 14 large chromatin blocks were observed in the nucleus. They ranged from 1.5–3.0 μm in diameter. At prophase the heterochromatic segments which transformed abruptly into euchromatic segments were located in the proximal regions of 20 chromosomes. The heterochromatic segments of the other chromosomes were not obvious. Thus, the karyotype at resting stage was considered to belong to the category of the prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.2–0.9 μm in length, and the positions of the centromeres of those chromosomes were median, except for eight (Nos. 11, 12, 27–32) submedian chromosomes. Among the 38 chromosomes six chromosomes (Nos. 1–6) were distinguishably long. Two longest chromosomes (Nos. 1, 2) were 2.2 μm in length and their arm ratios were 1.2. The second longest chromosome pair (Nos. 3, 4) was 2.0 μm in length and their arm ratios were 1.5. The third longest chromosome pair (Nos. 5, 6) was 1.8 μm in length and their arm ratios were 1.3. The other 32 chromosomes (Nos. 7–38) ranged from 1.5–0.9 μm in length and decreased gradually in size from the longest to the shortest chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium pugioniforme* A. Cunn., 2n=38, Tables 1 and 7, Fig. 6.

A plant was obtained from Australia. External morphological characteristics were as follows: Leaves were ovate and thick with an acuminate apex. Flowers were usually solitary and about 2.0 cm across. Flower color was light green. Thus, this description of the material follows Kränzlin (1910).

The chromosome number of the plant was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Morphology of the chromosomes at resting and mitotic prophase were similar to those of *D. beckleri* described above (p. 7). That is, the karyotype at resting stage was considered to belong to the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.3 μm to the shortest one of 0.7 μm, and the positions of their centromeres were mostly median, except for four (Nos. 27–30) submedian chromosomes. Among the 38 chromosomes eight (Nos. 31–38) were clearly shorter than the other 30 chromosomes. The longest chromosomes (Nos. 1, 2) had the small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species

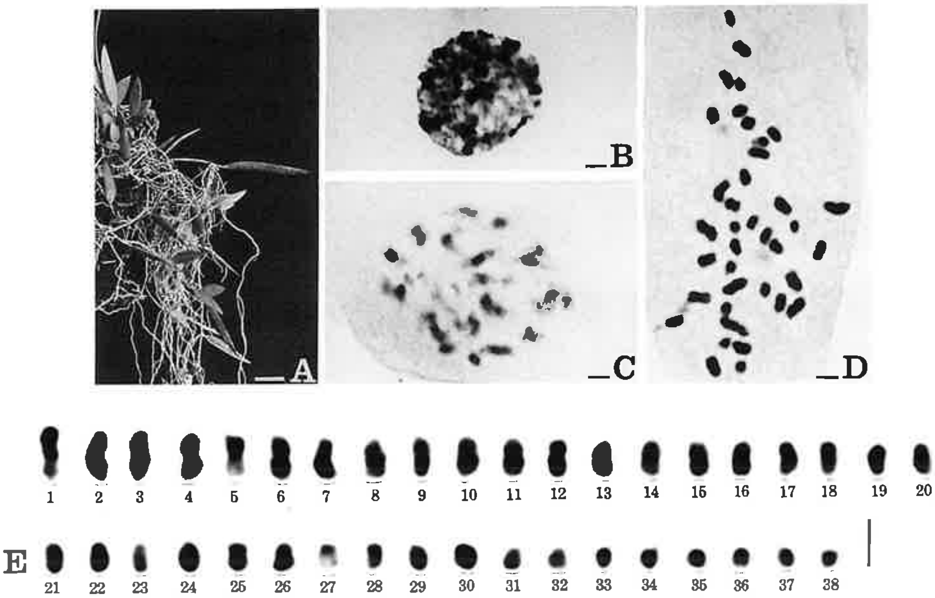

Fig. 6. *Dendrobium pugioniforme,* 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5) *Dendrobium rigidum* R. Br., 2n=38, Tables 1 and 8, Fig. 7.

A plant was obtained from Australia. External morphological characteristics were as follows: Leaves were inequilateral ovate and thick. Flowers were fully opened and about 1.5 cm across. Flower color was creamy with red marks. Thus, this description of the material follows Kränzlin (1910).

The chromosome number of the plant was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Morphology of the chromosomes at resting and mitotic prophase were similar to those of *D. beckleri* described above (p. 7). That is, the karyotype at resting stage was considered to belong to the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.0–1.0 μm in length, and the positions of their centromeres were either median or submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

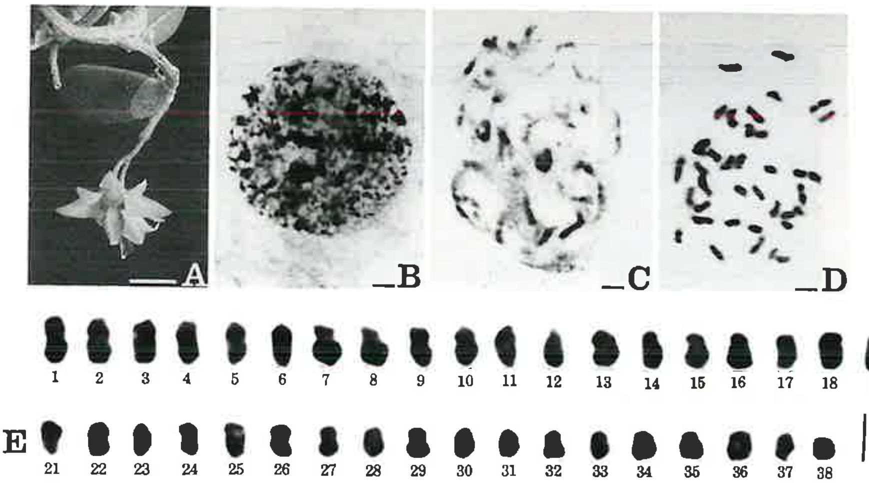

Fig. 7. *Dendrobium rigidum,* 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

6) *Dendrobium wassellii* S.T. Blake, 2n=38, Tables 1 and 9, Fig. 8.

A plant was obtained from Australia. External morphological characteristics were as follows: Leaves were erect and subterete, with five longitudinal grooves. Flowers were usually

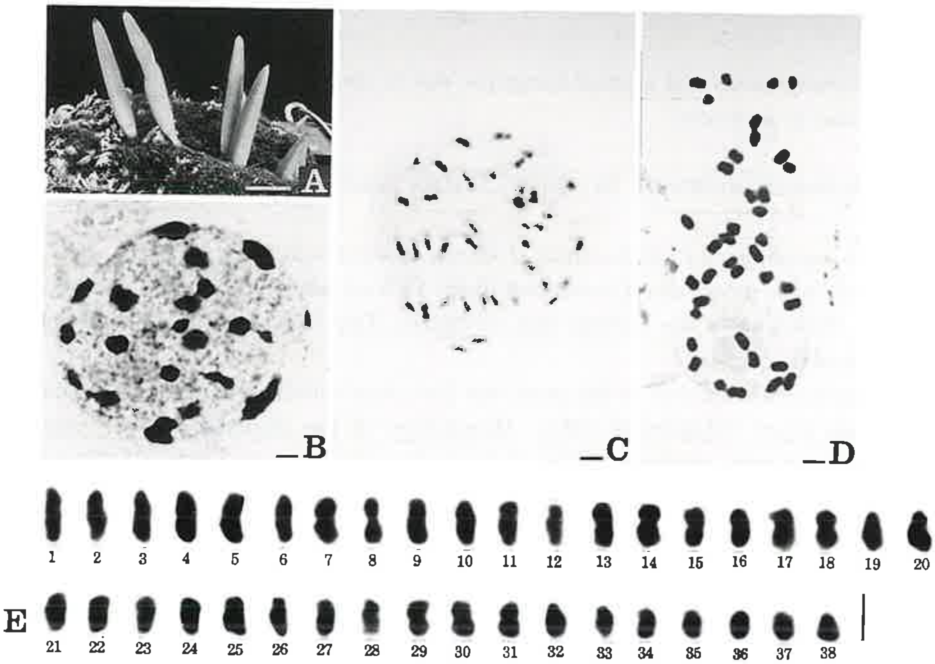

Fig. 8. *Dendrobium wassellii,* 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

inverted and about 1.2 cm across. Flower color was white with yellow lip. Thus, this description of the material follows Dockrill (1969).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. linguiforme* described above (p. 9). That is, the karyotype at resting stage could be classified into that of the prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.3–1.2 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes eight (Nos. 11, 12, 19, 20, 25–28) were submedian and the other 30 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3. Section Sarcopodium

1) *Dendrobium acuminatum* (Rolfe) Kränzl., 2n=40, Tables 1 and 10, Fig. 9.

Two plants were obtained from the Philippines. External morphological characteristics were as follows: Sympodial branches consisted of branched rhizomes terminated by pseudo-

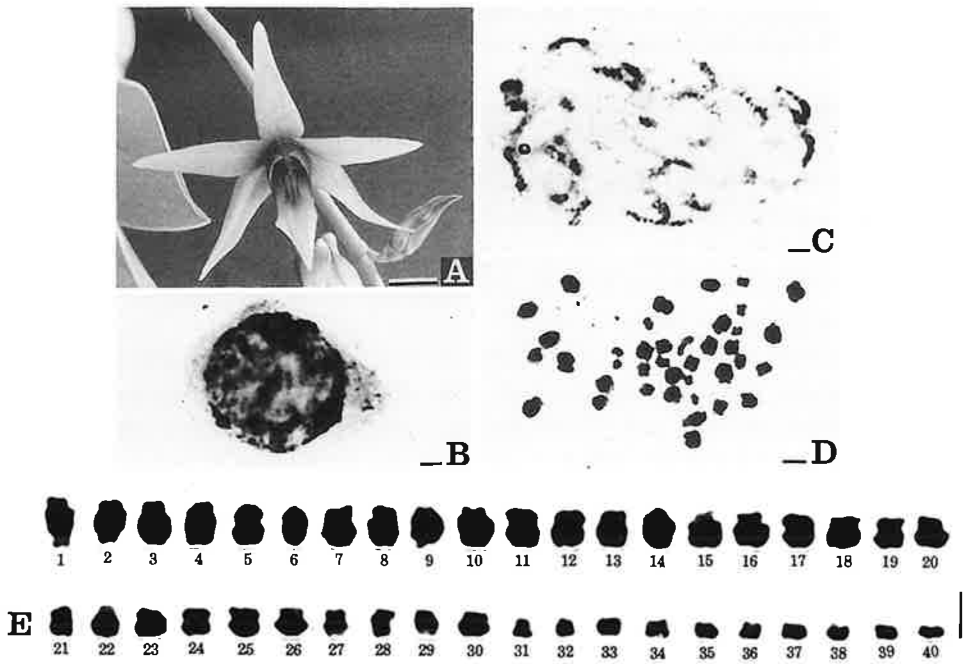

Fig. 9. *Dendrobium acuminatum*, 2n=40. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

bulb. Leaves were coriaceous, formed pair and lacked the leaf sheath. Flowers were whitish yellow in color with purple lines on the basal portions of the lip. Petals and sepals were acuminate. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the two plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Some of the blocks aggregated into large blocks as the chromocentral aggregation. They were approximately 1.0 μm in diameter. At prophase the chromosomes formed early condensed segments located in the proximal as well as in the distal and interstitial regions. That is, the karyotype at resting stage was considered to belong to the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.2–0.5 μm in length, and the positions of their centromeres were either median, submedian, subterminal, or terminal. Among the 40 chromosomes, two chromosomes (Nos. 1, 2) had two secondary constrictions in each of their long arms, respectively, and the positions of their centromeres were subterminal. Four chromosomes (Nos. 9, 10, 15, 16) had secondary constrictions in their long arms, and the positions of their centromeres were subterminal. Eight small chromosomes (Nos. 33–40) were one-armed consisted of only long arms, and the positions of their centromeres were terminal. Among the other 26 chromosomes, six (Nos. 3, 4, 7, 8, 29, 30) were submedian and the remainders were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and intermediate karyotype between the symmetric and asymmetric karyotype due to arm ratio.

2) *Dendrobium coelogyne* Reichb. f., 2n=40, Tables 1 and 11, Fig. 10.

Four plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were ovoid and bore from the creeping rhizomes at intervals of 5 cm long. Leaves formed pairs and were coriaceous, lacking leaf sheath. Flowers were solitary and yellowish brown with red spots. Lips were dark purple in color. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the four plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Many spherical small chromatin blocks which varied in number from 20 to 30 per nucleus were observed. They varied from 0.5–1.5 μm in diameter. Some of the blocks aggregated into large blocks as the chromocentral aggregation. At prophase the heterochromatic segments were located almost in the whole regions of certain several chromosomes. The heterochromatic segments of another chromosomes, which were located in the proximal regions, were transformed gradually into euchromatic segments located distally. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging

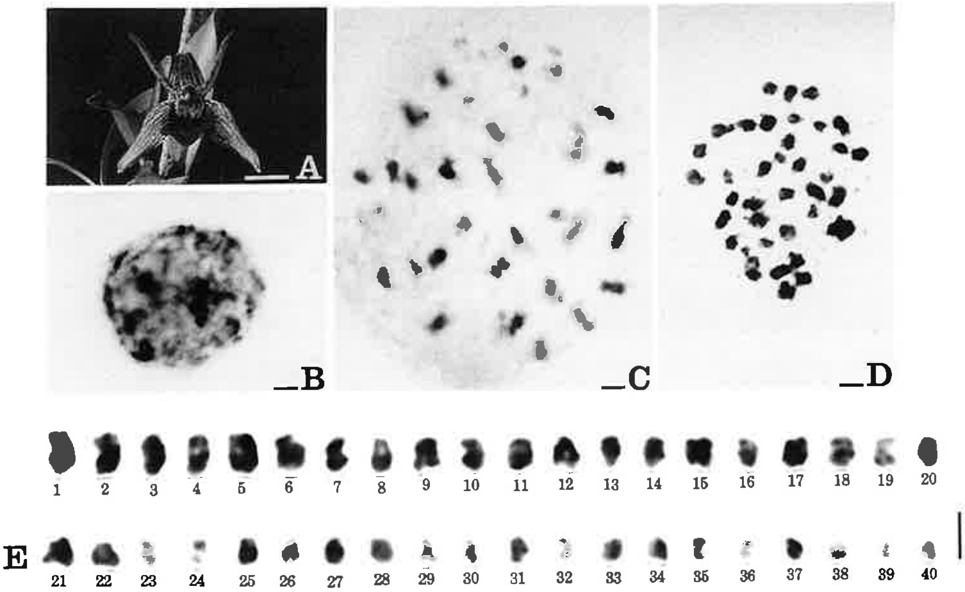

Fig. 10. *Dendrobium coelogyne,* 2n=40. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

from the longest one of 1.8 μm to the shortest one of 0.8 μm, and the positions of their centromeres were median or submedian. Among the 40 chromosomes 13 (Nos. 3–5, 7, 8, 33–40) were median and the other 27 were submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium cymbidioides* (Bl.) Lindl., 2n=40, Tables 1 and 12, Fig. 11.

Four plants were obtained from Indonesia. External morphological characteristics were as follows: Morphology of the stem and the leaves were similar to those of *D. acuminatum*, but the size was a little smaller. Flowers were about 5 cm across. Sepals and petals were acuminate and the color was purplish yellow. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the four plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. acuminatum* described above (p. 13). That is, the karyotype at resting stage was considered to belong to the complex chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.2–0.6 μm in length, and the positions of their centromeres were either median, submedian, subterminal or terminal. Morphology of the 40 chromosomes was similar to those of *D. acuminatum*. Two chromosomes

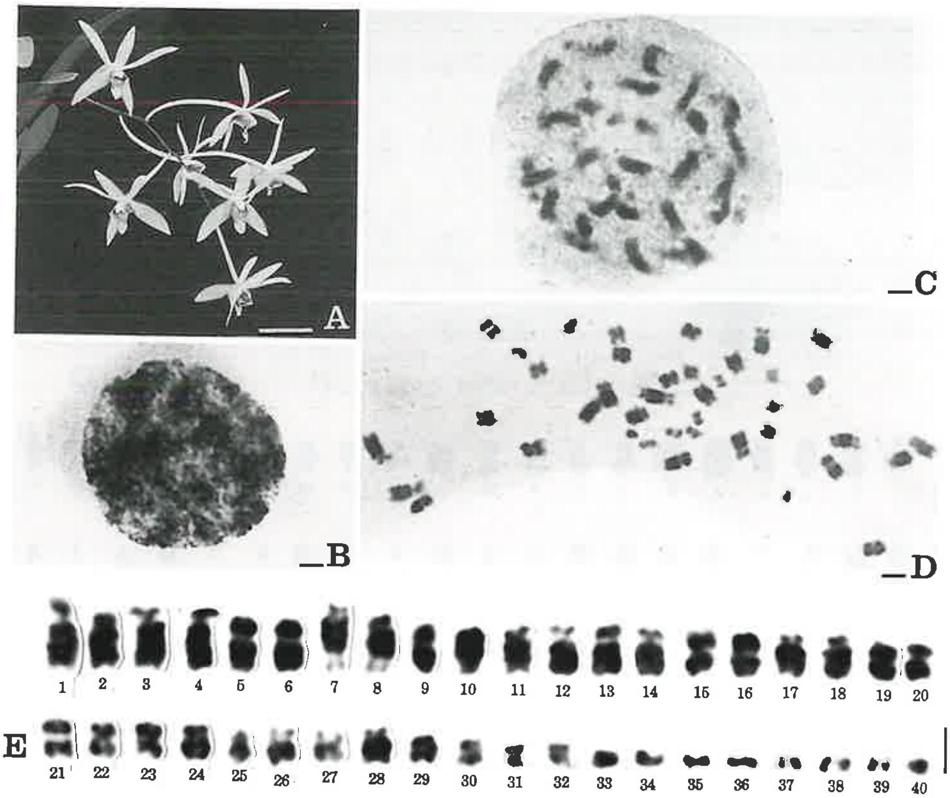

Fig. 11. *Dendrobium cymbidioides,* 2n = 40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

(Nos. 7, 8) had two secondary constrictions in each of their long arms, respectively, and the positions of their centromeres were subterminal. Six chromosomes (Nos. 1–4, 17, 18) had secondary constrictions in their long arms, and the positions of their centromeres were subterminal. Eight small chromosomes (Nos. 33–40) were one-armed and had the centromeres at distal ends of their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species had a conspicuous karyotype and showed a heterogeneous and bimodal karyotype due to chromosome length and intermediate karyotype due to arm ratio.

4) *Dendrobium nakaharaei* Schltr., 2n=40, Tables 1 and 13, Fig. 12.

Three plants were obtained from Formosa. External morphological characteristics were as follows: Pseudobulbs were ovoid and about 2–3 cm in length, with distinct corners. Each pseudobulbs were closely extended. Flowers were brown in color and about 2.5 cm across. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the three plants was 2n=40 at mitotic metaphase and con-

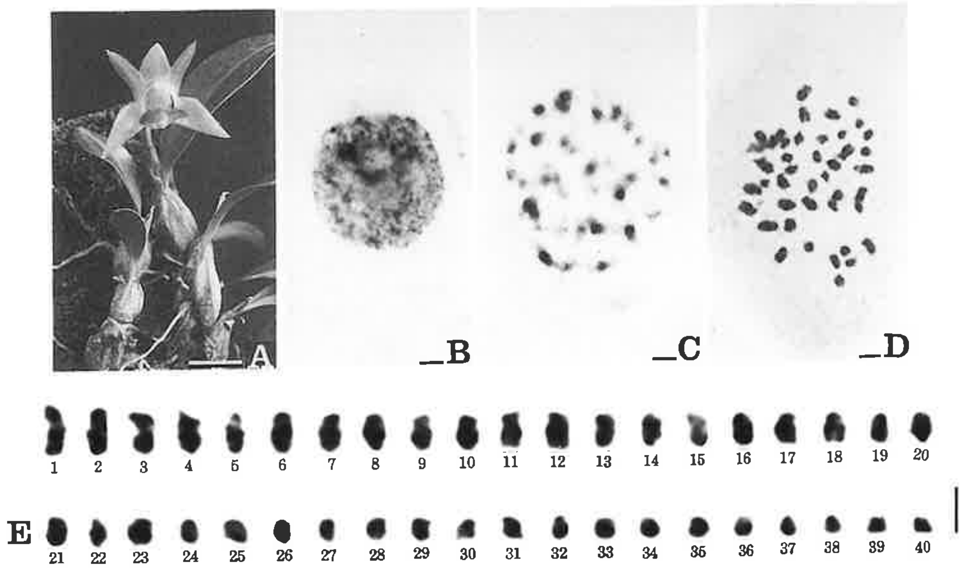

Fig. 12. *Dendrobium nakaharaei*, 2n = 40. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

firmed the previous report (Hashimoto 1982). Chromosome morphology at resting and mitotic prophase were similar to those of *D. coelogyne* described above (p. 14). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.0 μm to the shortest one of 0.7 μm, and the positions of the centromeres were either median or submedian. Among the 40 chromosomes 14 (Nos. 5–12, 17, 18, 21–24) were submedian and the other 26 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4. Section Dendrocoryne

1) *Dendrobium aemulum* R. Br., 2n=38, Tables 1 and 14, Fig. 13.

A plant was obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were slender and about 15 cm in length. Leaves were pairs and dark green in color. Flowers were white with some purple marks on the lip. Sepals and petals were linear and acute at the tip. Thus, this description of the material follows Schlechter (1927).

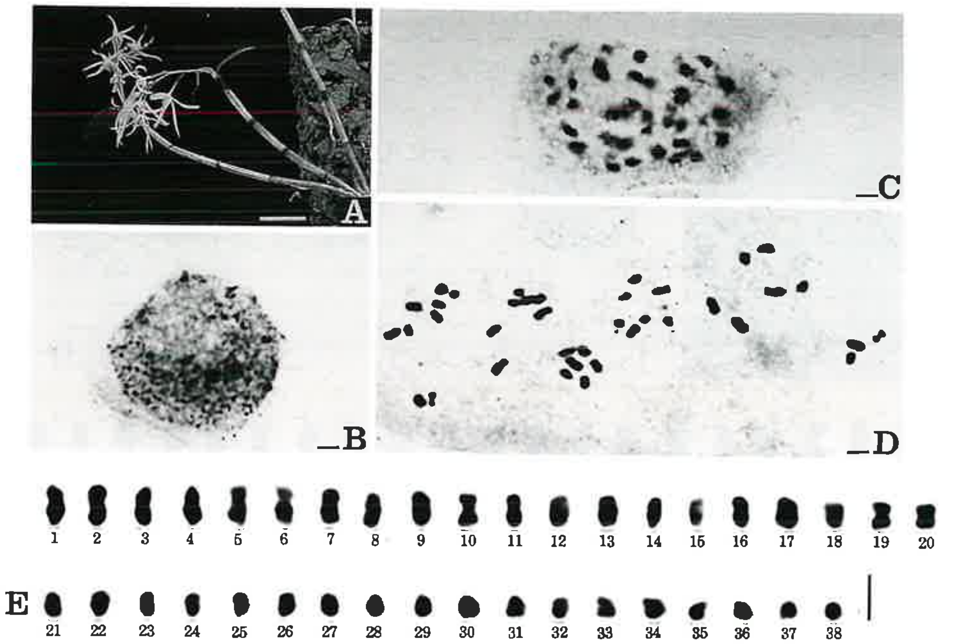

Fig. 13. *Dendrobium aemulum,* 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Several spherical small chromatin blocks which were approximately 0.8 μm in diameter varied in number from 10 to 15 per nucleus. Some of the blocks aggregated into large blocks as the chromocentral aggregation. At prophase the heterochromatic segments of some chromosomes were located in the proximal regions and transformed gradually to euchromatic segments located distally. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.7 μm to the shortest one of 0.7 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes five (Nos. 5, 6, 21–23) were submedian and the other 33 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium monophyllum* F. Muell., 2n=38, Tables 1 and 15, Fig. 14.

Two plants were obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were conical but not pointed at the apex. The leaf was solitary and oblong. Flowers were about 8 mm in width and yellow in color. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the two plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aemulum* described above (p. 17). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

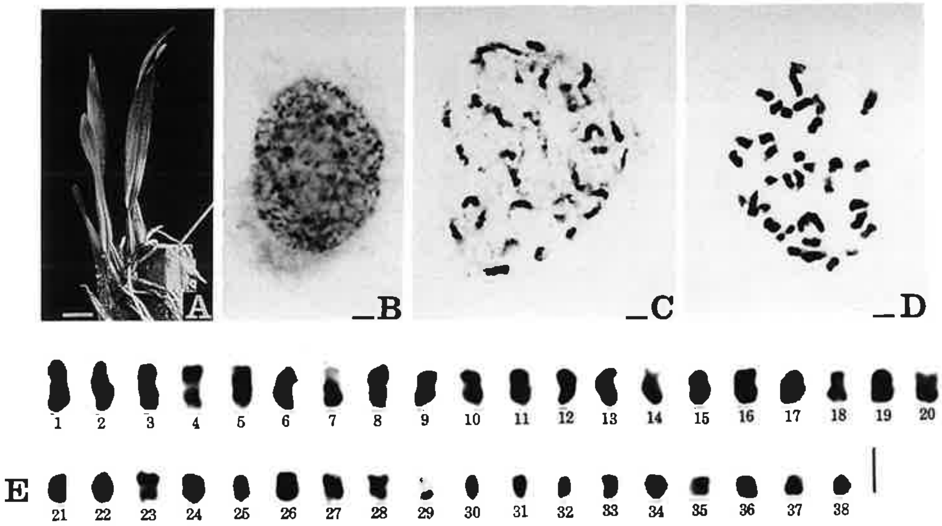

Fig. 14. *Dendrobium monophyllum,* 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase ranged from 2.2–0.8 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes six (Nos. 13, 14, 17, 18, 21, 22) were submedian and the other 32 were median. Two longest chromosomes (Nos. 1, 2) were distinguishably long. They were 2.2 μm in length and their arm ratios were 1.4.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium ruppianum* A. D. Hawkes, 2n=38, Tables 1 and 16, Fig. 15.

A plant was obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 30 cm in height. Leaves were attached to near the apex of the pseudobulb. Flowers were about 2.0 cm across and the color was white. Thus, this description of the material follows Dockrill (1969).

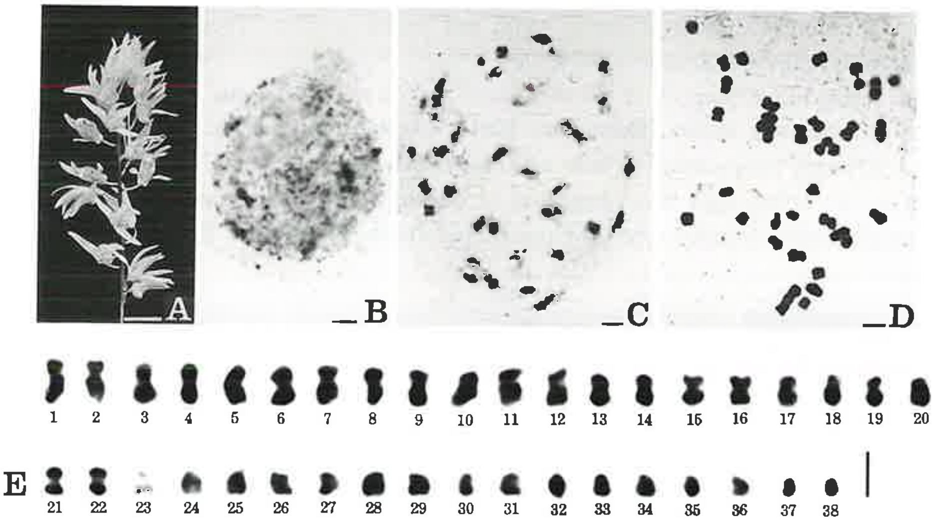

Fig. 15. *Dendrobium ruppianum,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aemulum* described above (p. 17). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.8 μm to the shortest one of 0.8 μm, and the positions of their centromeres were median or submedian. Among the 38 chromosomes seven (Nos. 1, 2, 7, 11, 12, 23, 24) were submedian and the other 31 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium schneiderae* F.M. Bail., 2n=38, Tables 1 and 17, Fig. 16.

A plant was obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were conical and about 2 cm in height. Leaves were usually paired and herbaceous. Flowers were about 8 cm in width and yellowish green in color. Thus, this description of the material follows Kränzlin (1910).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aemulum* described above (p. 17). That is, the karyotype at resting stage was considered to belong to an intermediate category between

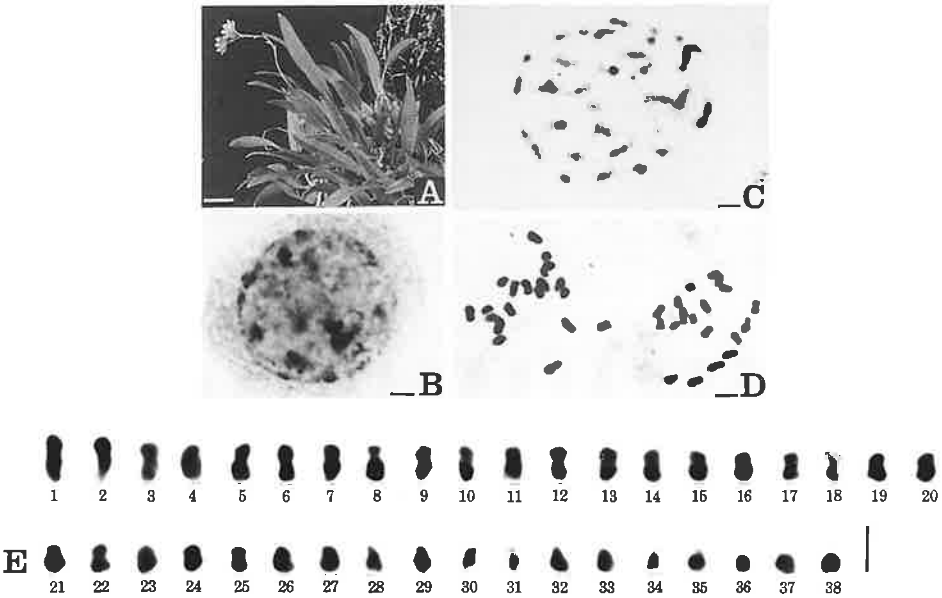

Fig. 16. *Dendrobium schneiderae,* 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.0–0.8 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes, eight (Nos. 1, 2, 27–32) were submedian and the other 30 were median. Two longest chromosomes (Nos. 1, 2) were 2.0 μm in length and their arm ratios were 1.9.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5. Section Latourea

1) *Dendrobium engae* Reeve, 2n=36, Tables 1 and 18, Fig. 17.

Two plants were obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 4 cm in length. Leaves were usually 2–4 and coriaceous. The length of leaf was about 12 cm and the width was 1.8 cm. Both plants have not bloomed yet in our Garden.

The chromosome number of the two plants was 2n = 36 which was previously documented by Jones *et al.* (1982). Chromosome morphology at resting and mitotic prophase were similar to those of *D. linguiforme* described above (p. 9). That is, the

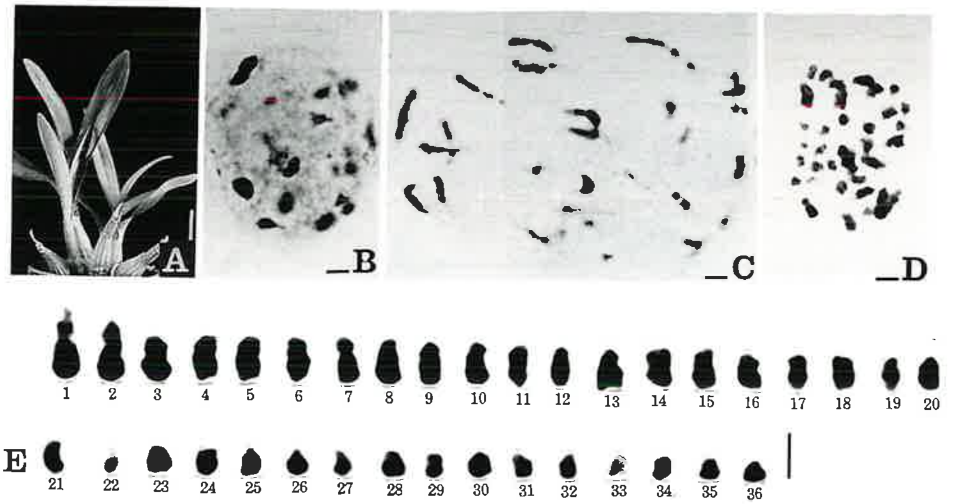

Fig. 17. *Dendrobium engae*, 2n=36. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

karyotype at resting stage was considered to belong to the category of the prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.7–0.8 μm in length, and the positions of their centromeres were either median or submedian. Among the 36 chromosomes 12 (Nos. 1, 2, 9, 10, 19, 20, 25–28, 31, 32) were submedian and the other 24 were median. Two longest chromosomes (Nos. 1, 2) were distinguishably long. They were 2.7 μm in length and their arm ratios were 2.0. Furthermore, two longest chromosomes had secondary constrictions in their short arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium finisterrae* Schltr., 2n=40, Tables 1 and 19, Fig. 18.

Two plants were obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 25 cm in length. Leaves were usually paired and about 15 cm in length. Flowers were about 4.2 cm in width. Sepals were yellow and hairy outside with brown spots. Petals were also yellow and wavy. Lips were curled toward inside. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the two plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Many spherical small chromatin blocks which varied in number from 35 to 40 per nucleus were observed. Some of the blocks aggregated into large blocks as the chromocentral aggrega-

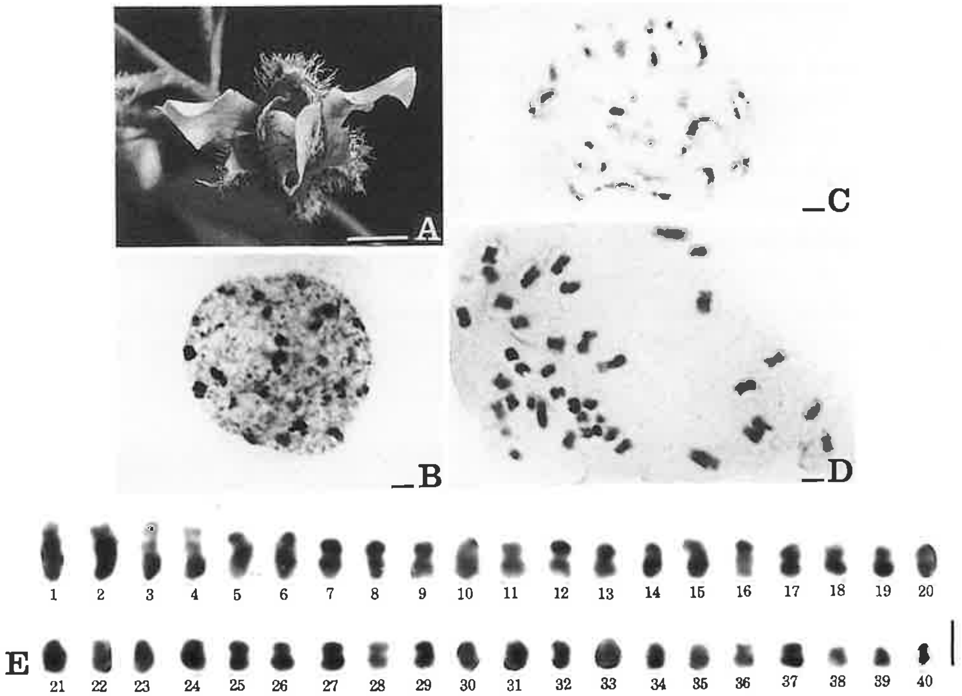

Fig. 18. *Dendrobium finisterrae,* 2n=40. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

tion. They were from 0.5–1.5 μm in diameter. At prophase the heterochromatic segments were located almost in the whole regions of several chromosomes. Thus, the karyotype at resting stage was considered to belong to the prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.6–1.0 μm in length, and the positions of their centromeres were either median, submedian, or subterminal. Among the 40 chromosomes six longest chromosomes (Nos. 1–6) were distinguishably long. The 1st and 2nd chromosomes were about 2.6 μm in length and had secondary constrictions in their long arms. Arm ratios of their chromosomes were 4.2, and the positions of their centromeres were subterminal. The 3rd and the 4th were about 2.5 μm and 2.4 μm in length, respectively, and had secondary constrictions in their long arms. The 5th and 6th were also clearly longer than the rest 34 chromosomes, and about 2.2 μm in length. Their centromeres were submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium macrophyllum* A. Rich., 2n=38, Tables 1 and 20, Fig. 19.

Two plants were obtained from the Philippines. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 30 cm in length. Leaves were coriaceous. Flowers were about 4 cm across. Sepals were yellowish green and hairy outside. Petals were yellow with purple spots on the outside surface. Lips were usually curled inside. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the two plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. finisterrae* described above (p. 22). That is, the karyotype at resting stage was considered to belong to the prochromosome type proposed by Tanaka (1971).

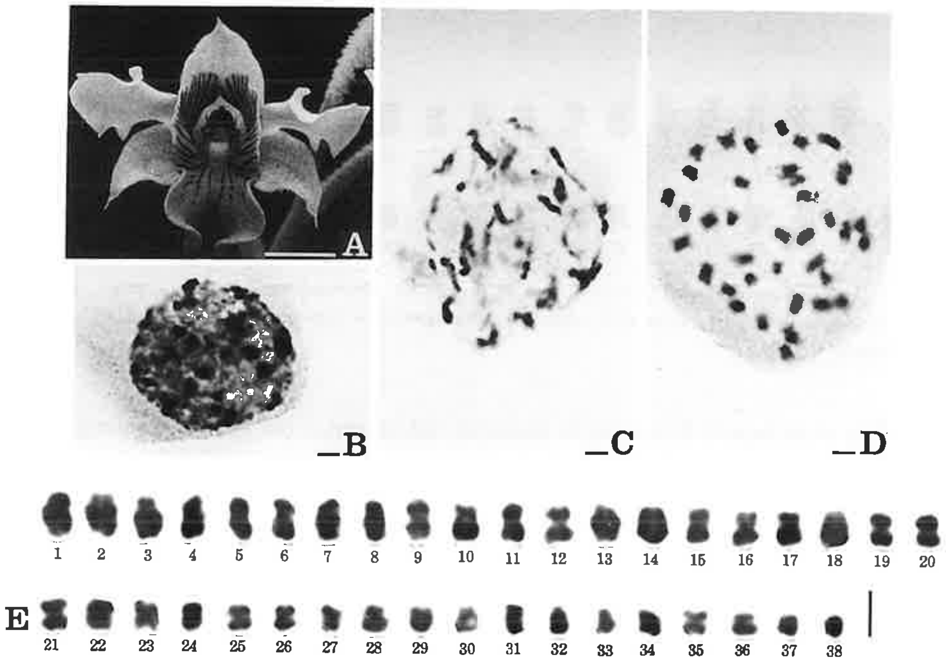

Fig. 19. *Dendrobium macrophyllum*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.0 μm to the shortest one of 0.9 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes 12 (Nos. 1–8, 13, 14, 33, 34) were submedian and the other 26 were median. Four chromosomes (Nos. 1–4) had small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

6. Section Callista

1) *Dendrobium aggregatum* Roxb. var. *majus* Rolfe, 2n=38, Tables 1 and 21, Fig. 20.

Five plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were ovoid and about 8 cm in length. Leaves were usually single and coriaceous. Flowers were about 3 cm across and pale golden yellow in color. Lips were broad and hairy toward the base. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the five plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Many spherical small chromatin blocks which varied in number from 25–30 per nucleus were also observed in the resting nucleus. They were approximately from 0.5–1.5 μm in diameter. Some of the blocks aggregated into large blocks as the chromocentral aggregation. At prophase the heterochromatic segments were located mainly in the proximal and interstitial regions of some chromosomes. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 0.8 μm, and the positions of their

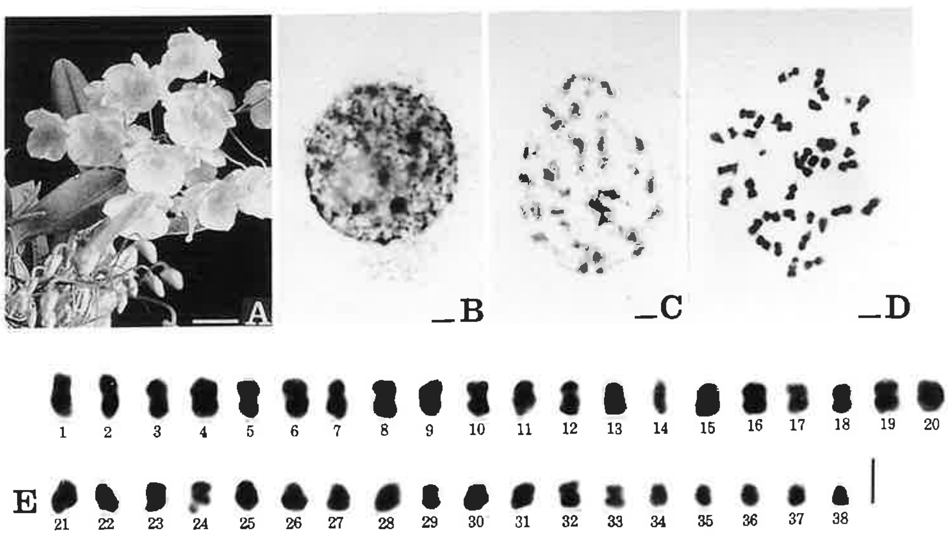

Fig. 20. *Dendrobium aggregatum* var. *majus*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

centromeres were almost median, except for two (Nos. 11, 12) submedian chromosomes.

According to the definition of the karyotypc proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium chrysotoxum* Lindl., 2n=38, Tables 1 and 22, Fig. 21.

Three plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 15–30 cm in length. Leaves were usually 2–4 and coriaceous. Inflorescences were arched and about 20 cm in length. Flowers were deep yellow and about 5 cm across. The margins of the lip was crisped and finely fringed. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aggregatum* var. *majus* descrived above (p. 25). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging

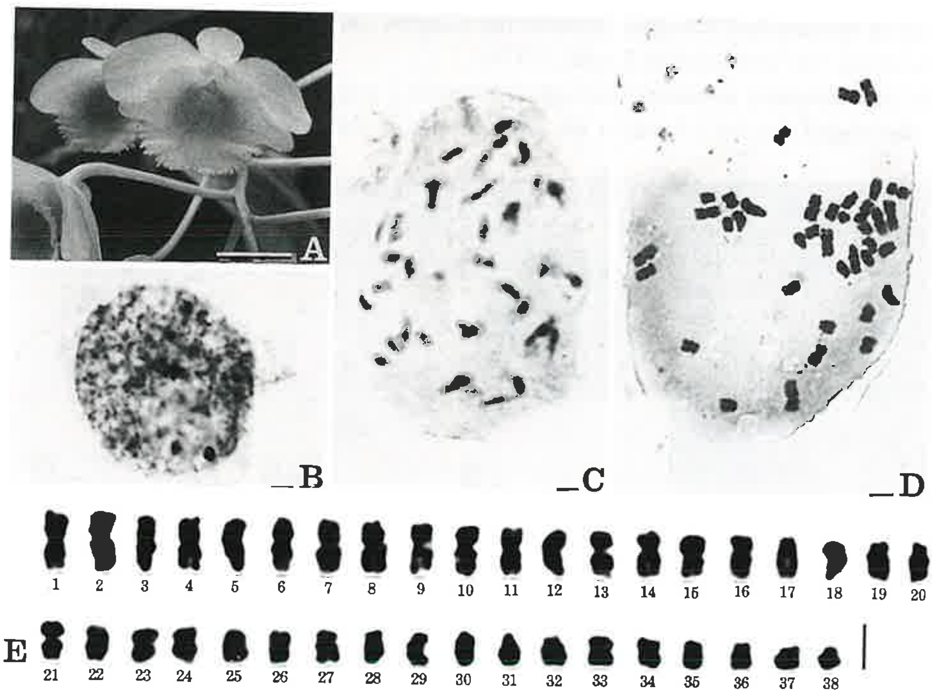

Fig. 21. *Dendrobium chrysotoxum,* 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

from the longest one of 2.5 μm to the shortest one of 0.9 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes ten (Nos. 19, 20, 27–32, 35, 36) were submedian, and the other 28 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium densiflorum* Lindl., 2n=40+1f, Tables 1 and 23, Fig. 22.

A plant was obtained from India. External morphological characteristics were as follows: Pseudobulbs were four angled and about 30 cm in length. Leaves were usually 3–4 and ovate. Inflorescences were drooping and about 25 cm in length. Flowers were pale yellow in color and about 4 cm across. Lips were round and hairy throughout the inner surface. Thus, this description of the material follows Schlechter (1927).

The chromosome number of the plant was 2n = 40 + 1f at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aggregatum* var. *majus* described above (p. 25). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging

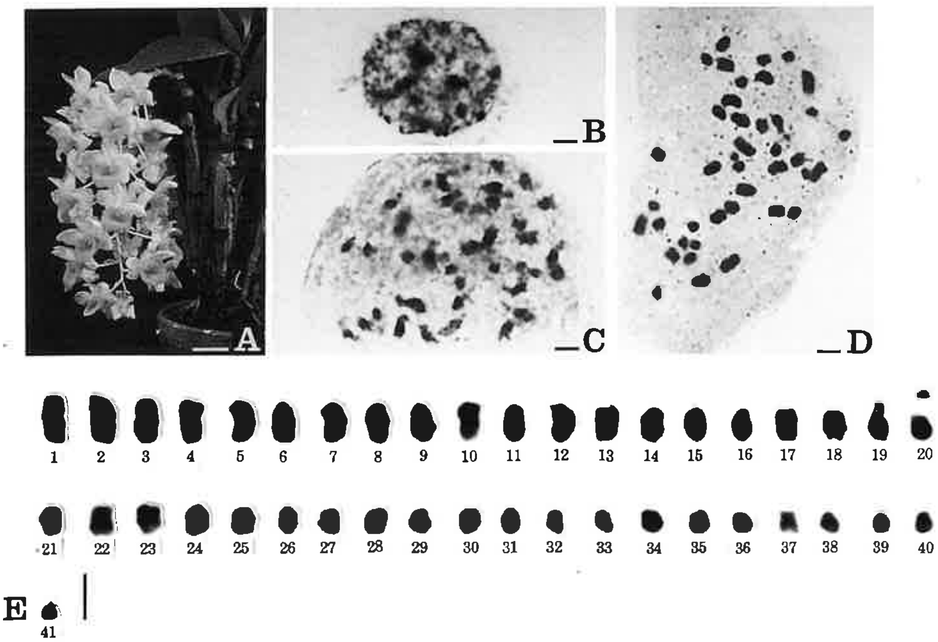

Fig. 22. *Dendrobium densiflorum*, 2n=40+1f. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

from the longest one of 2.0 μm to the shortest one of 0.6 μm, and the positions of their centromeres were almost median, except for four (Nos. 7, 8, 15, 16) submedian chromosomes. Two chromosomes (Nos. 19, 20) had secondary constrictions in their short arms and the smallest 41th chromosome was considered as an accessary chromosome.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium dixanthum* Reichb. f., 2n=40+2f, Tables 1 and 24, Fig. 23.

A plant was obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were slender and about 30 cm in length. Leaves were linear and herbaceous. Inflorescence bore from internode of the stem and was about 5 cm in length. Flowers were yellow and about 4 cm across. Lips were round and finely fringed. Thus, this description of the material follows Kränzlin (1910).

The chromosome number of the plant was 2n=40+2f at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aggregatum* var. *majus* described above (p. 25). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

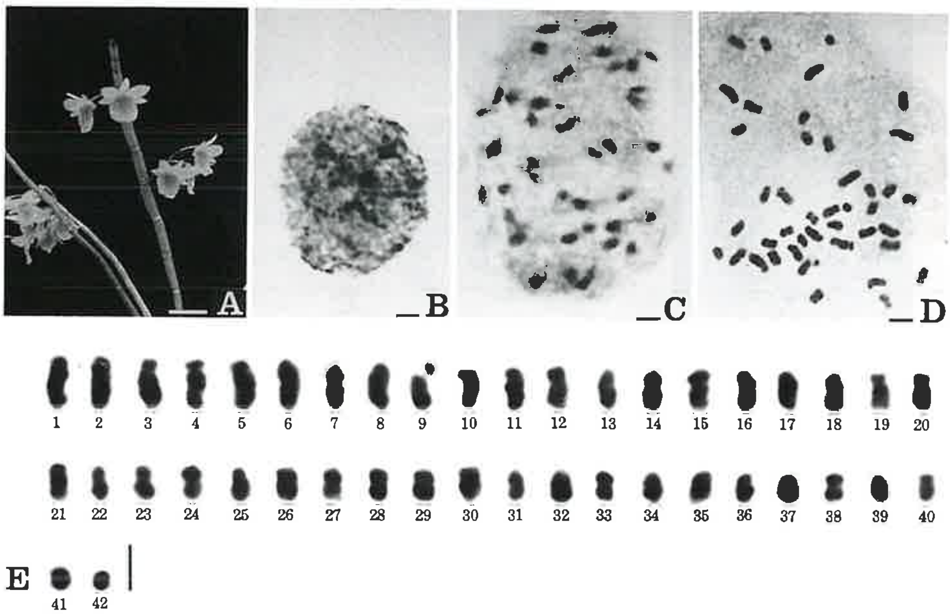

Fig. 23. *Dendrobium dixanthum*, 2n=40+2f. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.2 μm to the shortest one of 0.8 μm, and the positions of their centromeres either median, submedian, or subterminal. Among the 42 chromosomes two (Nos. 3, 4) were subterminal, 13 (Nos. 1, 2, 9, 10, 15, 16, 19–21, 25, 26, 39, 40) were submedian, and the other 27 were median. Furthermore, four chromosomes (Nos. 3, 4, 9, 10) had small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5) *Dendrobium palpebrae* Lindl., 2n=40, Tables 1 and 25, Fig. 24.

A plant was obtained from India. External morphological characteristics were as follows: Pseudobulbs were fusiform and angled. Leaves were usually 4–5 and coriaceous. Inflorescences were drooping and about 20 cm in length. Flowers were white with yellow spots on the lip. Basal portion of the lip was hairy. Thus, this description of the material follows Kränzlin (1910).

The chromosome number of the plant was 2n=40 which confirmed the previous report (Jones 1963). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aggregatum* var. *majus* described above (p. 25).

That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.4–0.7 μm in length, and the posi-

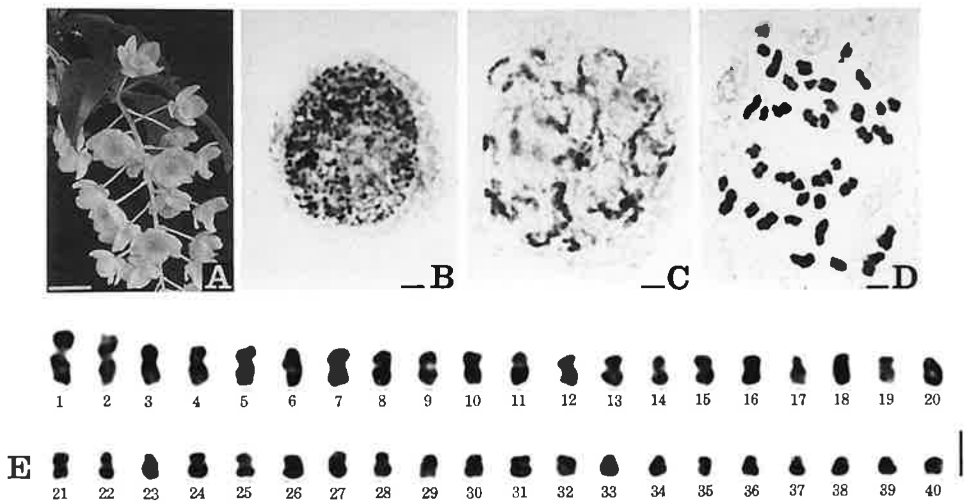

Fig. 24. *Dendrobium palpebrae,* 2n=40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

tions of the centromeres were median or submedian. Among the 40 chromosomes ten (Nos. 5, 6, 17–20, 23, 24, 33, 34) were submedian, and the other 30 were median. Two longest chromosomes (Nos. 1, 2) were distinguishably long. They were about 2.4 and 2.3 μm in length, and their arm ratios were 1.2 and 1.1, respectively.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

6) *Dendrobium sulcatum* Lindl., 2n=40, Tables 1 and 26, Fig. 25.

Two plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were slightly flattened and sulcate. Leaves were oblong and coriaceous. Inflorescences were drooping and had 8–10 flowers. Flowers were orange yellow in color and about 3 cm across. Lips were hairy and had two brownish red eyes. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the two plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. aggregatum* var. *majus* described above (p. 25). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type prop-

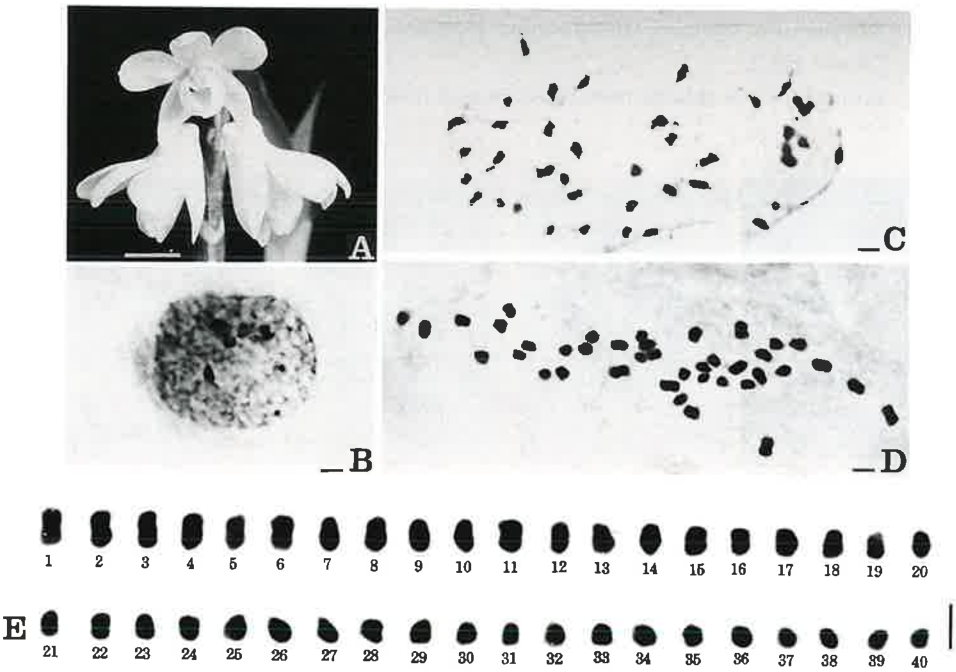

Fig. 25. *Dendrobium sulcatum*, 2n = 40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

osed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.6 μm to the shortest one of 0.8 μm, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes, nine (Nos. 7–10, 13, 14, 25–27) were submedian and the other 31 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

II Subgenus Eu-Dendrobium

1. Section Eugenanthe

1) *Dendrobium albo-sanguineum* Lindl., Tables 1 and 27, Fig. 26.

Four plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 20–35 cm in length. Flowers were about 8 cm across and bore 2–7. Sepals and petals were creamy white. Lips were pink in color with purple-colored spots. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the four plants was 2n=40 at mitotic metaphase, a new report to this species. The 2n=40 of this species was conspicuous for this section.

The chromosomes at resting stage formed many chromomeric granules and fibrous

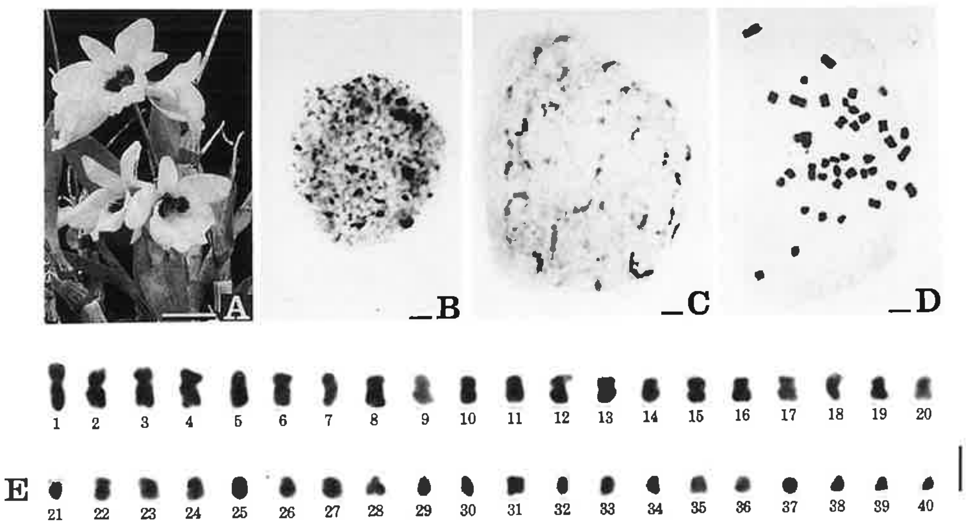

Fig. 26. *Dendrobium albo-sanguineum,* 2n=40. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

threads scattered in the nuclear space. Many spherical, small chromatic blocks which varied in number from 25 to 30 per nucleus were also observed in the resting nuclei. Some of the blocks aggregated into large blocks as the chromocentral aggregation. They were approximately from 0.5–1.5 μm in diameter. At prophase early condensed segments were located mainly in the proximal and interstitial regions of some chromosomes. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.1–0.7 μm in length, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes, four (Nos. 1–4) were obviously longer than the others. The 1st one was about 2.1 μm in length and the arm ratio was 1.6. The 2nd one was about 1.9 μm in length and the arm ratio was 1.1. The other two were 1.8 μm in length and the arm ratios were 1.6. The positions of the centromeres of the 40 chromosomes were mostly median, except for ten (Nos. 7, 8, 17–20, 27–30) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium brymerianum* Reichb. f., 2n=38, Tables 1 and 28, Fig. 27.

Three plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were fusiform and tough on the surface. Leaves were lanceolate and herbaceous. Flowers were deep orange in color. Sepals and petals were lingulate and lip margin was densely fringed. Thus, this description of the materials follows Schlechter (1927).

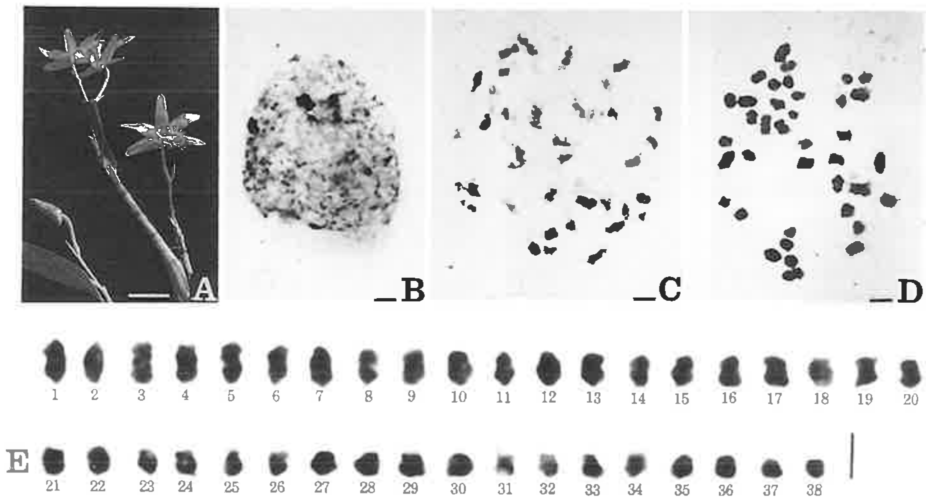

Fig. 27. *Dendrobium brymerianum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosome number of the three plants was 2n=38 which confirmed the previous report of Jones (1963), but was different from 2n=40 previously reported by Ito and Mutsuura (1957). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 0.8 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes, 12 (Nos. 3, 5, 21–26, 33–36) were submedian and the other 26 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium candidum* Lindl., 2n=38, Tables 1 and 29, Fig. 28.

Three plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were evenly flesh and about 15–30 cm in length. Flowers were pure white and about 3 cm across. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and

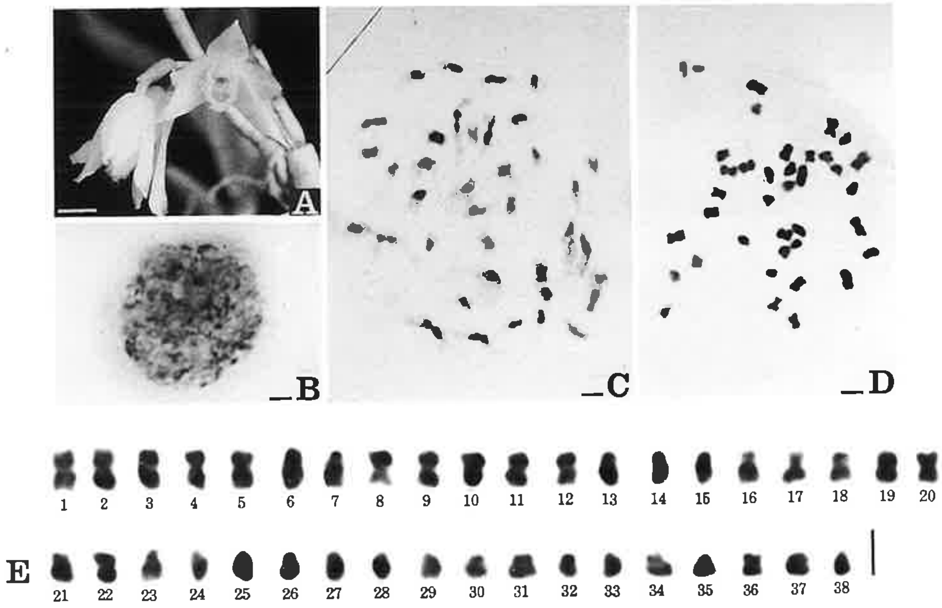

Fig. 28. *Dendrobium candidum,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.8 μm to the shortest one of 0.9 μm, and the position of their centromeres were either median or submedian. Among the 38 chromosomes, 12 (Nos. 6, 7, 13–16, 25–30) were submedian and the other 26 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium crassinode* Bens. et Reichb. f., 2n=38, Tables 1 and 30, Fig. 29.

This species have been widely cultivated under the name of *D. pendulum* Roxb. Five plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were swollen at node. Leaves were lanceolate and about 10 cm long. Flowers were about 7 cm across. Sepals and petals were white and their tips were purple. Lip margin was purple and the base was yellow. Thus, this description of the materials follows Kränzlin (1910).

The chromosome number of the five plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and

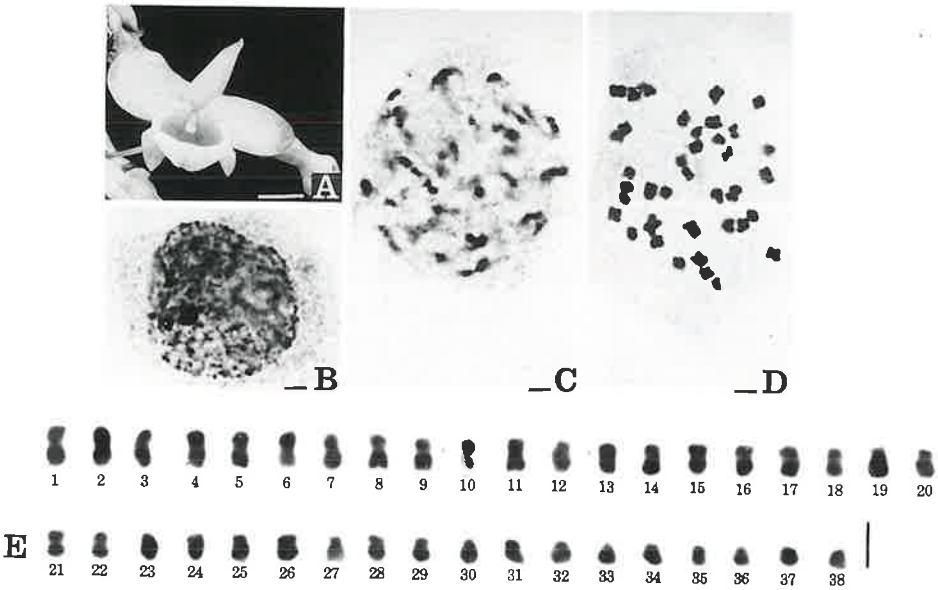

Fig. 29. *Dendrobium crassinode,* 2n=38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.8 μm to the shortest one of 0.8 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes, ten (Nos. 19, 20, 25–30, 33, 34) were submedian and the other 28 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5) *Dendrobium falconeri* Hook., 2n=38, Tables 1 and 31, Fig. 30.

Four plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were pendulous and swollen at node. Leaves were lanceolate and about 15 cm in length. Sepals and petals were white in color with violet tips. Basal portion of the lip was maroon in color with two orange-colored spots. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the four plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage were conspicuous. They were observed as many chromomeric granules and fibrous threads which were stained lightly. A few spherical, small chromatin blocks were observed in the resting nucleus. Some of the blocks aggregated into large blocks as the chromocentral aggregation.

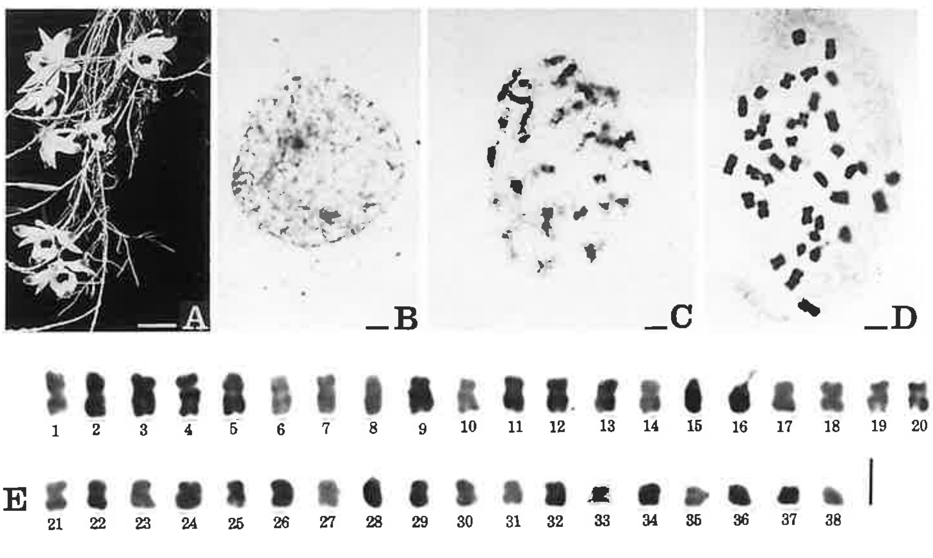

Fig. 30. *Dendrobium falconeri*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

They were approximately 0.8 μm in diameter and were about ten in number per nucleus. At prophase the heterochromatic segments of some chromosomes were located in the proximal regions and transformed gradually to euchromatic segments located distally. Thus, the karyotype at resting stage was considered to belong to the category of the simple chromocenter type according to Tanaka's classification (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.0 μm to the shortest one of 0.9 μm, and the positions of their centromeres were median, except for four (Nos. 3, 4, 9, 10) submedian chromosomes. Two chromosomes (Nos. 15, 16) had secondary constrictions on their short arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

6) *Dendrobium findleyanum* Par. et Reichb. f., 2n=38, Tables 1 and 32, Fig. 31.

Four plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were slightly flattened at the middle and swollen at node. Leaves were oblong and about 9 cm in length. Flowers were about 7 cm across. Sepals and petals were white in color with lilac at the apex. The tip of lip curved inside. Thus, this description of the materials follows Schlechter (1927).

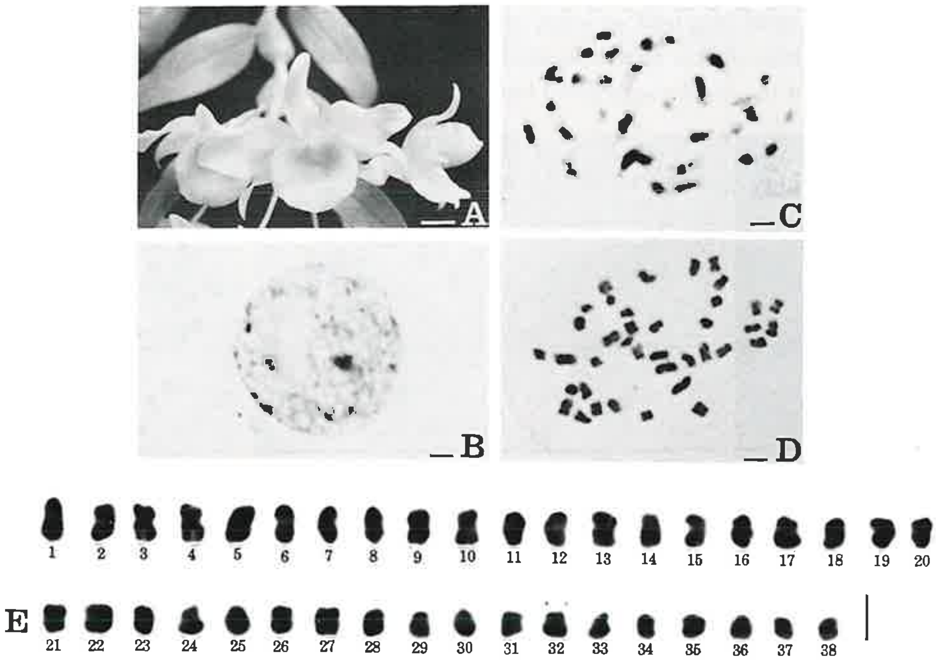

Fig. 31. *Dendrobium findleyanum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

The chromosome number of the four plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. falconeri* described above (p. 35). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.8 μm to the shortest one of 0.9 μm, and the positions of their centromeres were median, except for six (Nos. 13–16, 29, 30) submedian chromosomes. Two chromosomes (Nos. 15, 16) had small constrictions in their short arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

7) *Dendrobium friedricksianum* Reichb. f., 2n=38, Tables 1 and 33, Fig. 32.

Seven plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 60 cm in length. Leaves were oblong and about 10 cm in length. Flowers were about 7 cm across. Sepals and petals were waxy and creamy yellow in color. The base of the lip was pale yellow in color with two maroon spots. Thus, this description of the materials follows Kränzlin (1910).

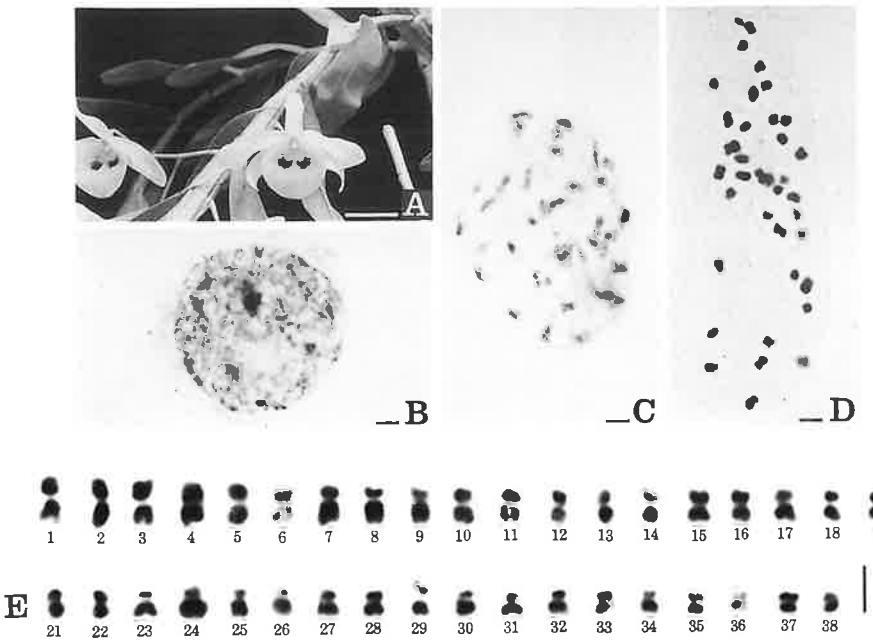

Fig. 32. *Dendrobium friedricksianum,* 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosome number of the seven plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.1 μm to the shortest one of 0.9 μm, and the positions of their centromeres were median, except for nine (Nos. 7–9, 23–26, 29, 30) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

8) *Dendrobium heterocarpum* Lindl., 2n=38, Tables 1 and 34, Fig. 33.

Six plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were nearly fusiform and about 20 cm in length. Leaves were oblong and deciduous. Flowers were about 6 cm across and pale creamy yellow in color with maroon blotches on the lip. Flowers had fragrance. Thus, this description of the materials follows

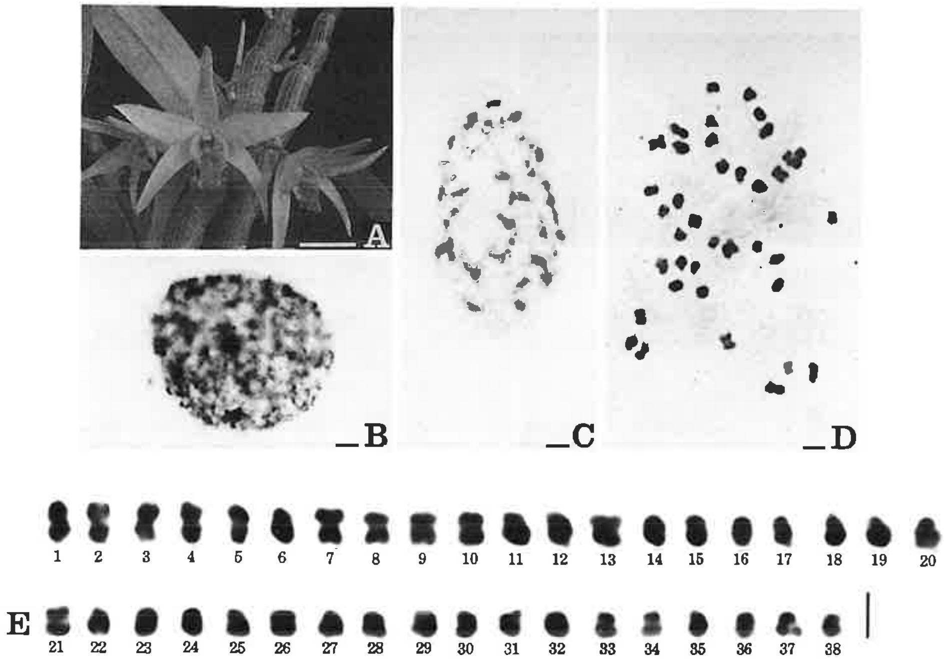

Fig. 33. *Dendrobium heterocarpum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

Schlechter (1927).

The chromosome number of the six plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 1.0 μm, and the positions of their centromeres were median, except for eight (Nos. 11, 12, 17–20, 35, 36) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

9) *Dendrobium monile* Kränzl., 2n=38, Tables 1 and 35, Fig. 34.

This species has been widely cultivated under the name of *D. moniliforme* Sw. A plant was collected from Gifu Prefecture, Japan. External morphological characteristics were as follows: Pseudobulbs were slightly fusiform. Leaves were lanceolate and about 5 cm in length. Flowers were white in color and had fragrance. Thus, this description of the material follows Schlechter (1927).

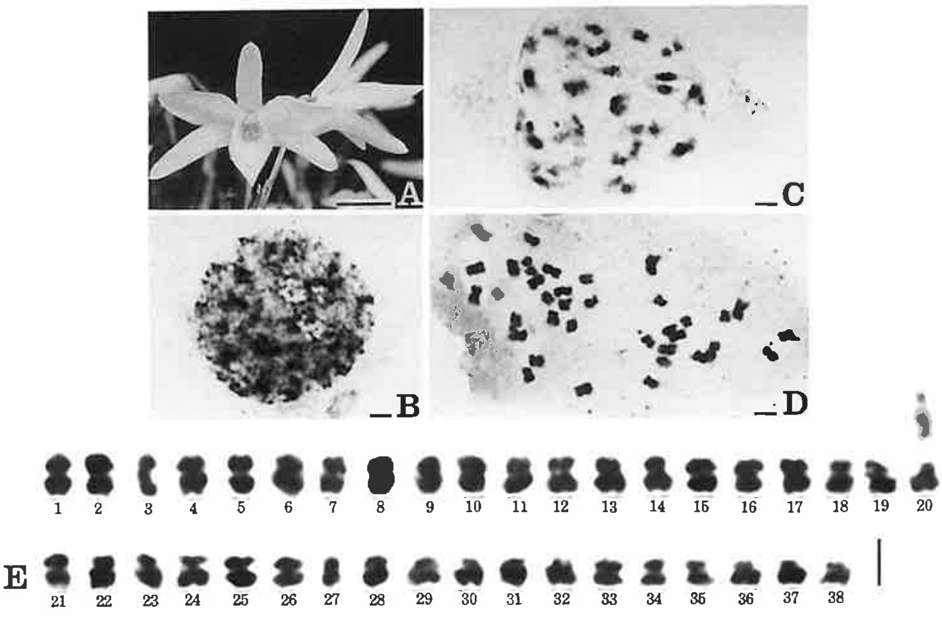

Fig. 34. *Dendrobium monile*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Karasawa and Hashimoto 1980, Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.8 μm to the shortest one of 1.0 μm, and the positions of their centromeres were median, except for seven (Nos. 23, 24, 31, 32, 36, 37, 38) submedian chromosomes. Two chromosomes (Nos. 19, 20) had secondary constrictions in their short arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

10) *Dendrobium moschatum* Sw., 2n=38, Tables 1 and 36, Fig. 35.

Five plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were evenly flesh and arched. Leaves were attached only on upper part of the pseudobulb which was about 150 cm in height. Inflorescence was about 20 cm in length and pendulous. Flowers were pale yellow in color and about 7 cm across. Lips were cup shaped and hairy inside. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the five plants was 2n=38 at mitotic metaphase and con-

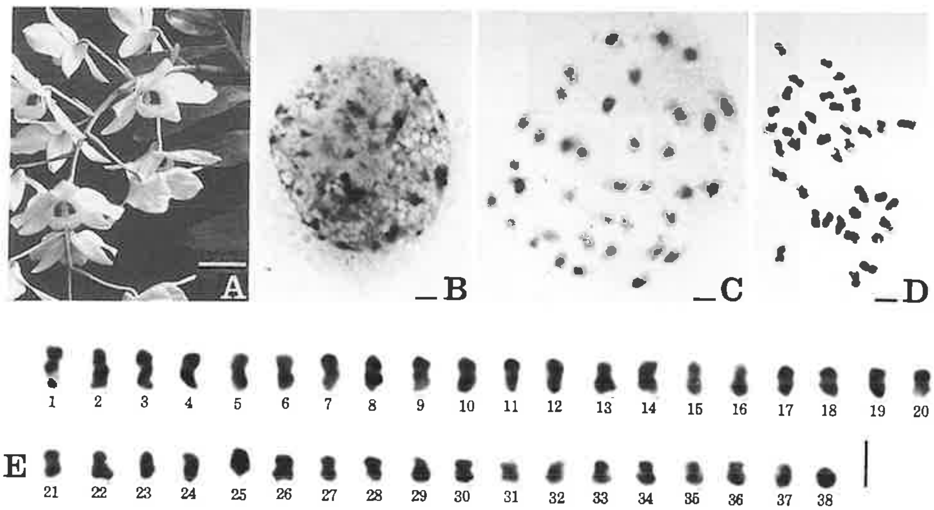

Fig. 35. *Dendrobium moschatum*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

firmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 0.9 μm, and the positions of their centromeres were median, except for six (Nos. 1, 15, 16, 23, 24, 29) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

11) *Dendrobium nobile* Lindl., 2n=38, Tables 1 and 37, Fig. 36.

A plant was obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were almost evenly flesh and erect. Leaves were oblong and about 10 cm in length. Flowers were waxy and about 8 cm across. Sepals and petals were white in color with rose on the tips. Lips were chestnut in color with lilac edges. Thus, this description of the material follows Schlechter (1927).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. falconeri* described above (p. 35). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka

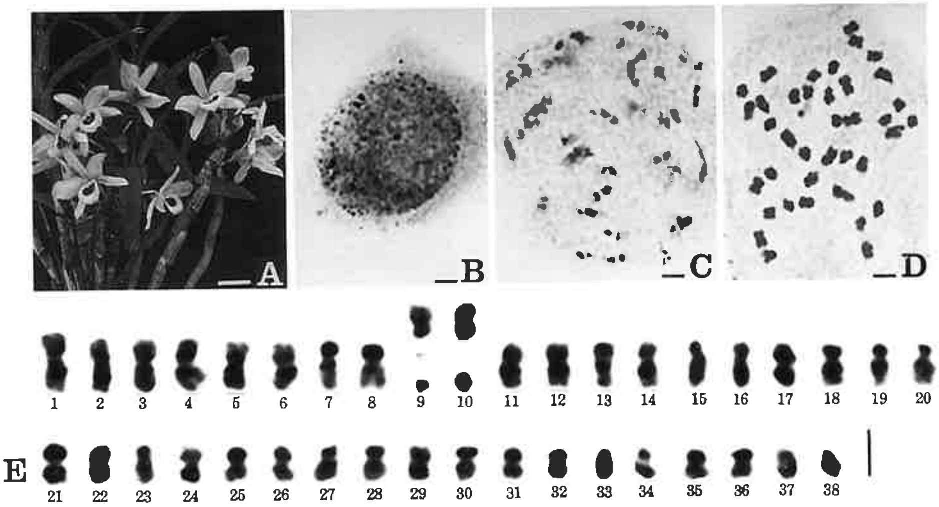

Fig. 36. *Dendrobium nobile*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

(1971).

The chromosome at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.5 μm to the shortest one of 1.2 μm, and the positions of their centromeres were median, except for nine (Nos. 7, 8, 10, 15, 16, 19, 20, 28, 34) submedian chromosomes. Two chromosomes (Nos. 9, 10) had secondary constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

12) *Dendrobium parishii* Reichb. f. 2n=38, Tables 1 and 38, Fig. 37.

Three plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were flesh and pendulous. Leaves was elliptic and about 10 cm in length. Flowers were about 5 cm across. Sepals and petals were purple in color. The base of the lip had two dark purple marks. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Many spherical, small chromatin blocks which ranged from 0.8 μm to 3.0 μm in diameter were observed in the resting nuclei. Some of the blocks aggregated into large blocks as the chromocentral aggregation. At prophase the heterochromatic segments of some chromosomes were located in the proximal regions and transformed gradually into euchromatic segments located distally. Thus, the karyotype at resting stage was considered to belong to the

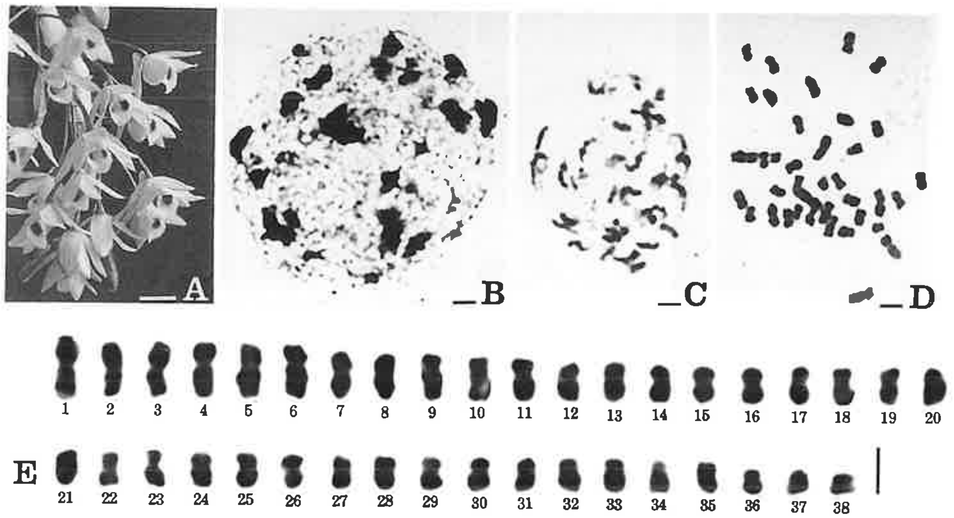

Fig. 37. *Dendrobium parishii*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.6–0.9 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes six (Nos. 9. 11, 31–34) were submedian and the other 32 were median. Six (Nos. 1–6) chromosomes were found to be clearly long, while three (Nos. 36–38) were shorter than the other chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

13) *Dendrobium pierardii* Roxb., 2n=38, Tables 1 and 39, Fig. 38.

Three plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were slender, pendulous and about 100 cm in length. Leaves were narrowly ovate. Flowers were about 5 cm across and weakly. Sepals and petals were mauve in color with purple veins. Lips were incurved at the base and round at tips. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage and mitotic prophase were similar to those of *D. parishii* described above (p. 42). The small chromatin blocks of the nucleus ranged from 0.8–2.0 μm in diameter, and the number of them was approximately 40 per nucleus. That is, the karyotype at resting stage was considered to belong to the prochromosome type according to Tanaka's classification (1971).

The chromosomes at mitotic metaphase ranged from 2.0–0.9 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes

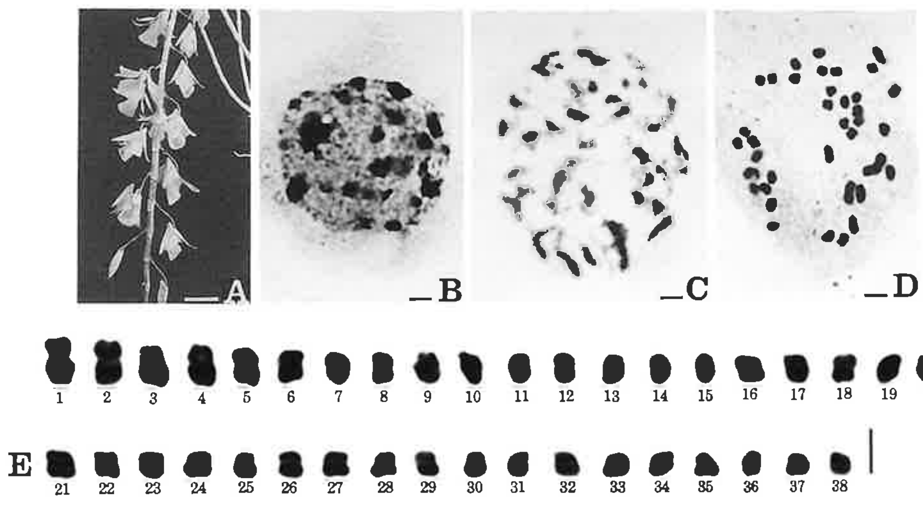

Fig. 38. *Dendrobium pierardii,* 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

four (Nos. 9, 10, 19, 20) were submedian and the other 34 were median. Four longest chromosomes (Nos. 1–4) were distinct in the chromosome set. The 1st chromosome was about 2.0 μm in length and the 2nd was 1.9 μm in length. The 3rd and the 4th chromosomes were 1.8 μm in length. The positions of the centromeres of these four chromosomes were all median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

14) *Dendrobium superbum* Reichb. f. var. *album* hort., 2n=38, Tables 1 and 40, Fig. 39.

A plant was obtained from Malaysia. External morphological characteristics were as follows: Pseudobulbs were cylindrical and arched downward. Leaves were oblong and deciduous. Flowers were about 10 cm across and had fragrance. The elementary species had the pink flower but this variety had the white flower. Thus, this description of the material follows Schlechter (1927).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage and mitotic prophase were found to be similar to those of *D. parishii* described above (p. 42). The chromocentral blocks which aggregated with each other were approximately 14 per nucleus. That is, the karyotype at resting stage was considered to belong to the prochromosome type according to Tanaka's classification (1971).

The chromosomes at mitotic metaphase ranged from 2.9–1.2 μm in length, and the positions of their centromeres were mostly median, except for two (Nos. 31, 32) submedian

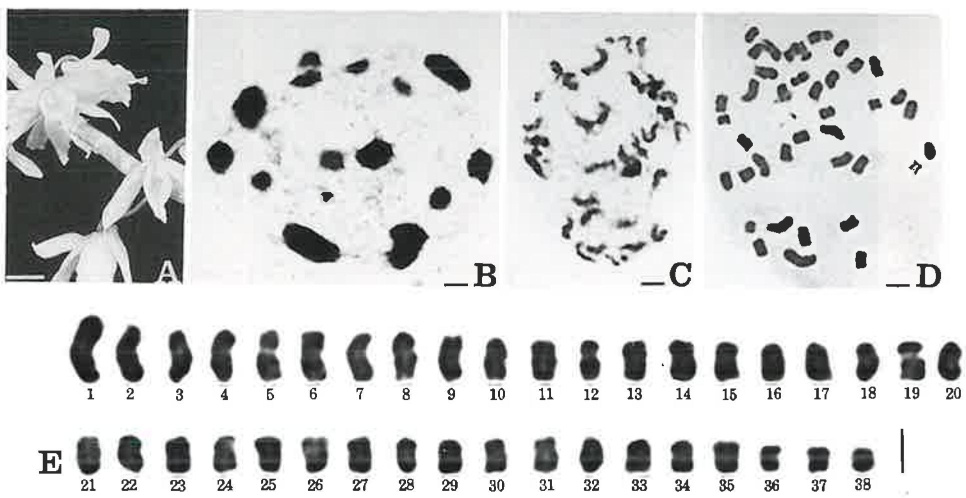

Fig. 39. *Dendrobium superbum* var. *album*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

chromosomes. Two longest chromosomes (Nos. 1, 2) in the complement were clearly distinct. They were about 2.9 μm and 2.5 μm in length, and their arm ratios were 1.1 and 1.3, respectively.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

15) *Dendrobium tortile* Lindl., 2n=38, Tables 1 and 41, Fig. 40.

Five plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 20 cm in length. Leaves were lanceolate and deciduous. Flowers were about 10 cm across. Sepals and petals were pinkish white in color and curled wavily. Lips were pale yellow in color with purple veins and pubescent. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the five plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.2–0.9 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes,

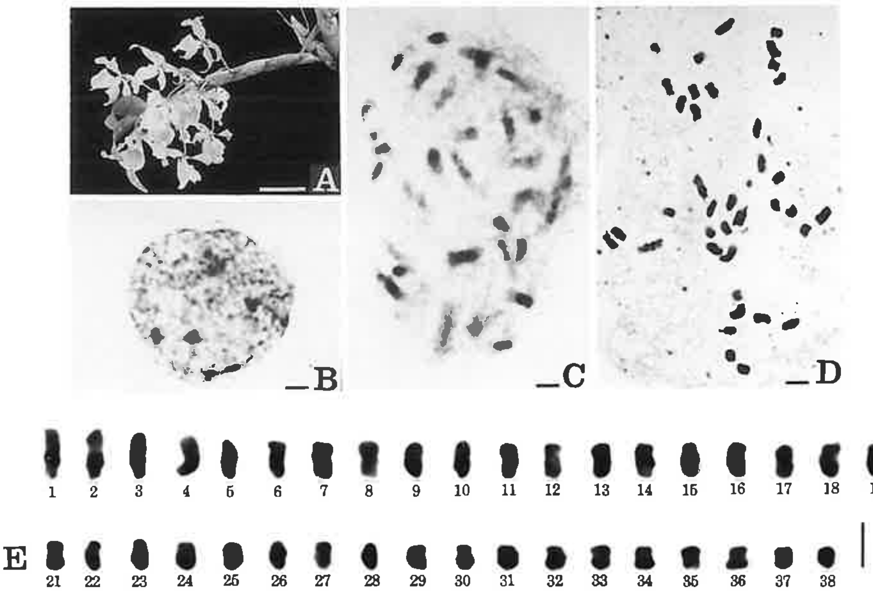

Fig. 40. *Dendrobium tortile,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 5.0 cm in A and 2.0μm in B–E).

ten (Nos. 5, 6, 19, 20, 22, 23, 29–32) were submedian and the other 28 were median. Four chromosomes (Nos. 1–4) were obviously longer than the others. The 1st and 2nd ones were both 2.2 μm in length, and their arm ratios were 1.4. The 3rd and 4th ones were both 2.0 μm in length, and their arm ratios were 1.2. These four chromosomes had the centromeres at the median region.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

16) *Dendrobium wardianum* Warn., 2n=38, Tables 1 and 42, Fig. 41.

Two plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were slenderly cylindrical and slightly swollen at node. Leaves were lanceolate and deciduous. Flowers had fragrance and lasted long time. Sepals and petals were white in color with purple tips. Lips were yellowish brown in color and had two maroon spots on the base. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the two plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category be-

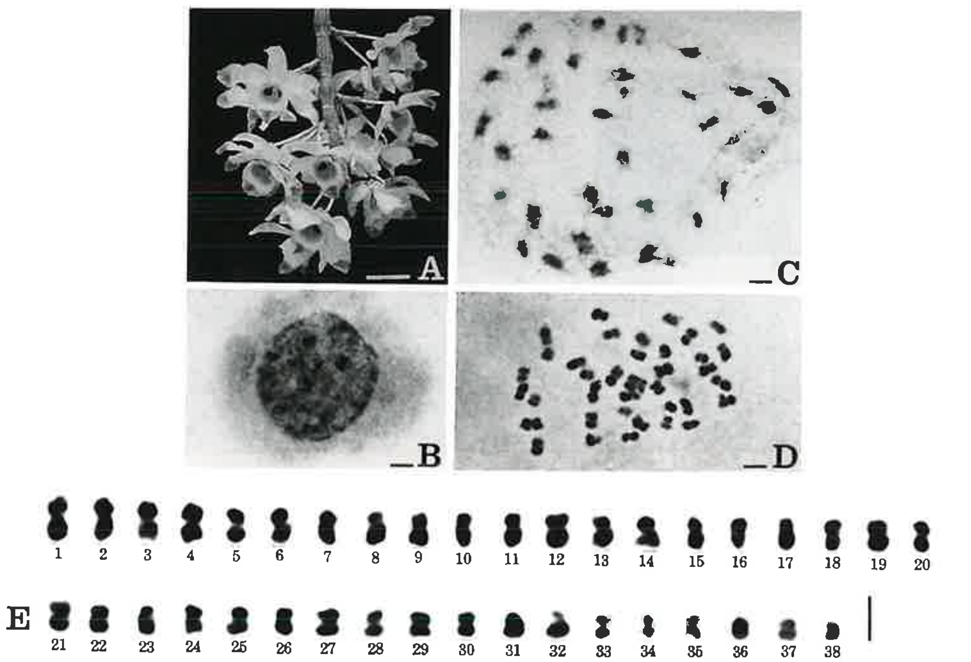

Fig. 41. *Dendrobium wardianum,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

tween the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 0.8 μm, and the positions of their centromeres were median, except for two (Nos. 31, 32) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2. Section Platycaulon

1) *Dendrobium platygastrium* Reichb. f., 2n=40, Tables 1 and 43, Fig. 42.

A plant was obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were peculiarly compressed. Upper portions of the pseudobulbs were wide and the bases were narrow. Leaves were herbaceous. Flowers were yellow in color and pendulous with the peduncle. Thus, this description of the material follows Schlechter (1927).

The chromosome number of the plant was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Many small chromatin blocks which varied in number from 30 to 40 showing irregular margin were observed in the resting nuclei. They ranged from 0.5–1.5 μm in diameter. Some of the blocks aggregated into large blocks which observed as the chromocentral aggregation. At prophase the early condensed segments were observed in the proximal as well as in the interstitial and

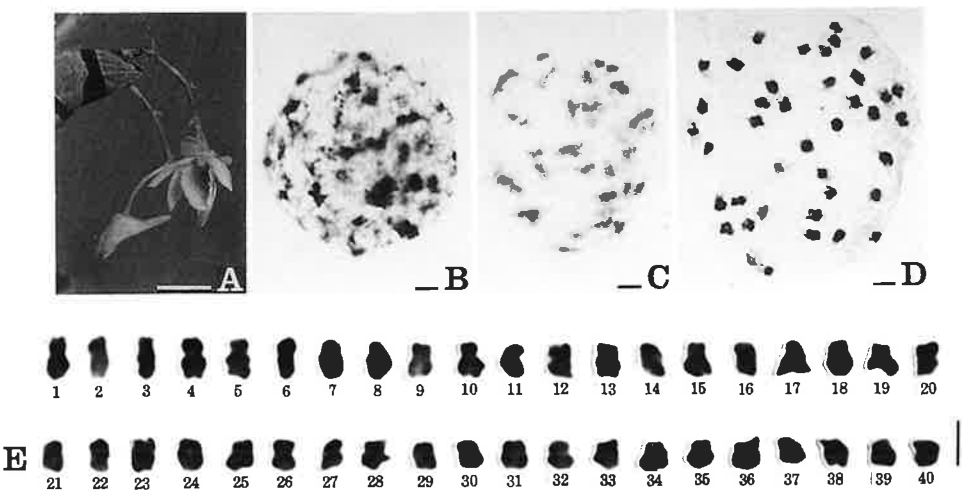

Fig. 42. *Dendrobium platygastrium*, 2n = 40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

distal regions of most chromosomes. That is, the karyotype at resting stage was considered to belong to the complex chromocenter type according to Tanaka's classification (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 1.1 μm, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes, 20 (Nos. 1–4, 9–16, 25–32) were median and the other 20 were submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3. Section Pedilonum

1) *Dendrobium amethystoglossum* Reichb. f., 2n=40, Tables 1 and 44, Fig. 43.

Three plants were obtained from the Philippines. External morphological characteristics were as follows: Pseudobulbs were cylindrical and about 60 cm in length. Leaves were narrowly oblong. Inflorescences were drooping. Flowers were about 3 cm across and white in color with purple lines on the middle of the lip. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. pierardii* described above (p. 43). That is, the karyotype at resting stage was considered to belong to the prochromosome type proposed by Tanaka (1971).

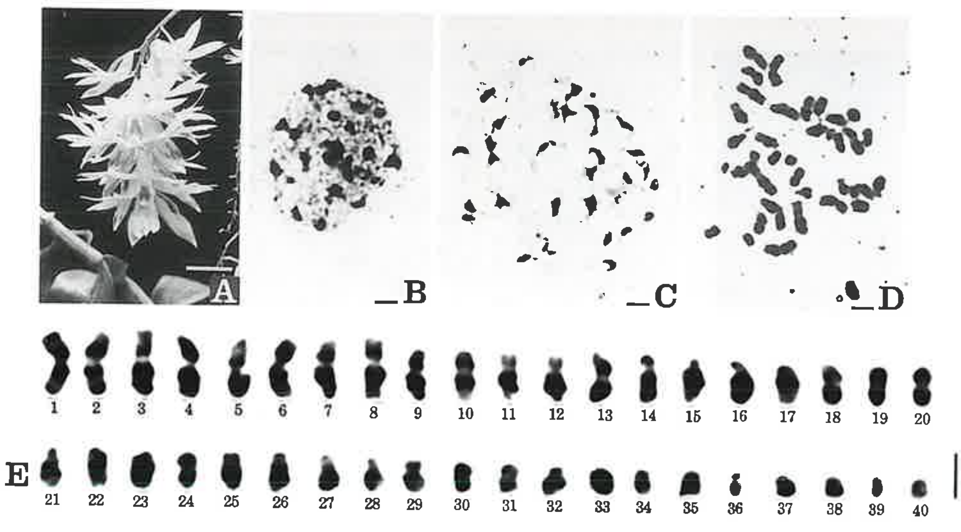

Fig. 43. *Dendrobium amethystoglossum*, 2n = 40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase ranged from 2.8–0.9 μm in length, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes eight long chromosomes were distinct; the longest one (No. 1) was 2.8 μm in length, and the arm ratio was 1.0. The second one was 2.7 μm in length, and the arm ratio was 1.1. The positions of these two were median. The other six chromosomes (Nos. 3–8) ranged from 2.6–2.5 μm, and the positions of their centromeres were median. Furthermore, four of them (Nos. 1–4) had small constrictions in their short and long arms, and the other six (Nos. 11–16) had secondary constrictions in their short and long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium bullenianum* Reichb. f., 2n=38, Tables 1 and 45, Fig. 44.

A plant was obtained from the Philippines. This species has been widely cultivated under the name of *D. topaziacum* Ames. External morphological characteristics were as follows: Pseudobulbs were slender and about 60 cm in length. Leaves were oblong. Flowers were pink in color with purple veins. Thus, this description of the material follows Schlech-

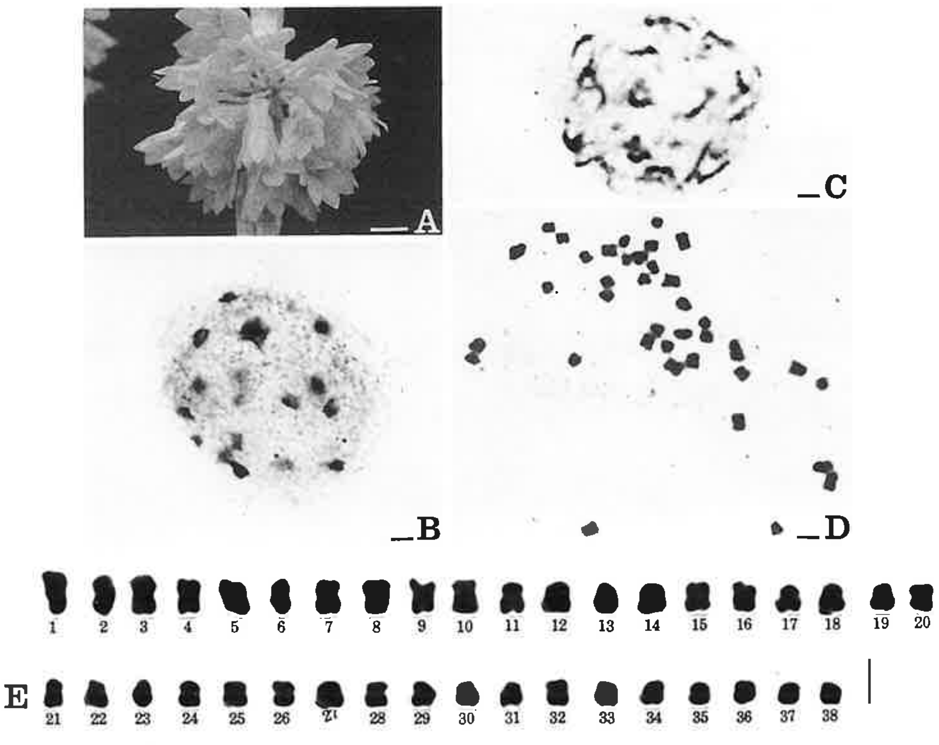

Fig. 44. *Dendrobium bullenianum,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

ter (1927).

The chromosome number of the plant was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage and mitotic prophase were found to be similar to those of *D. superbum* var. *album* described above (p. 44). That is, approximately 18 chromocentral aggregations per nucleus occurred. The karyotype at resting stage was considered to belong to the prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 1.9–1.0 μm in length, and the positions of their centromeres were mostly median, except for six (Nos. 10–12, 21–23) submedian chromosomes. Three chromosomes (Nos. 1–3) were longer than the others. The 1st one was 1.9 μm in length, and the arm ratio was 1.7. The 2nd and 3rd were 1.8 μm in length, and the arm ratios were 1.3 and 1.0, respectively. The positions of the centromeres of these three chromosomes were all median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium capituliflorum* Rolfe, 2n=38, Tables 1 and 46, Fig. 45.

Two plants were obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 20 cm in length. Leaves were dark green on the upper surface and purple on the under surface. Flowers were greenish

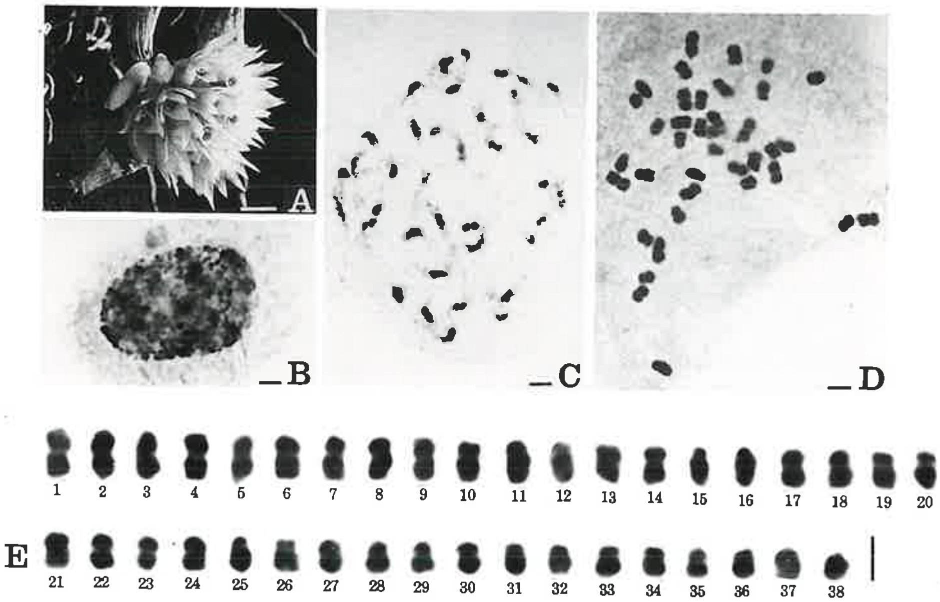

Fig. 45. *Dendrobium capituliflorum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

white in color and about 1.4 cm across. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the two plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1982). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.1 μm to the shortest one of 1.2 μm, and the positions of their centromeres were either median, submedian, or subterminal. Among the 38 chromosomes, two (Nos. 15, 16) were subterminal, eight (Nos. 11, 12, 25, 26, 31–34) were submedian, and the other 28 were median chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium miyakei* Schltr., 2n=38, Tables 1 and 47, Fig. 46.

Five plants were obtained from Formosa. External morphological characteristics were as follows: Pseudobulbs were cylindrical and about 40 cm in length. Leaves were oblong. In-

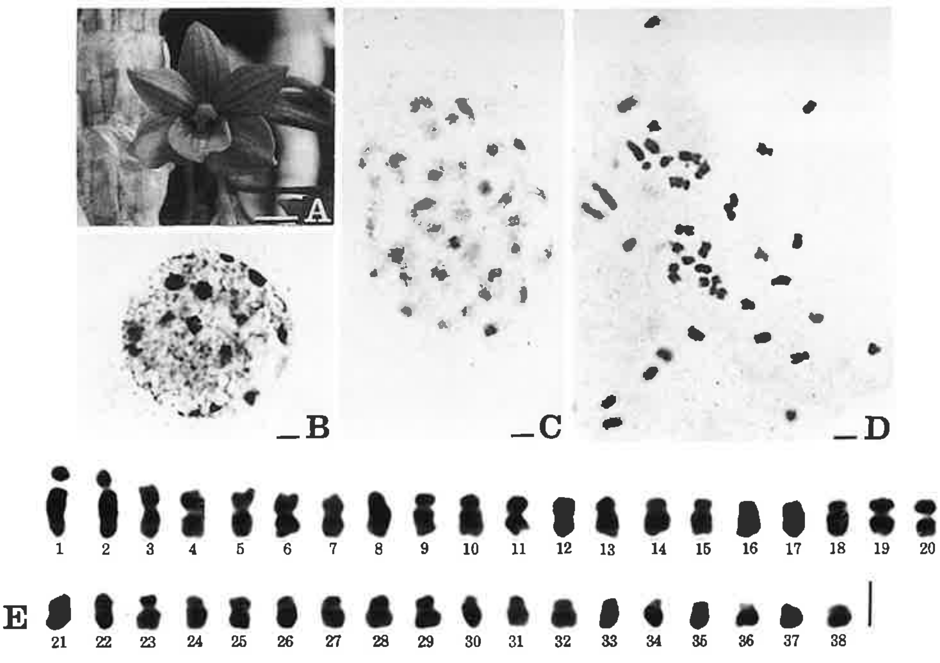

Fig. 46. *Dendrobium miyakei*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

florescences were about 5 cm in length. Flowers were purple in color with dark purple veins. Thus, this description of the materials follows Schlechter (1919).

The chromosome number of the five plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. bullenianum* described above (p. 49). That is, the karyotype at resting stage was considered to belong to the prochromosome type proposed by Tanaka (1971).

The chromosome lengths at mitotic metaphase ranged from 2.8–1.1 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes 18 (Nos. 1, 2, 8–10, 13–18, 26, 27, 30, 33–36) were submedian, and the other 20 were median chromosomes. Two longest chromosomes (Nos. 1, 2) were distinct. They were 2.8 μm in length, and their arm ratios were 3.0. Another two chromosomes (Nos. 9, 10) had small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5) *Dendrobium ramosii* Ames, 2n=40, Tables 1 and 48, Fig. 47.

A plant was obtained from the Philippines. External morphological characteristics were as follows: Stems were linear and about 0.4 cm in width. Leaves were lanceolate. Inflorescences were about 2 cm in length and bore about ten flowers. Flowers were purple in color. Thus, this description of the material follows Ames (1912).

The chromosome number of the plant was 2n = 40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic

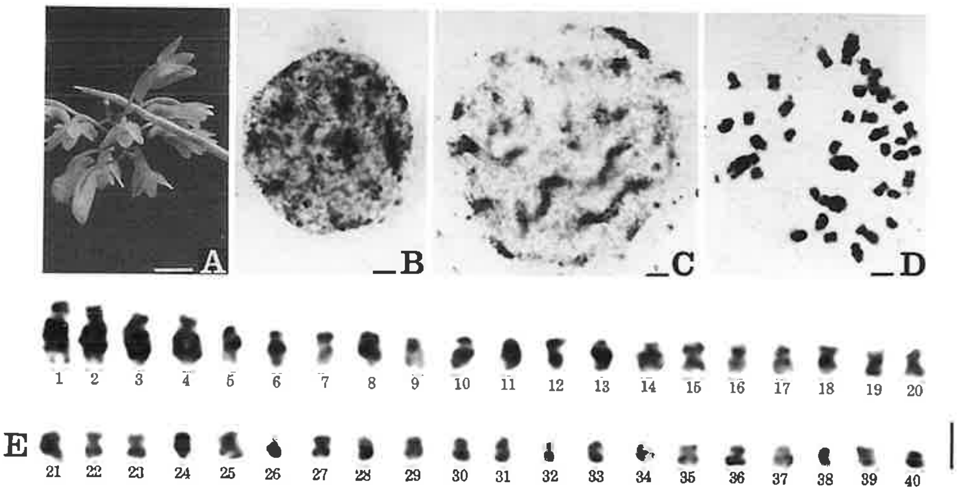

Fig. 47. *Dendrobium ramosii*, 2n = 40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

prophase were similar to those of *D. macraei* described above (p. 2). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase were conspicuous. Among the 40 chromosomes four longest chromosomes (Nos. 1–4) were all subterminal. That is, the 1st longest one was 2.6 μm in length, and the arm ratio was 3.3. The 2nd was 2.5 μm in length, and the arm ratio was 3.2. The 3rd and the 4th were 2.2 μm in length, and their arm ratios were 3.4. The other 36 chromosomes showed a gradual variation in length ranging from the longest one of 1.8 μm to the shortest one of 0.8 μm, and the positions of their centromeres were either median or submedian. Furthermore, four chromosomes (Nos. 1, 2, 13, 14) had small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

6) *Dendrobium secundum* (Bl.) Lindl., 2n=40, Tables 1 and 49, Fig. 48.

Four plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were cylindrical and slightly narrow at both ends. Leaves were lanceolate and deciduous. Infloresceneces were about 10 cm in length. Flowers were closely placed and pointed to one side, and were waxy and pink in color. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the four plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and

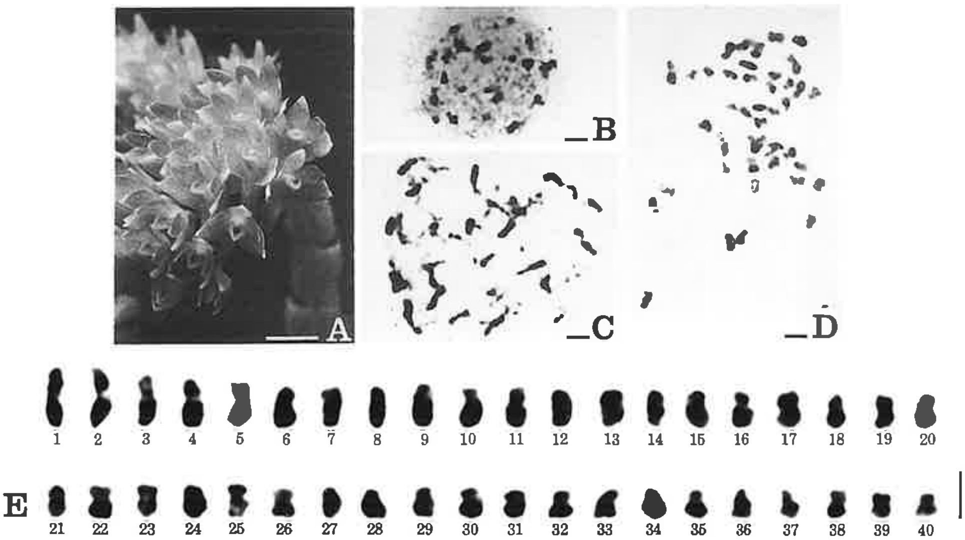

Fig. 48. *Dendrobium secundum,* 2n=40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

mitotic prophase were similar to those of *D. amethystoglossum* described above (p. 48). That is, the karyotype at resting stage was considered to belong to the prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.5–1.0 μm in length, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes 13 (Nos. 9, 10, 15, 16, 23–25, 31–36) were submedian and the other 27 were median chromosomes. Two longest chromosomes (Nos. 1, 2) were distinct. They were 2.5 μm in length and their arm ratios were 1.1.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

7) *Dendrobium smilliae* F. Muell., 2n=38, Tables 1 and 50, Fig. 49.

Three plants were obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were cylindrical and slender at both ends. Leaves were oblong and about 20 cm in length. Flowers were pale green in color and about 2 cm in length, with bright green tip of the lips. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. capituliflorum* described above (p. 50). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

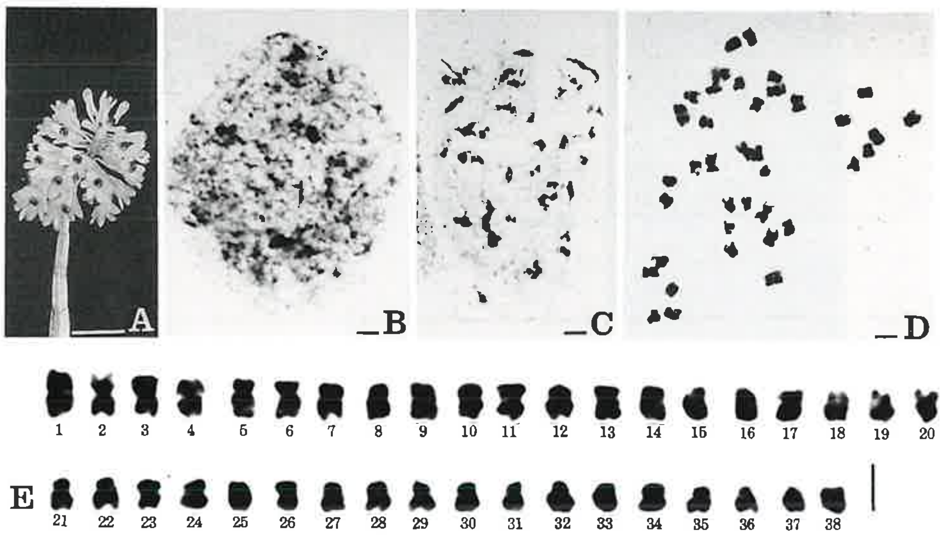

Fig. 49. *Dendrobium smilliae*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase ranged from 2.1–1.1 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes eight (Nos. 5, 6, 15, 16, 19–22) were submedian and the other 30 were median chromosomes. Two longest chromosomes (Nos. 1, 2) were distinct. They were about 2.1 μm and 2.0 μm in length, respectively and their arm ratios were 1.1 and 1.0, respectively.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4. Section Calyptochilus

1) *Dendrobium phlox* Schltr., 2n=38, Tables 1 and 51, Fig. 50.

A plant was obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were cylindrical and slender. Leaves were lanceolate. Flowers were tubular and bright yellow in color. Lip tips were inflexed. Thus, this description of the material follows Schlechter (1912).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many granules and fibrous threads scattered in the whole regions of the nucleus. Several spherical, small chromatin blocks which varied in number from 20 to 30 per nucleus were observed. They varied in size from 0.5–1.2 μm in diameter. Some of the blocks aggregated into large blocks as the chromocentral aggregation. Several chromosomes at mitotic prophase had early condensed segments in their whole regions and some chromosomes did not have any early condensed segments at all. That is, the karyotype at resting stage was considered to be-

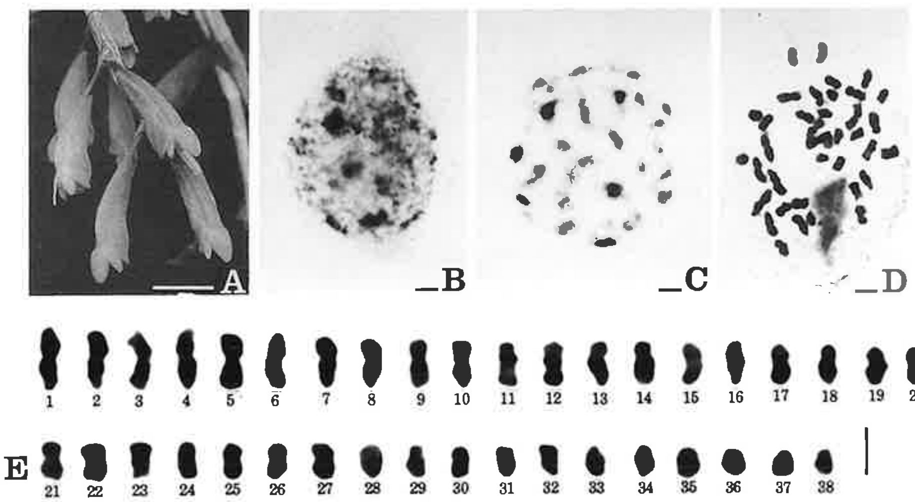

Fig. 50. *Dendrobium phlox,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

long to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.7 μm to the shortest one of 1.1 μm, and the positions of their centromeres were either median, submedian, or subterminal. Among the 38 chromosomes two (Nos. 11, 12) were subterminal, four (Nos. 13, 14, 37, 38) were submedian and the other 32 were median chromosomes. Two subterminal chromosomes had small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5. Section Cuthbertsonia

1) *Dendrobium sophronites* Schltr., 2n=38, Tables 1 and 52, Fig. 51.

A plant was obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 1.5 cm in length. Leaves were dark green in color and lanceolate with verucose surface. Flowers were solitary and about 3.5 cm in length. Flower color was dark red. Thus, this description of the material follows Schlechter (1912).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at interphase and mitotic prophase were similar to those of *D. phlox* described above (p. 55). That is, the karyotype

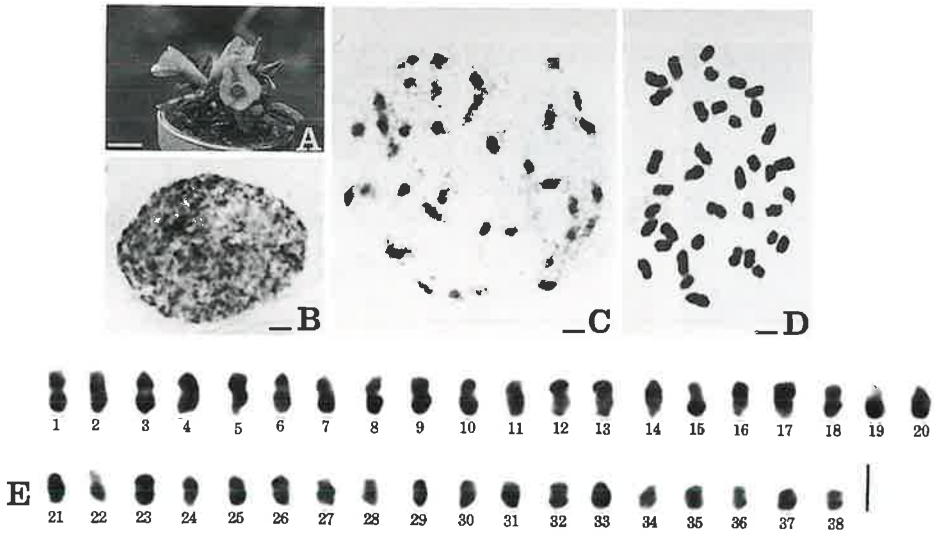

Fig. 51. *Dendrobium sophronites,* 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 0.9 μm, and the positions of their centromeres were mostly median, except for six (Nos. 19, 20, 27, 28, 33, 34) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

6. Section Oxyglossum

1) *Dendrobium quinquecostatum* Schltr., 2n=38, Tables 1 and 53, Fig. 52.

A plant was obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were conical and about 5 cm in length. Leaves were lanceolate and herbaceous with shallow hollow in the middle. Flowers were about 3 cm across and pinkish purple in color with reddish brown mentum. Lateral sepals surrounded the mentum. Thus, this description of the material follows Schlechter (1912).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at interphase and mitotic prophase were similar to those of *D. falconeri* described above (p. 35). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

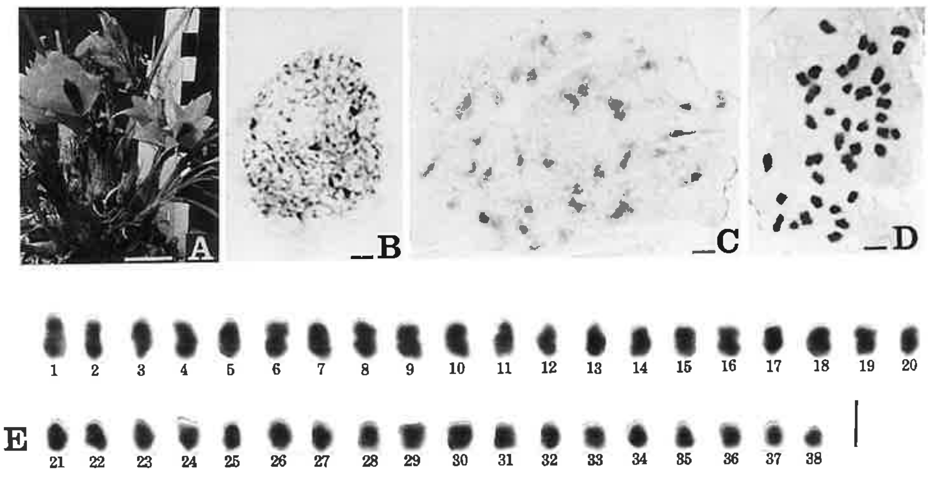

Fig. 52. *Dendrobium quinquecostatum*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase ranged from 1.8–0.8 μm in length, and the positions of their centromeres were mostly median, except for three (Nos. 11–13) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

7. Section Brachyanthe

1) *Dendrobium aduncum* Lindl., 2n=38, Tables 1 and 54, Fig. 53.

Three plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were cylindrical and branched. Leaves were lanceolate and about 8 cm in length. Flowers were pale pink in color and about 3 cm across. Menta were round in shape. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1982). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 1.9–0.8 μm in length, and the posi-

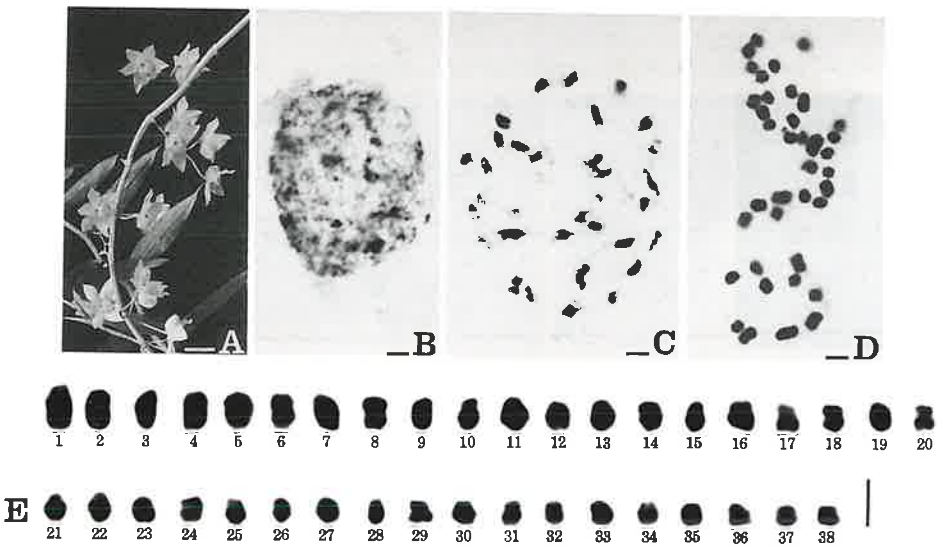

Fig. 53. *Dendrobium aduncum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

tions of their centromeres were either median or submedian. Among the 38 chromosomes 11 (Nos. 1, 3, 10, 11, 15, 21, 22, 25–28) were submedian and the other 27 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium stuposum* Lindl., 2n=38, Tables 1 and 55, Fig. 54.

Six plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were slender and cylindrical. Leaves were oblong. Flowers were white in color with reddish brown margins and about 1.5 cm across. Lip tips were bilobate. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the six plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.6–1.1 μm in length, and the positions of their centromeres were median or submedian. Three chromosomes (Nos. 1–3) were clearly longer than the others. The 1st longest chromosome was 2.6 μm in length, and the arm ratio was 1.2. The 2nd one was 2.2 μm in length, and the arm ratio was 1.4. The 3rd one was 2.1 μm in length, and the arm ratio was 1.1. Thus, the positions of the centro-

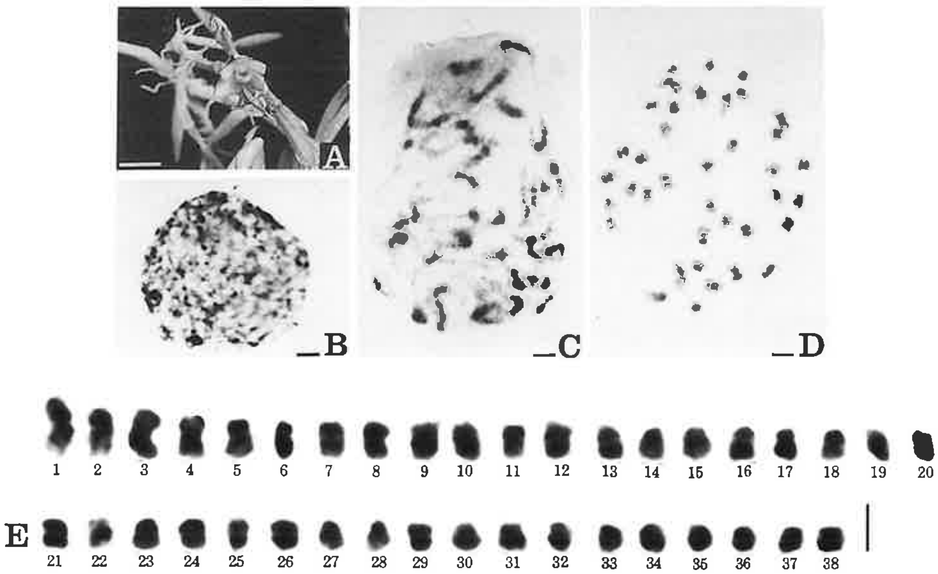

Fig. 54. *Dendrobium stuposum*, 2n=38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

meres of these three chromosomes were all median. Furthermore, 16 chromosomes (Nos. 15–20, 27, 28, 31–38) were submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

8. Section Stachyobium

1) *Dendrobium ciliatum* Par., 2n=40, Tables 1 and 56, Fig. 55.

Nine plants were obtained from Thailand. This species has been widely cultivated under the name of *D. delacourii* Guil. or *D. rupicola* Reichb. f.. External morphological characteristics were as follows: Pseudobulbs were fusiform and yellow in color. Leaves were narrowly oblong. Inflorescences were erect and bore about 20 flowers which were pale yellowish green in color with fringed lip. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the nine plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

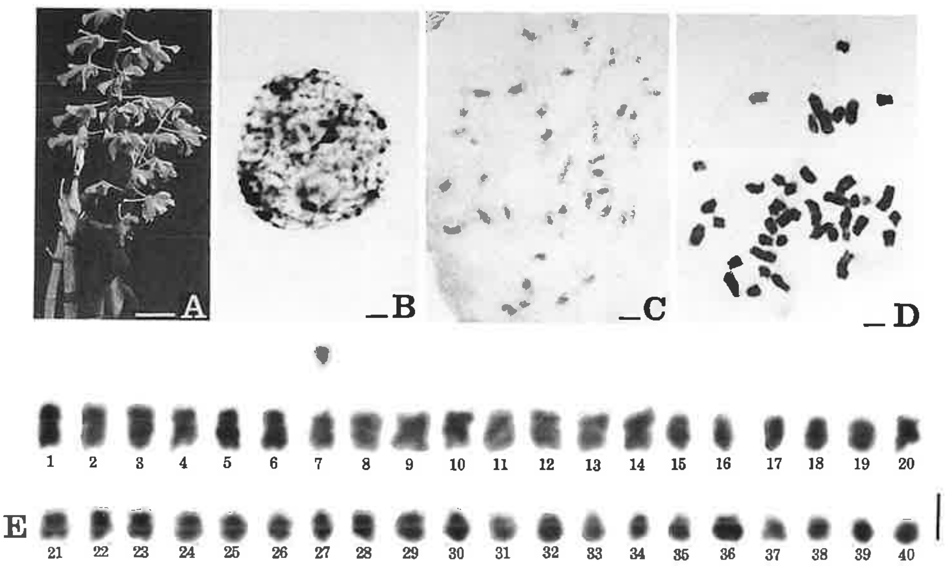

Fig. 55. *Dendrobium ciliatum*, 2n=40. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.8 μm to the shortest one of 0.9 μm, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes, 12 (Nos. 5, 6, 15–18, 29, 30, 33–36) were submedian and the other 28 were median chromosomes. The 7th chromosome had secondary constriction in the short arm.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium compactum* Rolfe, 2n=40, Tables 1 and 57, Fig. 56.

A plant was obtained from China. External morphological characteristics were as follows: Pseudobulbs were short and fusiform, about 4 cm in height. Leaves were herbaceous and lanceolate. Inflorescences were erect and bore about ten flowers. Flowers were yellowish green in color and about 1 cm across. Thus, this description of the material follows Kränzlin (1910).

The chromosome number of the plant was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. ciliatum* described above (p. 60). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.4 μm to the shortest one of 0.9 μm, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes, eight (Nos. 5, 6, 33–36, 39, 40) were submedian and the others were median.

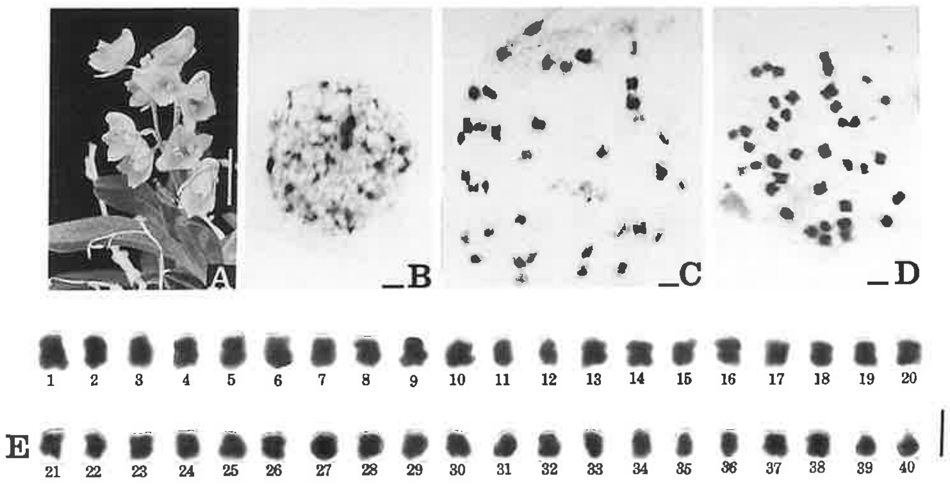

Fig. 56. *Dendrobium compactum*, 2n = 40. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium denudans* D. Don., 2n=40, Tables 1 and 58, Fig. 57.

Three plants were obtained from India. External morphological characteristics were as follows: Pseudobulbs were cylindrical and about 10 cm in length. Leaves were herbaceous and lanceolate. Inflorescences were erect and bore about ten flowers. Flowers were greenish white in color and about 2.5 cm across. Tips of the sepals and petals were acuminate. Thus, this description of the materials follows Kränzlin (1910).

The chromosome number of the three plants was 2n=40 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. ciliatum* described above (p. 60). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

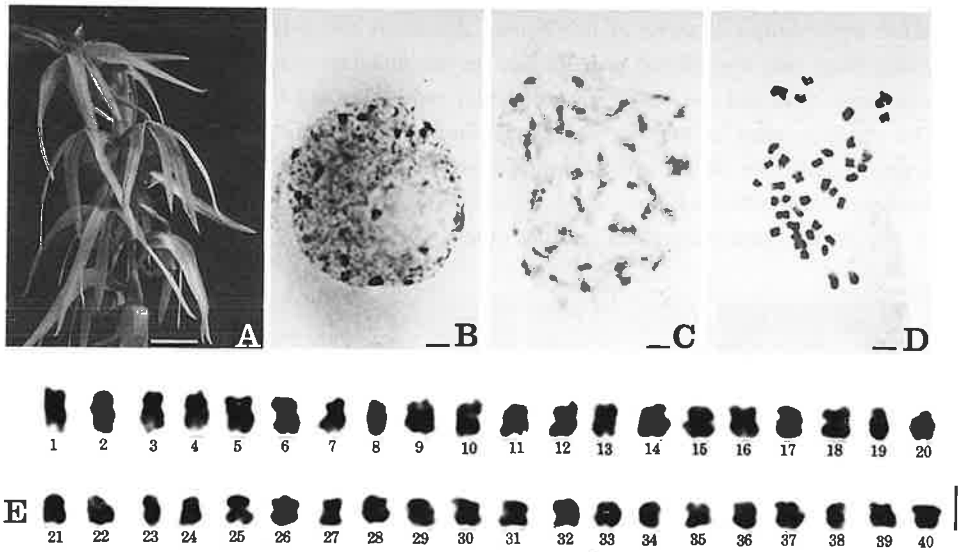

Fig. 57. *Dendrobium denudans*, 2n=40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 1.0 μm, and the positions of their centromeres were either median, submedian, or subterminal. Among the 40 chromosomes, two (Nos. 19, 20) were subterminal, 12 (Nos. 1–4, 8, 9, 13, 14, 37–40) were submedian and the other 26 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

9. Section Phalaenanthe

1) *Dendrobium bigibbum* Lindl. var. *compactum* C.T. White, 2n=38, Tables 1 and 59, Fig. 58.

Three plants were obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 20 cm in length. Leaves were oblong and coriaceous. Inflorescences which bore about ten flowers arose from near the top of the stem and arched. Flowers were white in color and about 5.5 cm in width. Menta were double. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage were observed as chromomeric granules and fibrous threads which were stained lightly. A few small chromatic blocks which varied in size and number were observed in the resting nucleus. Some of the blocks aggregated into large blocks as the chromocentral aggregation. Four large blocks which were stained darkly were approximately 1.0 μm in diameter. At prophase several chromosomes had early condensed segments throughout their regions, but some did not have any early condensed segment at all. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter

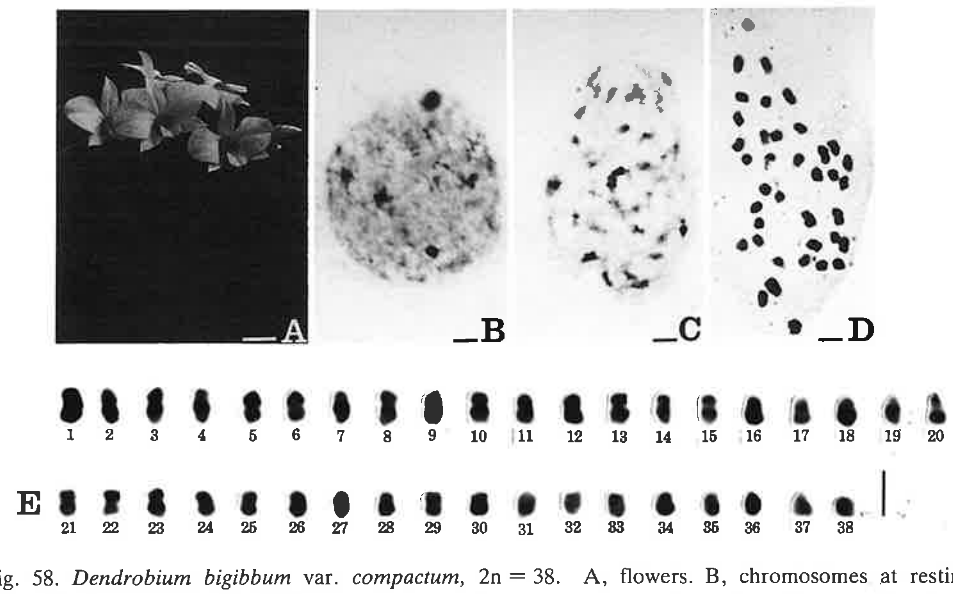

Fig. 58. *Dendrobium bigibbum* var. *compactum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.5 μm to the shortest one of 0.7 μm, and the positions of the centromeres were either median or submedian. Among the 38 chromosomes, 12 (Nos. 7, 8, 13, 14, 17–20, 33–36) were submedian, and the other 26 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium dicuphum* F. Muell., 2n=39, Tables 1 and 60, Fig. 59.

A plant was obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were narrow fusiform. Leaves narrow ovate and coriaceous. Inflorescences which bore about 20 flowers arose from near the top of the stems. Flowers were pink in color. Lips were narrower than those of *D. bigibbum* var. *compactum*. Thus, this description of the material follows Schlechter (1912).

The chromosome number of the plant was 2n=39 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the whole regions of the nucleus.

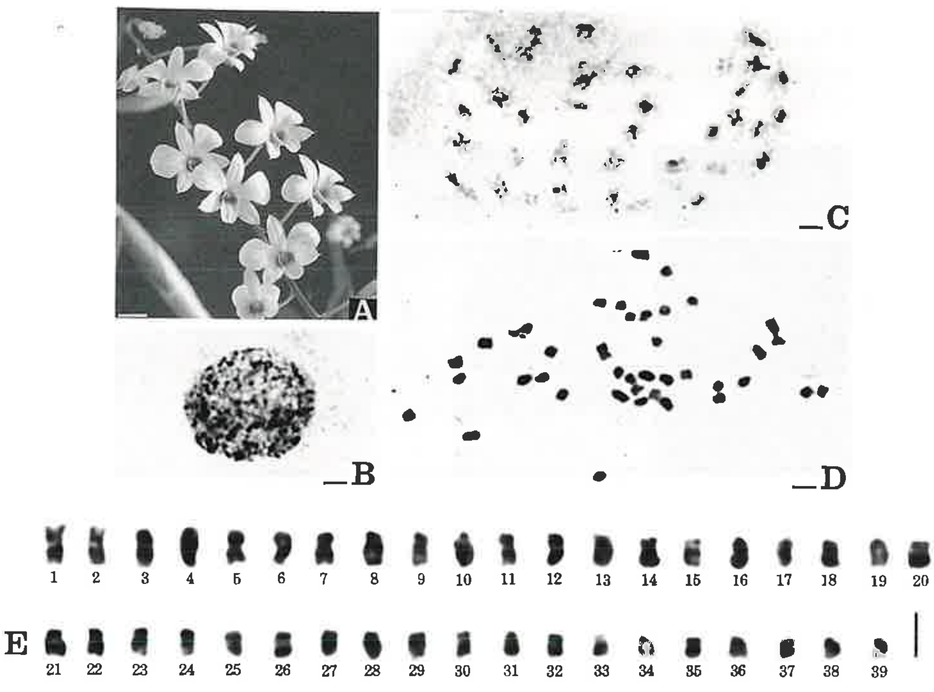

Fig. 59. *Dendrobium dicuphum*, 2n=39. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

Several spherical, small chromatin blocks which varied in number from 30–40 per nucleus were observed. They varied in size from 0.5 μm to 1.0 μm in diameter. Some of the blocks aggregated into large blocks which were observed as the chromocentral aggregation. Several chromosomes at mitotic prophase had early condensed segments in their whole regions, but the other chromosomes did not have. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from 1.7–0.9 μm, and the positions of their centromeres were either median or submedian. Among the 39 chromosomes, ten (Nos. 8–10, 23, 24, 27–31) were submedian and the other 29 were median. Four chromosomes (Nos. 1–4) were found to be slightly longer than the others.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium phalaenopsis* Fitzg., 2n=38, Tables 1 and 61, Fig. 60.

A plant was obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were narrow fusiform and about 60 cm in length. Leaves were lanceolate and about 20 cm in length. Inflorescences arose from near the top of the stems and arched. Flowers were graceful and pinkish white in color. Thus, this description of the material fol-

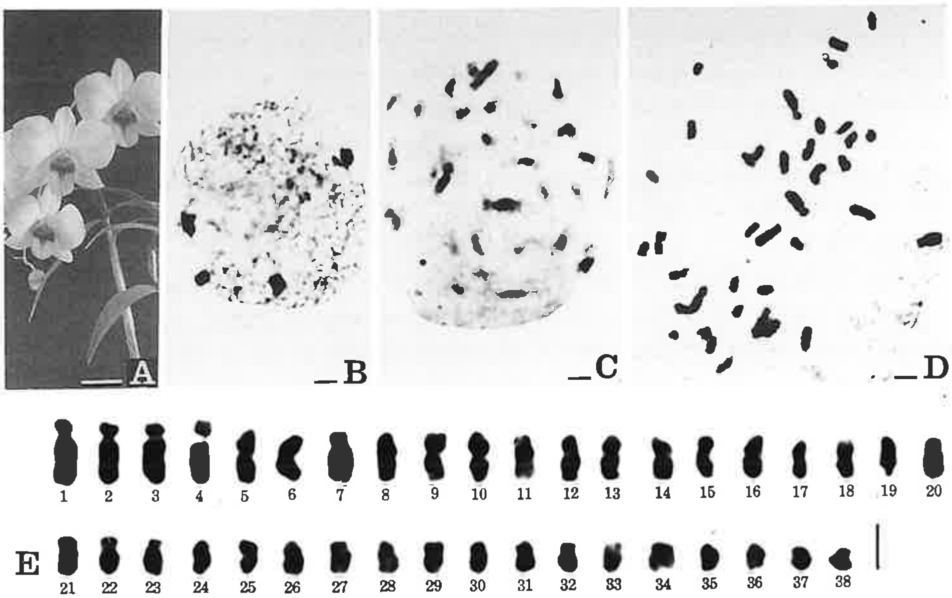

Fig. 60. *Dendrobium phalaenopsis*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

lows Schlechter (1927).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. bigibbum* var. *compactum* described above (p. 63). Thus, some chromomeric granules formed large blocks which varied in size from 0.5–2.0 μm in diameter. Among those blocks, four large ones were obvious. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.6–1.0 μm in length, and the positions of their centromeres were either median, submedian, or subterminal. Among the 38 chromosomes, four longest chromosomes were distinct: Two chromosomes (Nos. 1, 2) were about 2.6 μm in length, and the arm ratios were 3.3, the 3rd one was about 2.5 μm in length, and the arm ratio was 3.2. Thus, the positions of the centromeres of these three chromosomes were subterminal. The 4th chromosome was about 2.4 μm in length, and following the arm ratio of 3.0, the position of the centromere was submedian. These four chromosomes had secondary constrictions in their long arms. The other 34 chromosomes showed a gradual decrease in length and the positions of their centromeres were median, except for ten (Nos. 7, 8, 19–24, 27, 28) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium superbiens* Reichb. f., 2n=38, Tables 1 and 62, Fig. 61.

A plant was obtained from Australia. This species has been believed to be a natural hybrid between unknown species of the sections Phalaenanthe and Ceratobium. External morphological characteristics were as follows: Pseudobulbs were narrow fusiform and about 60 cm in length. Leaves were ovate and coriaceous. Inflorescences which bore about ten flowers arose from near the top of the stem and erect. Sepals and petals were wavy and twisted. Flower color was reddish purple. Thus, this description of the material follows Schlechter (1927).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage and mitotic prophase were similar to those of *D. dicuphum* described above (p. 64). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.9–0.8 μm in length, and the positions of their centromeres were either median, submedian, or subterminal. Among the 38 chromosomes, two longest chromosomes were distinct. The 1st longest chromosome (No. 1) was about 2.9 μm in length and the arm ratio was 4.8. The position of centromere was subterminal. The 2nd longest chromosome was about 2.3 μm in length and the arm ratio was 1.1. The positions of the centromeres was median. The other 36 chromosomes showed a

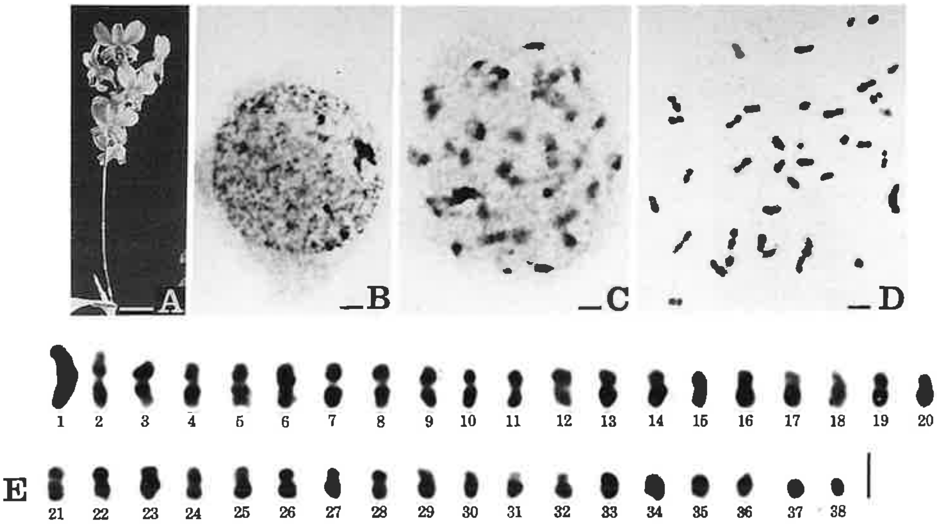

Fig. 61. *Dendrobium superbiens,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

gradual decrease in length ranged from the longest one of 2.0 μm to the shortest one of 0.8 μm, and the positions of their centromeres were mostly median, except for five (Nos. 17, 18, 23, 32, 33) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5) *Dendrobium williamsianum* Reichb. f., 2n=38, Tables 1 and 63, Fig. 62.

Three plants were obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were cylindrical and reached to 200 cm in height. Leaves were oblong, coriaceous and about 9 cm in length. Inflorescence which bore about ten flowers arose from near the top of the stem. The flower was bloomed toward the downwards. Sepals and petals were white and lips were dark purple in color. Thus, this description of the material follows Schlechter (1912).

The chromosome number of the three plants was 2n=38, a new report to this species.

The chromosomes at resting stage and mitotic prophase were similar to those of *D. bigibbum* var. *compactum* described above (p. 63). That is, some chromomeric granules formed four large chromocentral aggregations. They were divided into two large and two medium sized aggregations which were darkly stained. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 3.8–0.8 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes

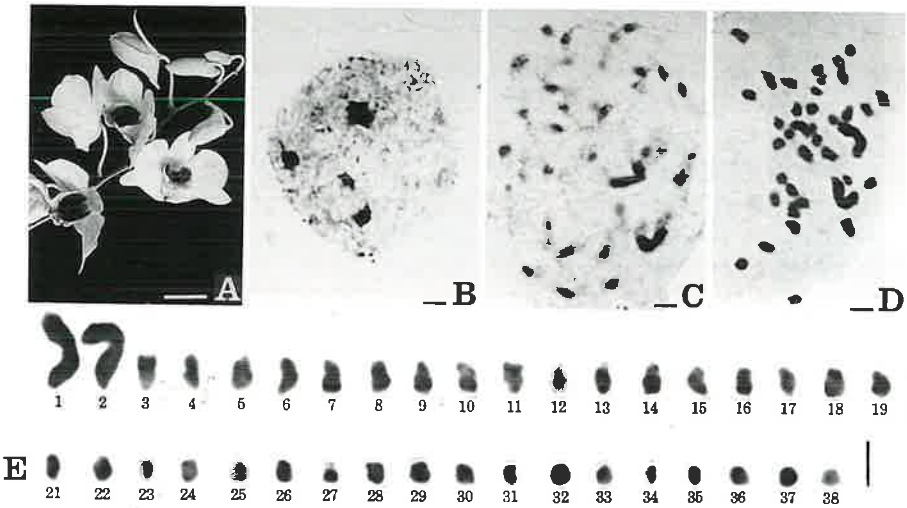

Fig. 62. *Dendrobium williamsianum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

two longest chromosomes were distinct. They were about 3.8 μm in length, and their arm ratios were median. The other 36 chromosomes showed a gradual variation in length, and the positions of the centromeres were mostly median, except for ten (Nos. 11–14, 19–22, 31, 32) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

10. Section Eleutheroglossum

1) *Dendrobium canaliculatum* R. Br., 2n=38, Tables 1 and 64, Fig. 63.

Four plants were obtained from Australia. External morphological characteristics were as follows: Pseudobulbs were fusiform and about 10 cm in length. Leaves were fleshy, yellowish green and about 1.5 cm in width. Sepals and petals were twisted. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the four plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. pierardii* described above (p. 43). Thus, the karyotype at resting stage was considered to belong to the prochromosome type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.4–1.0 μm in length, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes the longest chromosome was distinguishably about 2.4 μm in length, and due to the arm

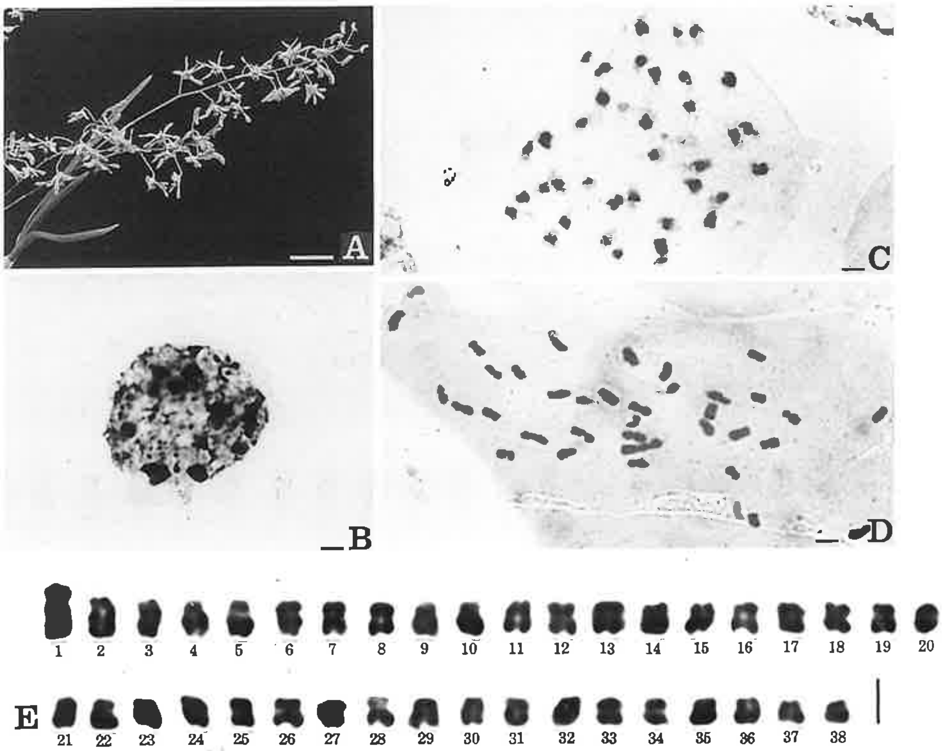

Fig. 63. *Dendrobium canaliculatum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

ratio of 2.4, the position of the centromere was submedian. Of the other 37 chromosomes, five (Nos. 2, 4, 5, 31, 32) were submedian and 32 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

11. Section Ceratobium

1) *Dendrobium gouldii* Reichb. f., 2n=38, Tables 1 and 65, Fig. 64.

Two plants were obtained from Papua New Guinea. External morphological characteristics were as follows: Pseudobulbs were cylindrical and about 100 cm in length. Leaves were ovate, coriaceous and about 8 cm in length. Inflorescence which bore about 20 flowers arose from near the top of the stem and arched. Flowers were yellowish brown in color. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the two plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and

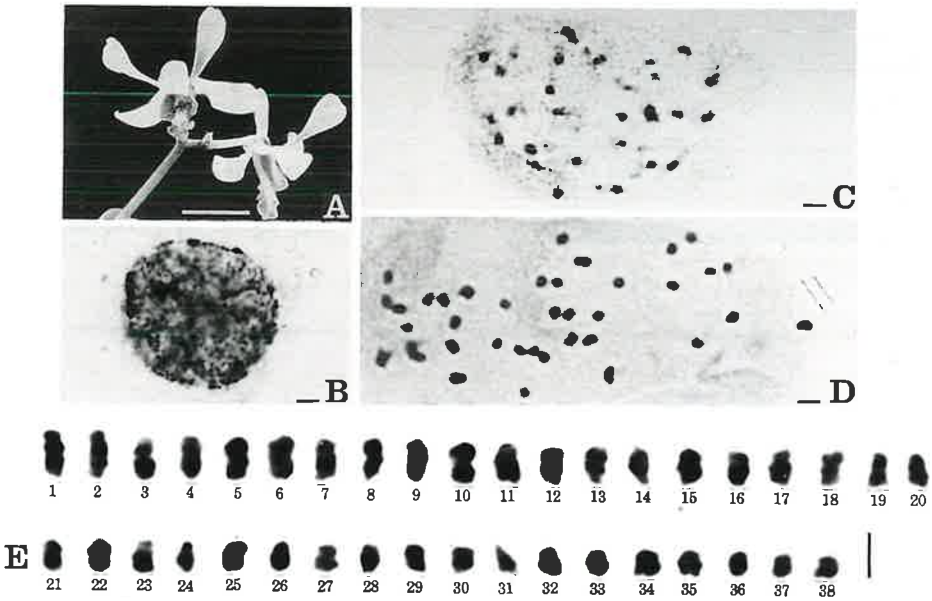

Fig. 64. *Dendrobium gouldii*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). That is, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.2–0.9 μm in length, and the positions of the centromeres were median or submedian. Among the 38 chromosomes, certain chromosomes were distinct; four chromosomes (Nos. 1–4) were longer than the others. The 1st and the 2nd chromosomes were about 2.2 μm in length and their arm ratios were 1.0, and the 3rd and the 4th were about 2.0 μm in length and their arm ratios were 1.0. Furthermore, two chromosomes (Nos. 13, 14) had secondary constrictions in their long arms and four chromosomes (Nos. 1, 2, 23, 24) had small constrictions in their short and long arms, respectively.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium lasianthera* J.J. Sm., 2n=38, Tables 1 and 66, Fig. 65.

A plant was obtained from the Philippines. External morphological characteristics were as follows: Pseudobulbs were cylindrical and reached to 200 cm in height. Leaves were ovate and coriaceous. Inflorescences arose from near the top of the stem and erect. Flowers were showy and lasted long time. Petals were twisted and the color of the lip was purple.

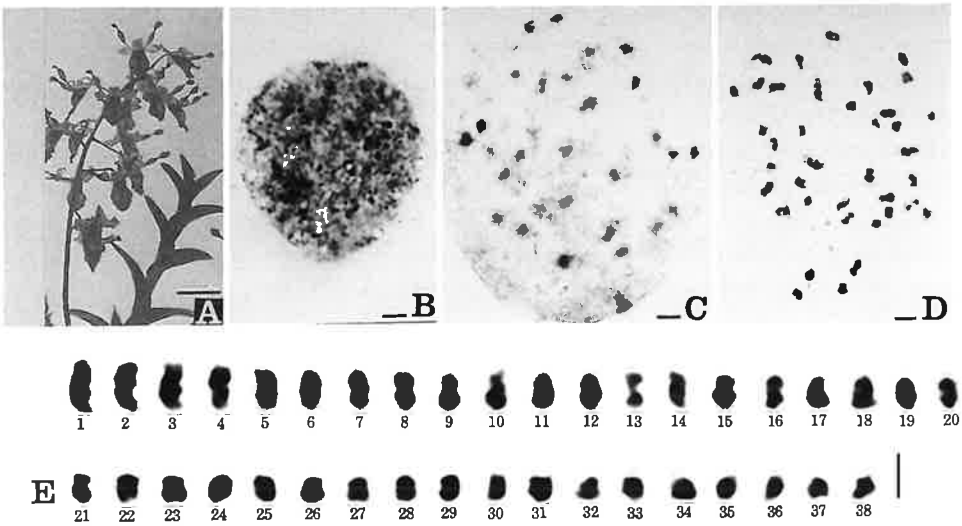

Fig. 65. *Dendrobium lasianthera,* 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 4.0 cm in A and 2.0μm in B–E).

Thus, this description of the material follows Schlechter (1927).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. albo-sanguineum* described above (p. 31). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.2–0.9 μm in length, and the positions of their centromeres were all median. Among the 38 chromosomes, four (Nos. 1–4) were distinct. Namely, the 1st and the 2nd chromosomes were about 2.2 μm in length, and their arm ratios were 1.0. The 3rd chromosome was about 2.1 μm in length, and the arm ratio was 1.1. The 4th chromosome was 2.0 μm in length, and the arm ratio was 1.0. These four chromosomes were clearly longer than the other 34 chromosomes and had small constrictions in their short and long arms, respectively.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and an asymmetric karyotype due to arm ratio.

12. Section Distichophyllum

1) *Dendrobium uniflorum* Griff., 2n=40, Tables 1 and 67, Fig. 66.

Two plants were obtained from Malaysia. External morphological characteristics were as follows: Stems were slender and about 40 cm in length. Leaves were persistent and about 10 cm in length. Flowers were solitary and arose from the each nodes of the middle of the stem. Flower color was milky white. Lips were flat. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the two plants was 2n = 40, a new report to this species. Chromosome morphology at resting and mitotic prophase were similar to those of *D. bigibbum* var. *compactum* described above (p. 63). Namely, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

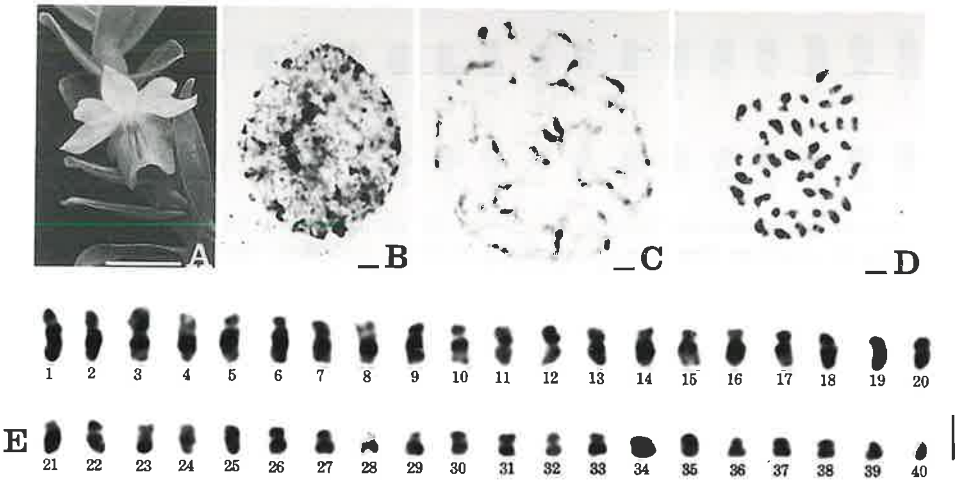

Fig. 66. *Dendrobium uniflorum,* 2n = 40. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase ranged from 2.3–0.8 μm in length, and the positions of their centromeres were either median or submedian. Among the 40 chromosomes, 16 (Nos. 1, 2, 5–10, 14–17, 21, 22, 25, 28) were submedian and the other 24 were median. Six chromosomes (Nos. 1–6) were longer than the others. The 1st and the 2nd were 2.3 μm in length, and their arm ratios were 2.8 and 2.3, respectively, while the 3rd and the 4th were 2.3 μm in length, and their arm ratios were 1.3. The 5th and the 6th were 2.2 μm and 2.1 μm in length, respectively and their arm ratios were 2.7 and 2.5, respectively.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

13. Section Oxygenianthe

1) *Dendrobium formosum* Roxb. var. *giganteum* Reichb. f., Tables 1 and 68, Fig. 67.

Five plants were obtained fromThailand. External morphological characteristics were as follows: Pseudobulbs were cylindrical and about 40 cm in length. Leaves were oblong and coriaceous. Leaf sheaths were hairy. Flowers were about 10 cm across and pure white in color with yellow blotch on the lip. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the five plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. bigibbum* var. *compactum* described above (p. 63). The large blocks which were observed eight per nucleus were obvious. Thus, the karyotype at resting stage was considered to belong to an intermediate category between

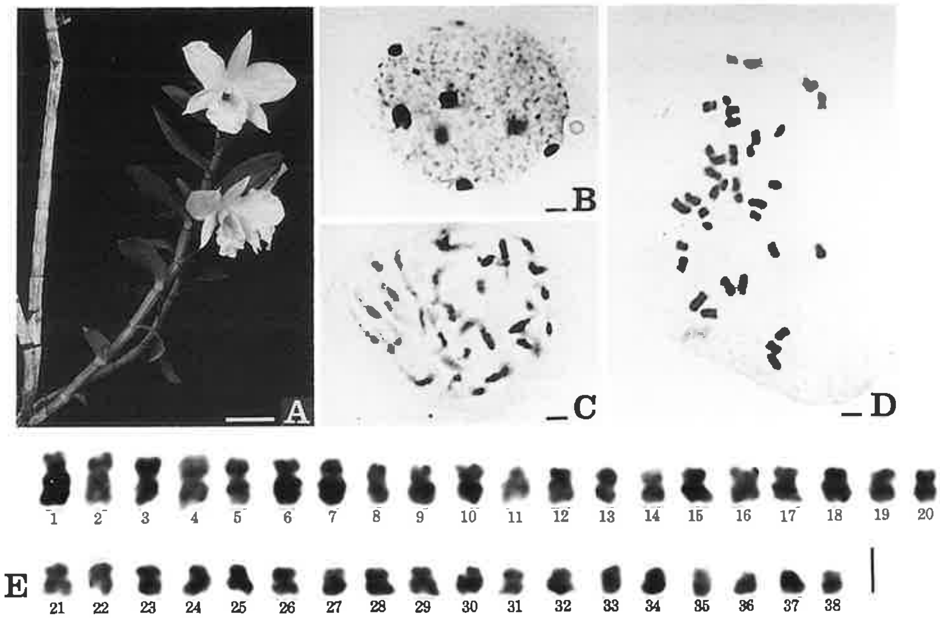

Fig. 67. *Dendrobium formosum* var. *giganteum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 3.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase ranged from 2.3–1.0 μm in length, and the positions of the centromeres were either median or submedian; eight (Nos. 1, 2, 6, 7, 11, 12, 17, 18) were submedian and the other 30 were median chromosomes. Among the 38 chromosomes, two (Nos. 1–2) were about 2.3 μm in length and their arm ratios were 1.9.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium infundibulum* Lindl., 2n=38, Tables 1 and 69, Fig. 68.

Two plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were slender, cylindrical and about 40 cm in length. Leaves were narrow ovate and about 8 cm in length. Leaf sheaths were covered with black hairs. Flowers were about 8 cm across and ivory white in color with yellow blotch on the base of the lip. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the two plants was counted to be 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. bigibbum* var. *compactum* described above (p. 63). Four large blocks per nucleus were obvious. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

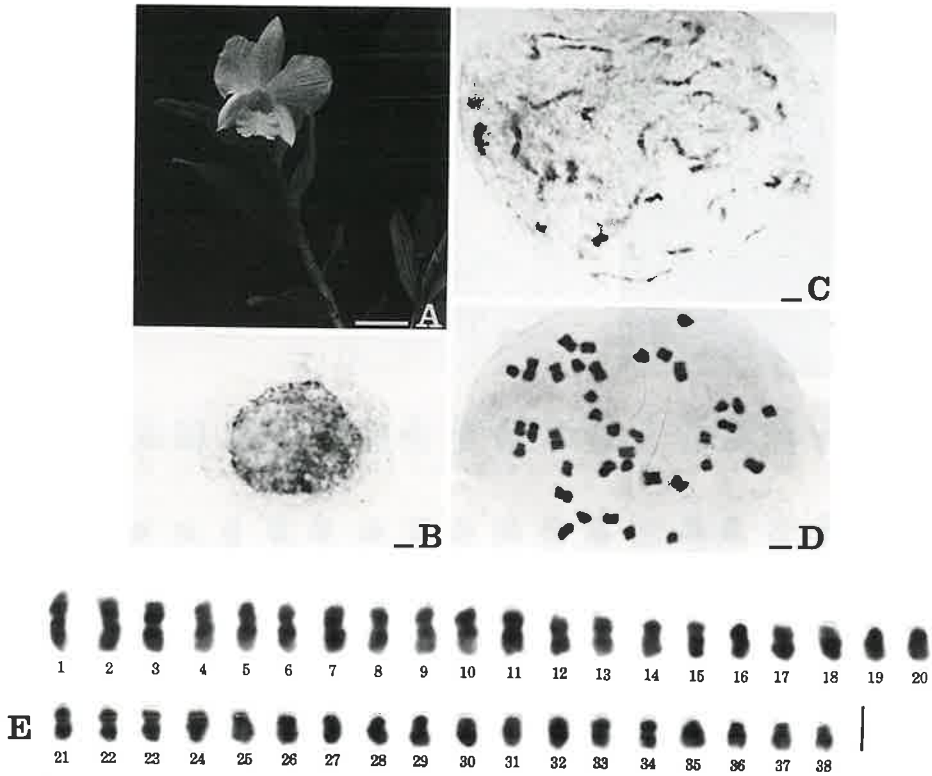

Fig. 68. *Dendrobium infundibulum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase were divided into two groups: The first group consisted of eleven long chromosomes ranged from 2.6–2.0 μm in length, in which the positions of the centromeres were all median. The second group consisted of the other short chromosomes ranged from 1.8–1.2 μm in length, in which the positions of the centromeres were either median or submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyptype due to arm ratio.

3) *Dendrobium sanderae* Rolfe, 2n=40, Tables 1 and 70, Fig. 69.

A plant was obtained from the Philippines. External morphological characteristics were as follows: Pseudobulbs were cylindrical and about 80 cm in length. Leaves arranged closely and oblong in shape. Inflorescence which bore about four flowers arose from the apex of the stem. Flowers were white in color with purple lines on the lip. Thus, this description of the material follows Schlechter (1927).

The chromosome number of the plant was 2n=40, which confirmed the previous report (Shindo and Kamemoto 1963).

Chromosome morphology at resting and mitotic prophase were similar to those of *D. formosum* var. *giganteum* described above (p. 72). Small chromatin blocks which varied in size from 0.5–0.8 μm in diameter were observed in the resting nuclei, but large blocks could not be found. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 1.8–0.8 μm in length, and the positions of their centromeres were either median or submedian; 12 chromosomes (Nos. 1, 2, 13–16, 19, 20, 25–28) were submedian and the other 28 chromosomes were median. Among the 40 chromosomes, two longest ones (Nos. 1, 2) were about 1.8 μm in length, and

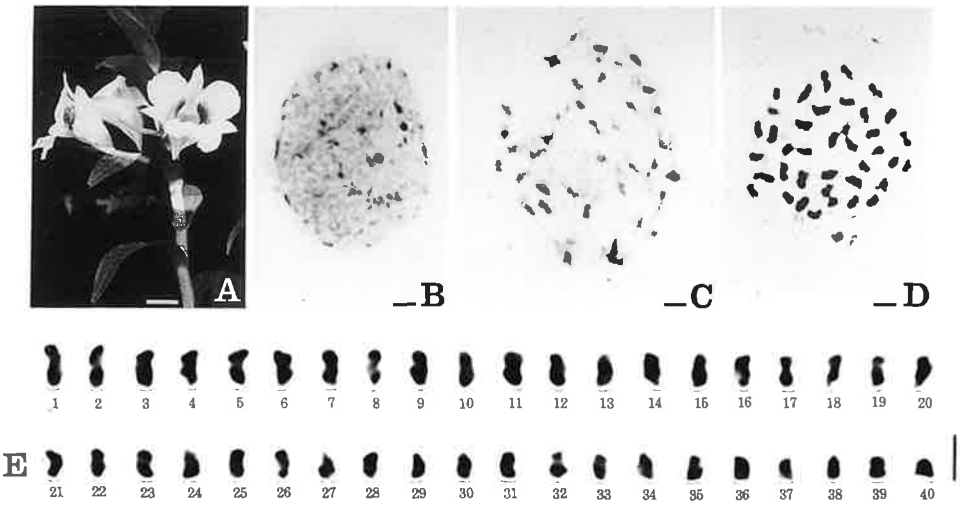

Fig. 69. *Dendrobium sanderae*, 2n=40. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

their arm ratios were both 2.6.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium scabrilingue* Lindl., 2n=38, Tables 1 and 71, Fig. 70.

Three plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were about 30 cm in length and cylindrical, swollen near the top. Leaf sheaths were covered with black haris. Leaves were oblong and persistent. Flowers which arose from node of the stem had fragrance and were ivory white in color with yellow blotch on the middle of the lip. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. sanderae* described above (p. 75). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase were divided into two groups; the first group consisted of ten long chromosomes ranged from 3.2–2.5 μm in length, in which the positions of their centromeres were all median, except for one (No. 9) submedian chromosome. The second group consisted of the other 28 short chromosomes ranged from 2.2–1.2 μm in length, in which the positions of their centromeres were median, submedian, or subtermin-

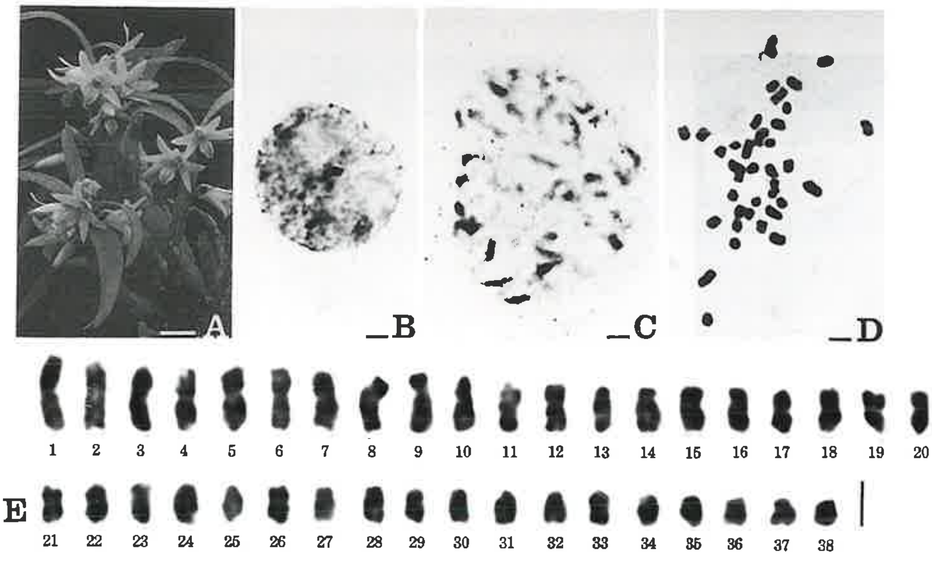

Fig. 70. *Dendrobium scabrilingue*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

al. Namely, two (Nos. 13, 14) were subterminal, seven (Nos. 23, 24, 27, 28, 31, 32, 34) were submedian and the other 19 were median chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5) *Dendrobium sutepense* Rolfe, 2n=38, Tables 1 and 72, Fig. 71.

Three plants were obtained from Thailand. External morphological characteristics were as follows: Pseudobulbs were slender, cylindrical and about 30 cm in length. Leaves were lanceolate and persistent. Leaf sheaths were covered with black hairs. Inflorescences which bore 1–2 flowers arose from node near the apex. Flowers were about 3 cm across and ivory white in color, with yellow blotch in the middle of the lip. Thus, this description of the materials follows Seidenfaden and Smitinand (1960).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. sanderae* described above (p. 75). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase were divided into two groups: The first group

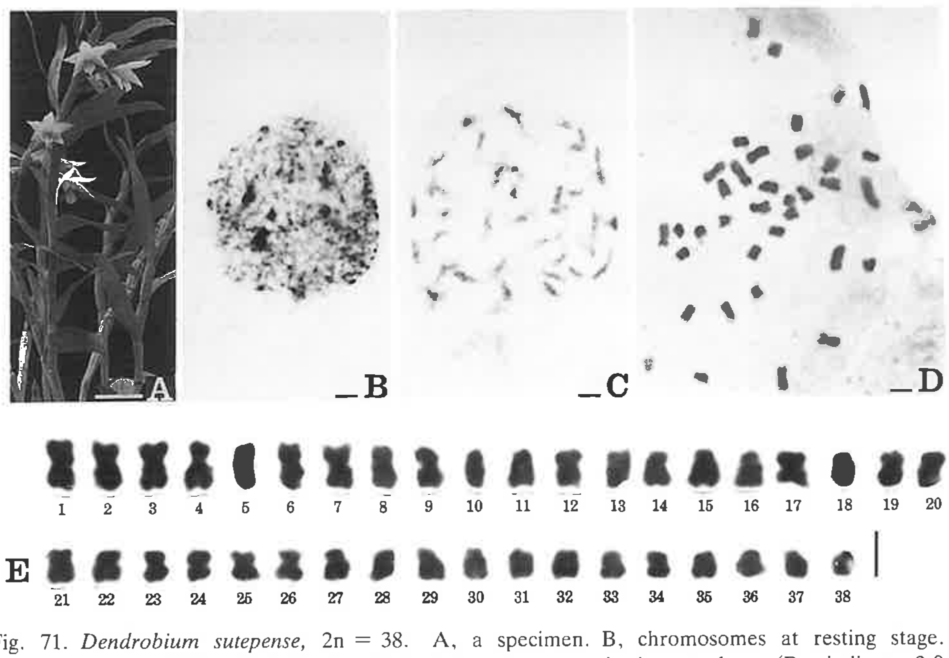

Fig. 71. *Dendrobium sutepense*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 2.0 cm in A and 2.0μm in B–E).

consisted of nine long chromosomes ranged from 2.1–1.9 μm in length, in which the positions of the centromeres were all median. The second group consisted of the other 29 short chromosomes ranged from 1.7–1.1 μm in length, in which the positions of the centromeres were mostly median, except for eight (Nos. 15, 16, 27–32) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

III Subgenus Rhopalobium

1. Section Rhopalanthe

1) *Dendrobium clavator* Ridl., 2n=38, Tables 1 and 73, Fig. 72.

Three plants were obtained from Thailand. External morphological characteristics were as follows: Stems were very slender and their two internodes were swollen. Leaves were terete and about 9 cm in length. Flowers were greenish yellow in color and about 1.9 cm across. Thus, this description of the materials follows Kränzlin (1910).

The chromosome number of the three plants was 2n=38, a new report to this species. The chromosomes at resting stage were observed as chromomeric granules and fibrous threads scattered in the whole region of the nucleus. Many spherical, small chromatin blocks which varied in number from 20 to 30 per nucleus were observed in the resting nuclei. They varied in size from 0.5–0.8 μm in diameter. At prophase the heterochromatic seg-

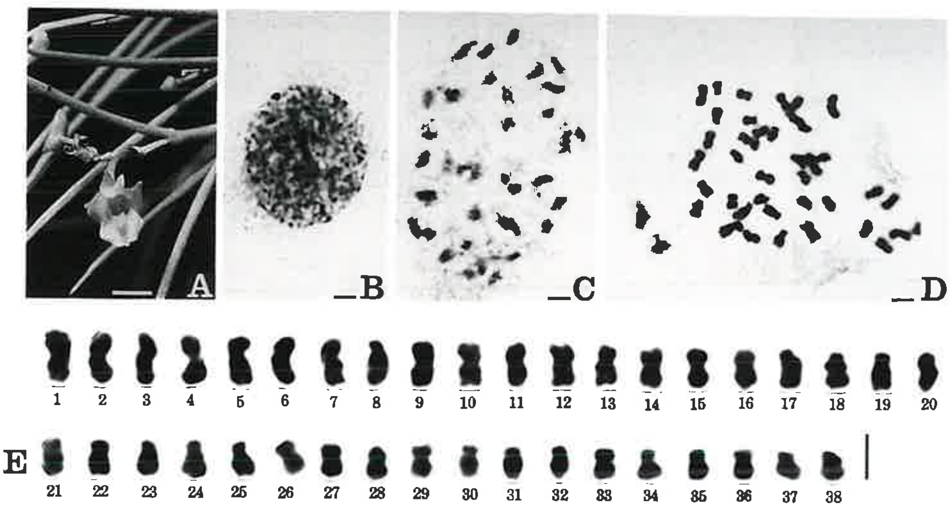

Fig. 72. *Dendrobium clavator*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

ments were located in the whole regions of some chromosomes but not all chromosomes. Thus, the karyotype at resting stage were considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 2.2 μm to the shortest one of 1.2 μm, and the positions of their centromeres were either median, submedian, or subterminal. Among the 38 chromosomes, one (No. 17) was subterminal, 13 (Nos. 5–8, 18–20, 23–25, 30–32) were submedian and the other 24 were median. Two chromosomes (Nos. 7, 8) had small constrictions in their long arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium crumenatum* Sw., 2n=38, Tables 1 and 74, Fig. 73.

Two plants were obtained from the Philippines. External morphological characteristics were as follows: Stems were slender and some internodes at basal portion were swollen. Leaves were thick and leathery. Flowers were white in color and about 4 cm across. Thus, this description of the materials follows Schlechter (1927).

The chromosome number of the two plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. At the same stage about 20 large blocks which varied in size from 0.8–2.0 μm in diameter were observed in the resting nuclei. They aggregated with each other and their margins were

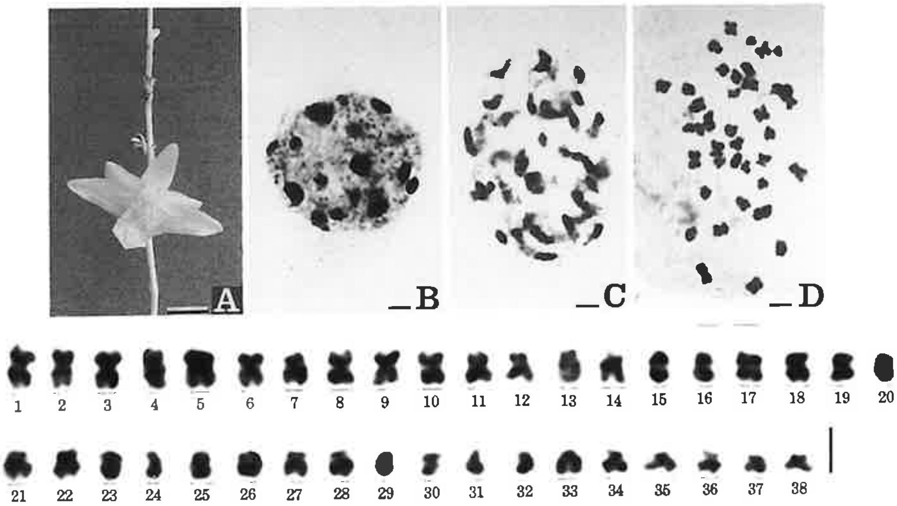

Fig. 73. *Dendrobium crumenatum*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

smooth. At prophase the early condensed segments were observed in the proximal regions of the chromosomes. Thus, the karyotype of this species at resting stage was considered to belong to the category of the prochromosome type according to Tanaka's classification (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.8 μm to the shortest one of 0.8 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes, eight (Nos. 27, 28, 31–36) were submedian and the other 30 were median. Two chromosomes (Nos. 13, 14) had secondary constrictions in their short arms.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium equitans* Kränzl., 2n=38, Tables 1 and 75, Fig. 74.

Three plants were obtained from Formosa. External morphological characteristics were as follows: Stems were slender and one internode at the basal portion was swollen. Leaves were terete, slightly flattened and erect. Flowers arose from the apex of the stem and their color was white. Thus, this description of the materials follows Kränzlin (1910).

The chromosome number of the three plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting stage

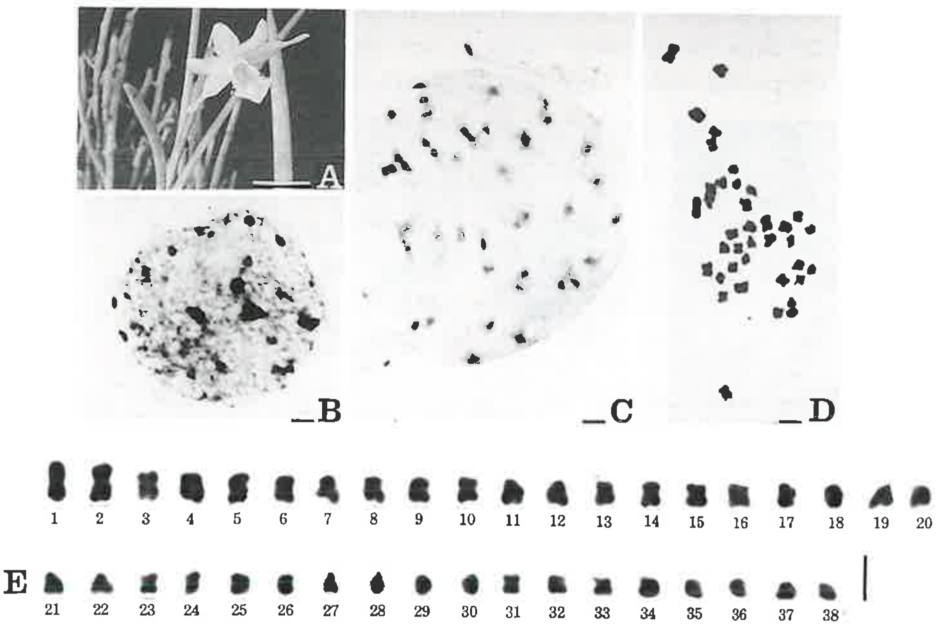

Fig. 74. *Dendrobium equitans*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

and mitotic prophase were found to be similar to those of *D. clavator* described above (p. 78). Small chromatin blocks which varied in size from 0.3–0.6 μm in diameter were slightly larger than those of *D. clavator*. Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 1.8–0.8 μm in length, and the positions of their centromeres were either median or submedian; six chromosomes (Nos. 11, 12, 21, 22, 27, 28) were submedian and the other 32 were median. Among the 38 chromosomes, two (Nos. 1, 2) were distinct; the 1st one was about 1.8 μm in length and the arm ratio was 1.0 and the 2nd one was about 1.7 μm in length and the arm ratio was 1.1.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

IV Subgenus Xerobium

1. Section Aporum

1) *Dendrobium acinaciforme* Roxb., 2n=38, Tables 1 and 76, Fig. 75.

Two plants were obtained from Thailand. External morphological characteristics were as follows: Stems were about 25 cm in length with flesh leaves distichously from the base to the middle. Apical part of the stem lacked any leaf. Leaves were falcate, lanceolate with acute apex. Flowers were solitary and yellowish white in color. Thus, this description of the materials follows Kränzlin (1910).

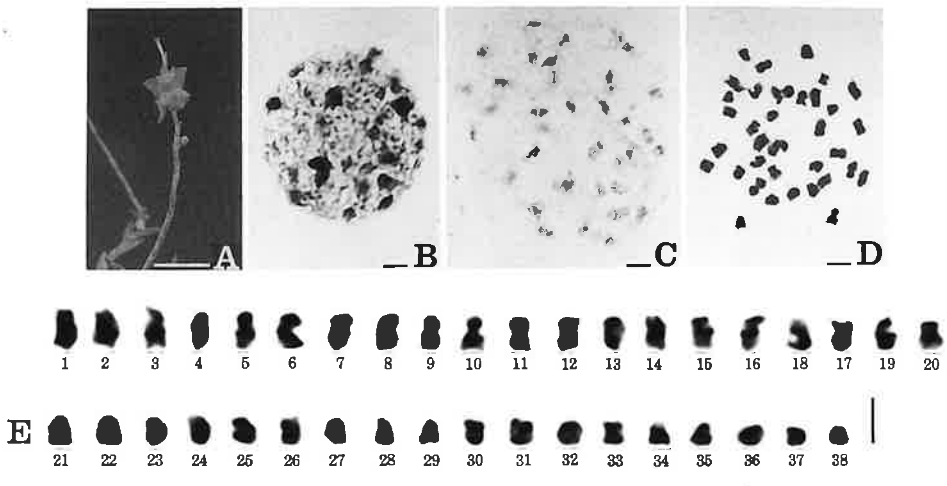

Fig. 75. *Dendrobium acinaciforme*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

The chromosone number of the two plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1982). The chromosomes at resting stage formed many chromomeric granules and fibrous threads scattered in the nuclear space. Many spherical, small, chromatin blocks which varied in size from 0.5–1.5 μm in diameter were observed in the resting nuclei. Some of the blocks aggregated into large blocks which were observed as the chromocentral aggregation. Approximately 20 blocks per nucleus were observed. Some chromosomes at mitotic prophase had early condensed segments in the proximal as well as in the interstitial regions, but another chromosomes did not have any. Thus, the karyotype of the resting chromosomes was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.7 μm to the shortest one of 0.8 μm, and the positions of their centromeres were either median or submedian. Among the 38 chromosomes 18 (Nos. 3–6, 13–16, 21–30) were submedian and the other 20 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2) *Dendrobium distichum* Reichb. f., 2n=38, Tables 1 and 77, Fig. 76.

Two plants were obtained from the Philippines. External morphological characteristics were as follows: Vegetative morphology was similar to that of *D. acinaciforme* but leafy at the shoot apex. Leaves were about 2 cm in length and 0.6 cm in width. Many flowers bore from the apex of the stem and were about 0.7 cm across. Flower color was reddish brown. Thus, this description of the materials follows Kränzlin (1910).

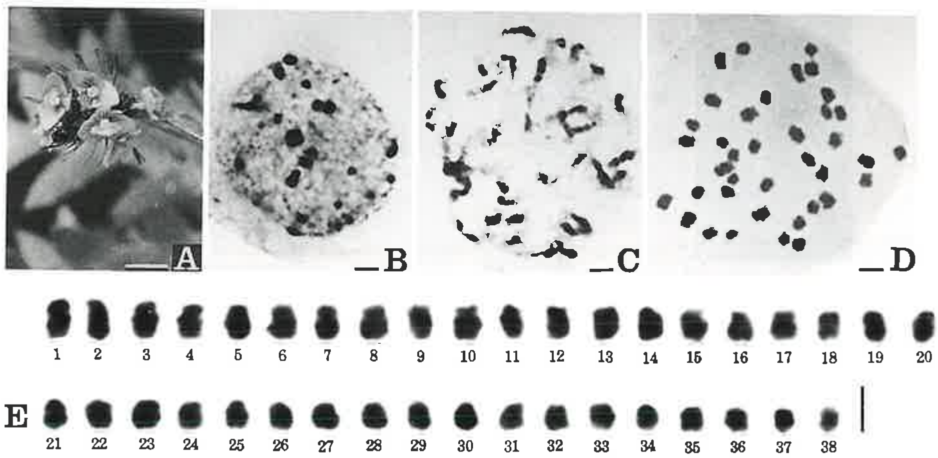

Fig. 76. *Dendrobium distichum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

The chromosome number of the two plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. acinaciforme* described above (p. 81). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.7 μm to the shortest one of 1.0 μm, and the positions of their centromeres were either median, submedian, or subterminal; among the 38 chromosomes, one (No. 4) were subterminal, 17 (Nos. 3, 9–14, 25–34) were submedian and the other 20 were median.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

3) *Dendrobium leonis* Reichb. f., 2n = 38, Tables 1 and 78, Fig. 77.

Three plants were obtained from Thailand. External morphological characteristics were as follows: Vegetative morphology was similar to that of *D. acinaciforme* and leafy at the shoot apex. Leaves were 2.5 cm in length and 1 cm in width. Flowers were usually solitary and 2 cm in length. Flower color was dull gold with purple lines at the base. Thus, this description of the materials follows Kränzlin (1910).

The chromosome number of the three plants was 2n = 38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. acinaciforme* described above (p. 81). Thus,

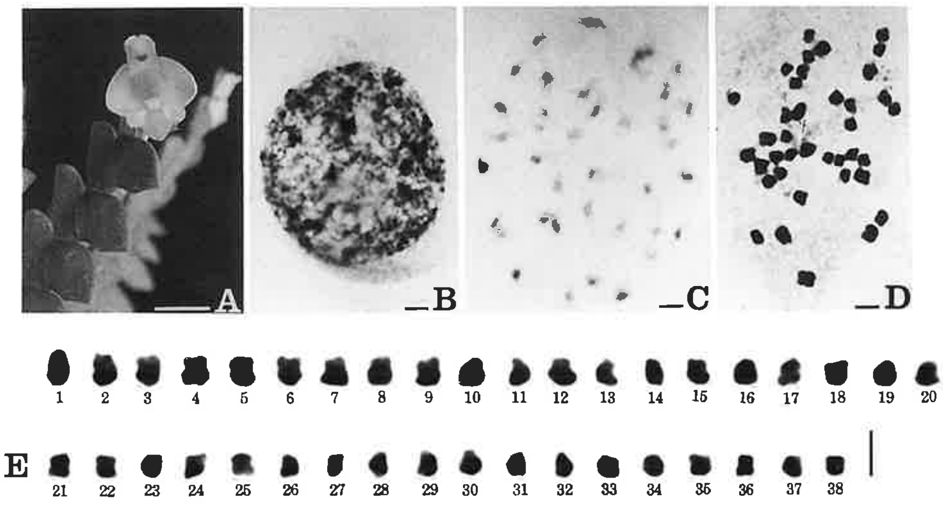

Fig. 77. *Dendrobium leonis,* 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.5 μm to the shortest one of 1.0 μm, and the positions of their centromeres were either median or submedian; among the 38 chromosomes, 12 (Nos. 11–16, 27–32) were submedian and the other 26 were median. The mitotic metaphase chromosomes of this species were smaller than the others described in this paper.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4) *Dendrobium mannii* Ridl., 2n=38, Tables 1 and 79, Fig. 78.

Two plants were obtained from Malaysia. External morphological characteristics were as follows: Vegetative morphology was similar to that of *D. acinaciforme* but leafy at the shoot apex. Leaves were about 2 cm in length. Flowers arose from leafless, old stem and was white in color with yellow blotch on the middle of the lip. Thus, this description of the materials follows Kränzlin (1910).

The chromosome number of the two plants was 2n=38, a new report to this species. Chromosome morphology at resting and mitotic prophase were similar to those of *D. leonis* described above (p. 83). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase ranged from 2.1–0.9 μm in length, and the posi-

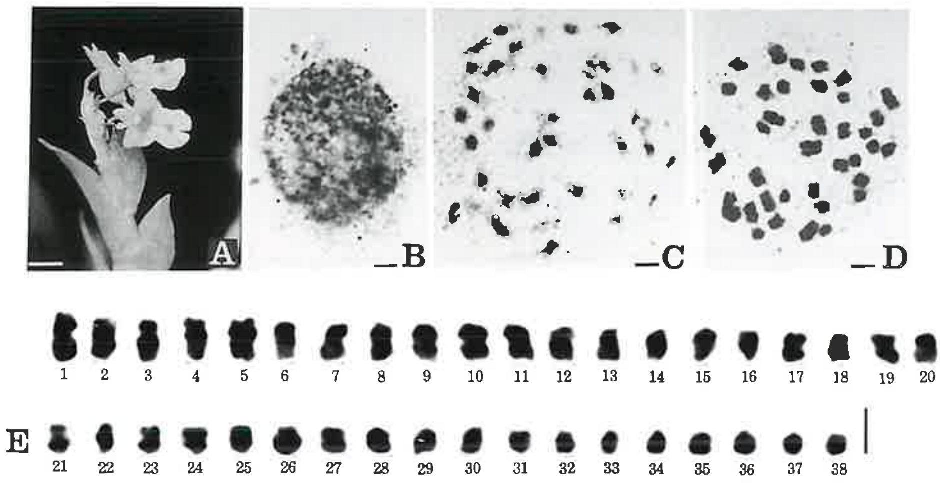

Fig. 78. *Dendrobium mannii*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

tions of their centromeres were either median or submedian; 11 (Nos. 4–6, 13–16, 31–34) were submedian and the other 27 were median. Among the 38 chromosomes, five (Nos. 1–5) were longer than the other chromosomes. The longest one was about 2.1 μm in length, and the arm ratio was 1.3. The 2nd and the 3rd longest ones were 1.9 μm in length, and their arm ratios were 1.1 and 1.7, respectively. The 4th and the 5th longest ones were 1.9 μm in length, and their arm ratios were 2.8.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

5) *Dendrobium subulatum* (Bl.) Lindl., 2n=38, Tables 1 and 80, Fig. 79.

Two plants were obtained from Malaysia. External morphological characteristics were as follows: Stems were thin throughout and the upper, leafless part was short. Leaves were about 1.5 cm in length and somewhat terete. The base of the leaf was not overlapping. Flowers were greenish yellow in color and about 0.8 cm in length. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the two plants was 2n = 38, a new report to this species. Chromosome morphology at resting and mitotic prophase were similar to those of *D. acinaciforme* described above (p. 81). Thus, the karyotype at resting stage was considered to belong to an intermediate category between the complex chromocenter type and the simple chromocenter type proposed by Tanaka (1971).

The chromosomes at mitotic metaphase showed a gradual decrease in length ranging from the longest one of 1.4 μm to the shortest one of 0.8 μm, and the positions of their centromeres were either median or submedian; 14 (Nos. 1, 2, 9–14, 21–24, 29, 30) were

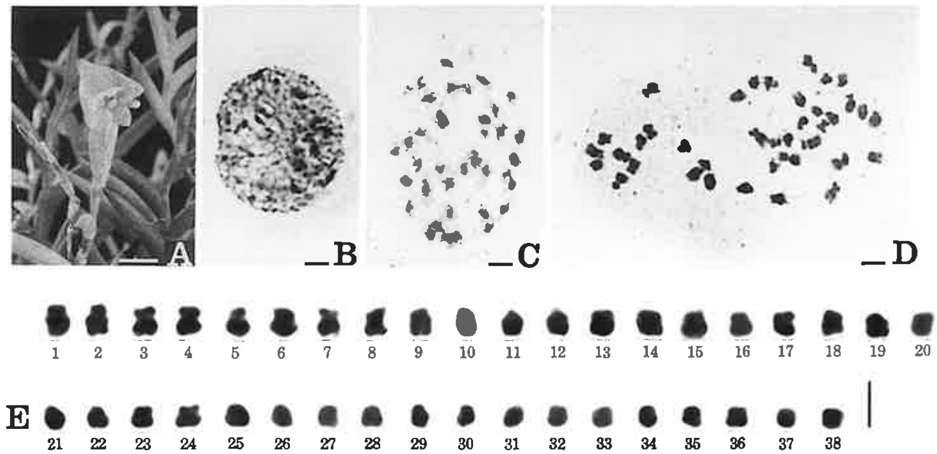

Fig. 79. *Dendrobium subulatum,* 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 0.5 cm in A and 2.0μm in B–E).

submedian and the other 24 were median.

According to the definition of the karyotype porposed by Tanaka (1980), this species showed a homogeneous and gradual karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

2. Section Grastidium

1) *Dendrobium bambusiaefolium* Par. et Reichb. f., 2n=38, Tables 1 and 81, Fig. 80.

Two plants were obtained from Thailand. External morphological characteristics were as follows: Stems were slender and stiff, resembled to a small bamboo. Flowers arose from nodes of the stem and bloomed only for a day. Flower color was green. Thus, this description of the materials follows Kränzlin (1910).

The chromosome number of the two plants was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1982). Chromosome morphology at resting and mitotic prophase were similar to those of *D. crumenatum* described above (p. 79). Thus, the karyotype at resting stage was considered to belong to the prochromosome type according to Tanaka's classification (1971).

The chromosomes at mitotic metaphase were conspicuous; four small chromosomes (Nos. 35–38) had the centromeres at the distal. The other 34 chromosomes showed a gradual decrease in length ranging from the longest one of 1.9 μm to the shortest one of 0.8 μm, and the positions of their centromeres were almost median, except for two (Nos. 4, 5) submedian chromosomes.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmet-

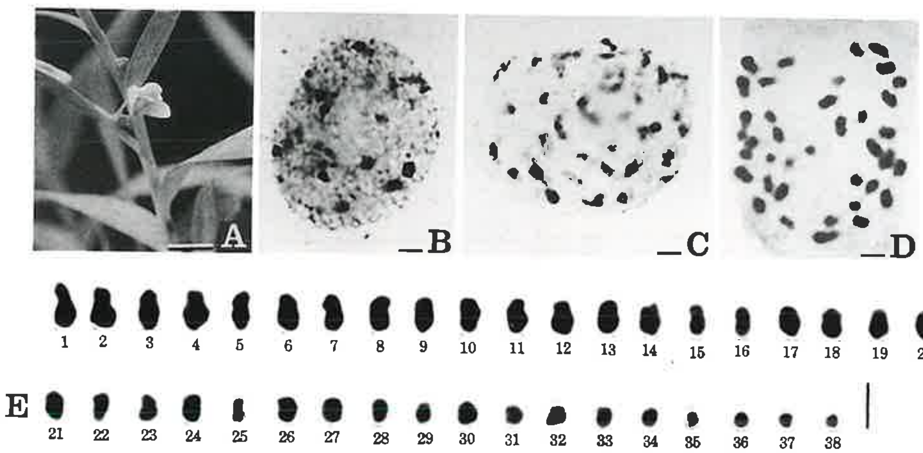

Fig. 80. *Dendrobium bambusiaefolium*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

ric karyotype due to arm ratio.

3. Section Dichopus

1) *Dendrobium insigne* Reichb. f., 2n=36+2f, Tables 1 and 82, Fig. 81.

Four plants were obtained from Papua New Guinea. External morphological characteristics were as follows: Stems were terete, stiff and about 60 cm in height. Flowers were golden yellow in color with many reddish orange spots. Sepals and petals curved forward. Thus, this description of the materials follows Schlechter (1912).

The chromosome number of the four plants was 2n = 36 + 2f at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. crumenatum* described above (p. 79). The chromatin blocks which varied in size from 0.8–2.5 μm in diameter were slightly larger than those of *D. crumenatum*. Furthermore, at mitotic prophase, two early condensed chromosomes were observed in each nucleus. Thus, the karyotype at resting stage was considered to belong to the prochromosome type according to Tanaka's classification (1971).

The chromosomes at mitotic metaphase were conspicuous and the two longest and two shortest chromosomes were distinct; the first and the second chromosomes were 2.4 μm in length, and their arm ratios were 1.7. The positions of the centromeres of these two chromosomes were median. The 37th and the 38th chromosomes were extremely short, about 0.6 μm in length, and their arm ratios were both 1.0. These two chromosomes might be accessary chromosomes. Thus, the chromosome number of this species seemed to be 2n = 36+2f, which was the conspicuous number in this paper.

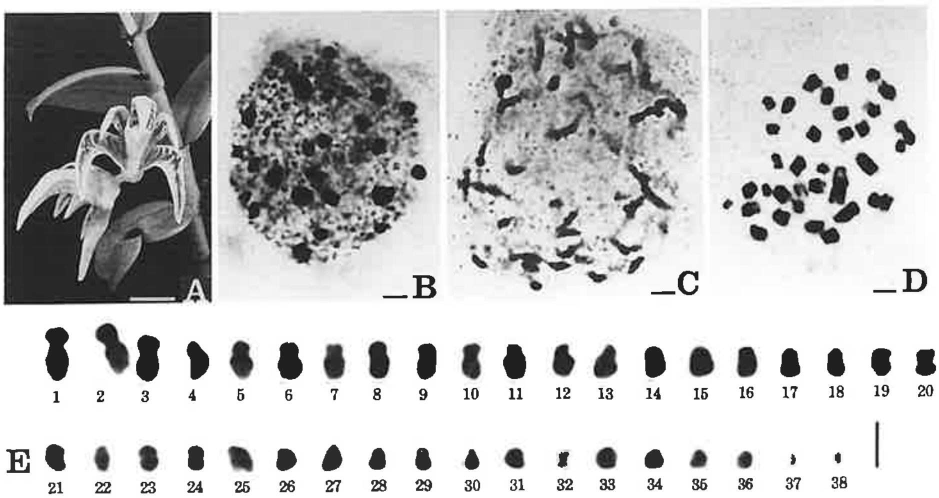

Fig. 81. *Dendrobium insigne,* 2n = 36 + 2f. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

4. Section Monanthos

1) *Dendrobium agrostophyllum* F. Muell., 2n=38, Tables 1 and 83, Fig. 82.

A plant was obtained from Australia. External morphological characteristics were as follows: Stems were cylindrical and about 60 cm in length. Leaves were narrow ovate and herbaceous. Flowers were cup-shaped and about 2.5 cm across. Flower color was yellow. Thus, this description of the material follows Kränzlin (1910).

The chromosome number of the plant was 2n=38 at mitotic metaphase and confirmed the previous report (Hashimoto 1981). Chromosome morphology at resting and mitotic prophase were similar to those of *D. crumenatum* described above (p. 79). Thus, the karyotype at resting stage was considered to belong to the prochromosome type according to Tanaka's classification (1971).

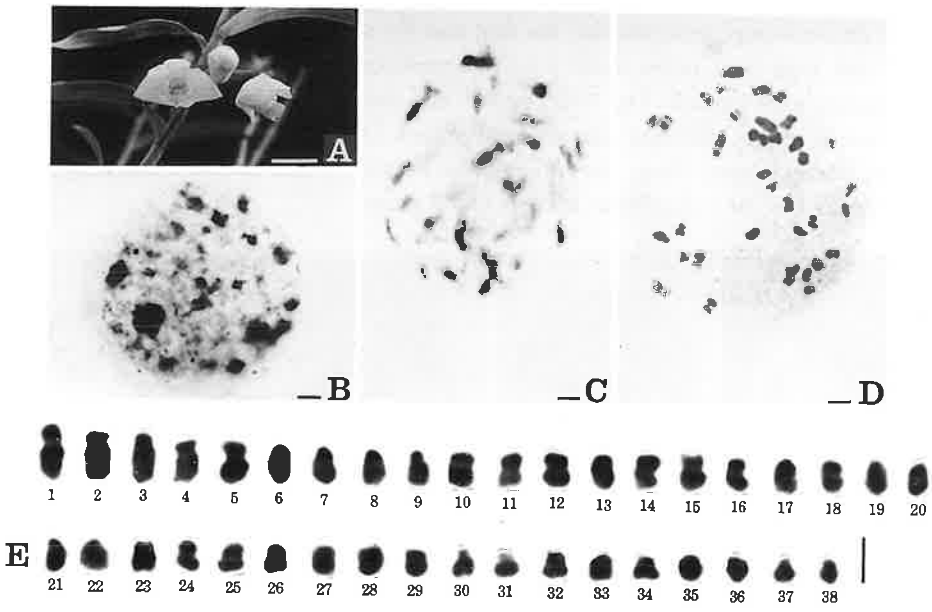

Fig. 82. *Dendrobium agrostophyllum*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D and E, chromosomes at mitotic metaphase. (Bar indicates 1.0 cm in A and 2.0μm in B–E).

The chromosomes at mitotic metaphase ranged from 2.2–1.0 μm in length, and the positions of their centromeres were either median or submedian; ten (Nos. 1–4, 6, 9, 21, 22, 30, 31) were submedian and the other 28 were median chromosomes. Among the 38 chromosomes, three longest chromosomes were distinct; the 1st one was 2.2 μm in length and the arm ratio was 2.1. The 2nd and the 3rd ones were about 2.1 μm in length, and their arm ratios were 2.5. The positions of the centromeres of these three chromosomes were all submedian.

According to the definition of the karyotype proposed by Tanaka (1980), this species showed a heterogeneous and bimodal karyotype due to chromosome length and a symmetric karyotype due to arm ratio.

Discussion

I. Karyomorphological characteristics of *Dendrobium*

1. Chromosome number

The chromosome numbers of 82 taxa in 24 sections in four subgenera in the genus *Dendrobium* studied were shown in Table 1. The chromosome numbers of six taxa, *D. albosanguineum* 2n=40, *D. williamsianum* 2n=38, *D. uniflorum* 2n=40, *D. clavator* 2n=38, *D. mannii* 2n=38 and *D. subulatum* 2n=38, were recorded here for the first time. The chromosome numbers of 27 taxa reported as the author's previous original counts and 15 taxa redocumented by the author (Hashimoto 1981, 1982) were re-confirmed.

The data obtained in this study showed that a taxon had the somatic chromosome number of 36, 60 taxa had the somatic chromosome number of 38, 17 taxa had the somatic chromosome number of 40, and the other four had somatic chromosome numbers of 36+2f, 39, 40+1f, and 40+2f, respectively. Excepting these chromosome numbers of 2n=36+2f, 39, 40+1f and 40+2f occurred only in horticultural or natural variants, the basic numbers of *Dendrobium* could be x=18, 19 and 20.

The chromosome numbers of 24 representatives of the Schlechter's 41 sections were as follows: The basic chromosome number of x=18 was found in two sections, Latourea (one taxon) and Dichopus (one taxon). However, the other taxa in the section Latourea showed x=19 and x=20, respectively. The basic chromosome number of x=19 was found in 19 sections; all taxa in 14 sections, namely Desmotrichum (2 taxa), Rhizobium (6 taxa), Dendrocoryne (4 taxa), Calyptochilus (1 taxon), Cuthbertosonia (1 taxon), Oxyglossum (1 taxon), Brachyanthe (2 taxa), Phalaenanthe (5 taxa), Eleutheroglossum (1 taxon), Ceratobium (2 taxa), Rhopalanthe (3 taxa), Aporum (5 taxa), Grastidium (1 taxon) and Monanthos (1 taxon) had x=19, while the other five sections carried resulting two or more basic numbers; sect. Callista showed x=19 (2 taxa) and x=20 (1 taxon), sect. Eugenanthe showed x=19 (15 taxa) and x=20 (1 taxon), sect. Pedilonum showed x=19 (4 taxa) and x=20 (3 taxa), sect. Oxygenianthe showed x=19 (4 taxa) and x=20 (1 taxon), sect. Latourea showed x=18 (1 taxon), x=19 (1 taxon) and x=20 (1 taxon). And the other four sections carried one basic number of x=20.

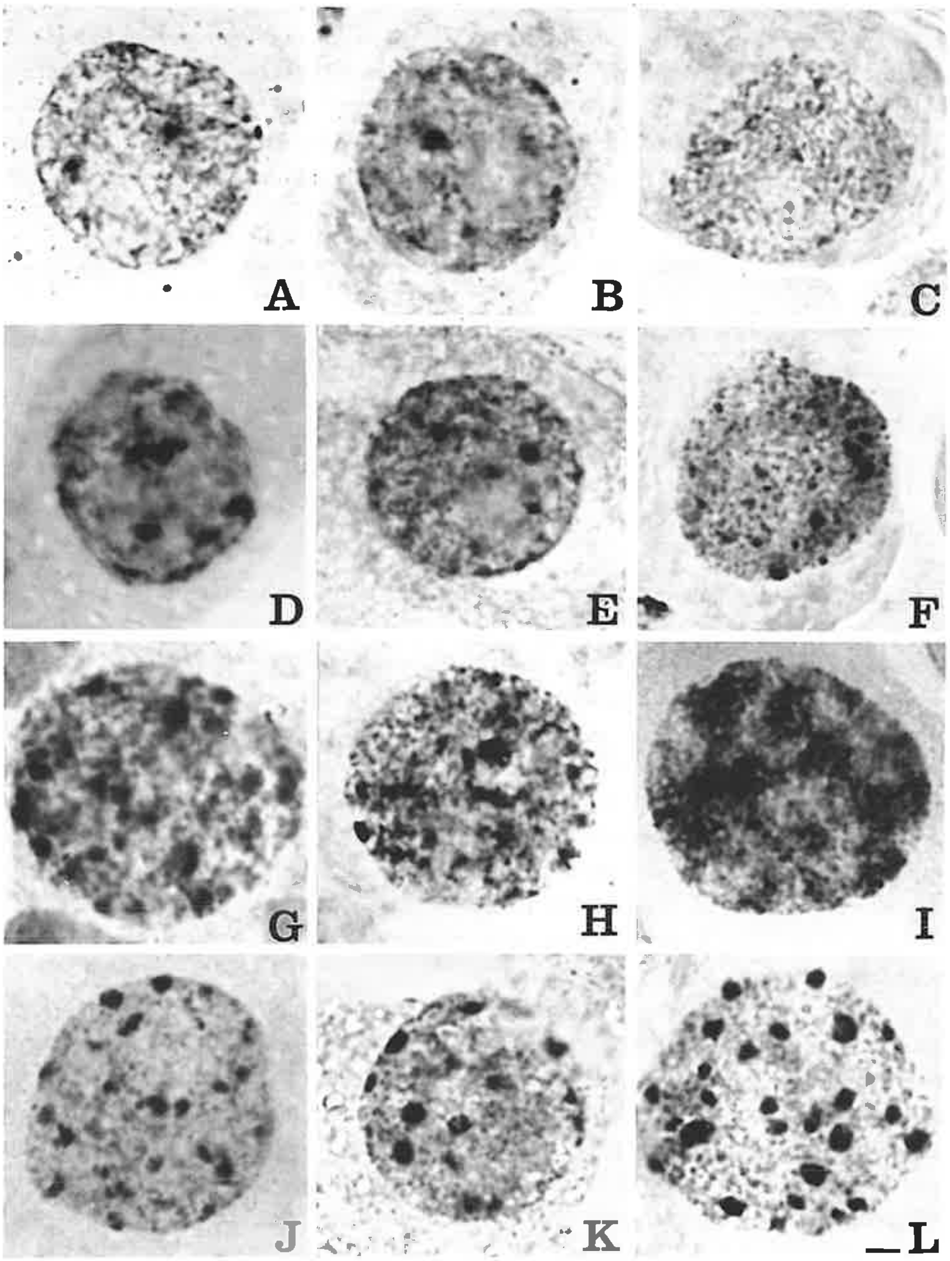

Fig. 83. Four types of the shapes of chromosomes at resting stage in *Dendrobium*. A, B, C; simple chromocenter type: A, *D. falconeri*, B, *D. findleyanum*, C, *D. quinquecostatum*. D,E,F; intermediate type: D, *D. coelogyne*, E, *D. aggregátum* var. *majus*, F, *D. albo-sanguineum*. G,H,I; complex chromocenter type: G, *D. beckleri*, H, *D. rigidum*, I, *D. cymbidioides*. J,K,L; prochromosome type: J, *D. finisterrae*, K, *D. miyakei*, L, *D. insigne*. (Bar indicates 2.0μm in length in A–L).

Thus, among the members of the sections two groupings, the taxa showing single basic chromosome number and the taxa showing different basic numbers, were given. The result suggests that the examination of the chromosome numbers are valid for clarification of the phylogenetic classification and species relationships in the genus *Dendrobium*.

2. Morphology of chromosomes at resting stage

Chromosomes in the resting nuclei of 82 taxa of *Dendrobium* were found to be highly variable amongst the taxa. There were four clearly different karyotype according to Tanaka's classification (1971): The simple chromocenter type, the complex chromocenter type, the intermediate type between those two types and the prochromosome type (Fig. 83).

The simple chromocenter type was observed in three out of 16 taxa of sect. Eugenanthe and one taxon of sect. Oxyglossum. The complex chromocenter type was observed in all taxa of sect. Desmotrichum (2 taxa) and sect. Platycaulon (1 taxon) and in four taxa of sect. Rhizobium (6 taxa) and two taxa of sect. Sarcopodium (4 taxa). The intermediate type between the simple chromocenter type and the complex chromocenter type was observed in all taxa of sect. Dendrocoryne (4 taxa), Callista (6 taxa), Calyptochilus (1 taxon), Cuthbertosonia (1 taxon), Brachyanthe (2 taxa), Stachyobium (3 taxa), Phalaenanthe (5 taxa), Ceratobium (2 taxa), Distichophyllum (1 taxon), Oxygenianthe (5 taxa) and Aporum (5 taxa), and in two taxa of sect. Sarcopodium (4 taxa), ten taxa of sect. Eugenanthe (16 taxa), two taxa of sect. Pedilonum (7 taxa) and two taxa of sect. Rhopalanthe (3 taxa). The prochromosome type was observed in all taxa of sect. Latourea (3 taxa), Eleutheroglossum (1 taxon), Grastidium (1 taxon), Dichopus (1 taxon) and Monanthos (1 taxon) and in two taxa of sect. Rhizobium (6 taxa), three taxa of sect. Eugenanthe (16 taxa), four taxa of sect. Pedilonum (7 taxa) and one taxon of sect. Rhopalanthe (3 taxa).

Thus, among the members of every sections two groups, a group with the taxa showing the single type of resting nuclei and the other group with the taxa showing different type of nuclei, could be divided. The result suggests that the examination of the resting nuclei is valid for clarification of the phylogenetic classification and species relationships in the genus *Dendrobium*.

3. Morphology of chromosomes at mitotic prophase

The morphology of the chromosomes at mitotic prophase was found to be corresponded to that of resting nuclei. That is, the prophase chromosomes which showed the simple chromocenter type at resting stage had heterochromatic segments in the proximal regions of some chromosomes of the complement. Those heterochromatic segments transformed gradually into partially aggregated distal segments showed a gradual transition from heterochromatin to euchromatin. The prophase chromosomes which showed the complex chromocenter type at resting stage had heterochromatic segments in the proximal regions as well as in the interstitial and distal regions of most chromosomes of the complement. The prophase chromosomes which showed an intermediate type between the complex chromocenter type and the simple chromocenter type at resting stage had the heterochromatic segments in the proximal regions as well as in the interstitial and distal regions of some chromosomes of the complement. The prophase chromosomes which showed the prochromosome type at resting stage had the heterochromatic segments which transformed abruptly into euchromatic segments located in the distal regions.

4. Morphology of chromosomes at mitotic metaphase

Among 82 taxa in 24 sections studied, 38 taxa in 18 sections showed the bimodal karyotype according to chromosome length, while the other 44 taxa in 17 sections showed the gradual karyotype according to alignment of chromosome length. The bimodal karyotype were found in all taxa of sect. Eleutheroglossum (1 taxon), sect.Ceratobium (2 taxa), sect. Distichophyllum (1 taxon), sect. Oxygenianthe (5 taxa), sect. Grastidium (1 taxon), sect. Dichopus (1 taxon) and sect. Monanthos (1 taxon) and in two taxa of sect. Rhizobium (6 taxa), two taxa of sect. Sarcopodium (4 taxa), two taxa of sect. Dendrocoryne (4 taxa), two taxa of sect. Latourea (3 taxa), one taxon of sect. Brachyanthe (5 taxa), three taxa of sect. Phalaenanthe (5 taxa), one taxon of sect. Rhopalanthe (3 taxa) and one taxon of sect. Aporum (5 taxa).

The major-sized chromosomes, which have been noted by several authors (Vajrabhaya

Fig. 84. Three karyotypes of the chromosomes at mitotic metaphase in *Dendrobium*. A; homogeneous, gradual and symmetric karyotype in *D. wardianum*. B; heterogeneous, bimodal and symmetric karyotype with four quite long chromosomes in *D. ramosii*. C; heterogeneous, bimodal and intermediate karyotype with eight quite short chromosomes in *D. cymbidioides*. (Bars indicate 2.0μm in length).

& Randolph 1960, Jones 1963, Wilfret & Kamemoto 1971, Jones *et al.* 1982), were observed in some of the bimodal karyotype. They varied in number from one showed in *D. canaliculatum* (Fig. 63) to ten showed in *D. scabrilingue* (Fig. 70) in their chromosome complements. On the other hand, extremely small-sized chromosomes were observed in some of the bimodal karyotype. They varied in number from 4 to 10 in their chromosome complements. Such as, there were two different karyotypes in bimodal karyotype (Fig. 84). Especially, two taxa of sect. Sarcopodium, three taxa of sect. Phalaenanthe, three taxa of sect. Latourea and two taxa of sect. Pedilonum had notably large chromosomes in their complements.

A comparison of average chromosome lengths was carried out in *Dendrobium*. As the result, the average chromosome lengths of these 82 taxa were calculated as 1.39 μm. Average length of 1.95 μm for *D. scabrilingue,* sect. Oxygenianthe, 1.76 μm for *D. superbum* var. *album*, sect. Eugenanthe, 1.75 μm for *D. phlox*, sect. Calyptochilus, were obviously longer than that of the other taxa. In contrast, average length of 1.03 μm for *D. equitans,* sect. Rhopalanthe, 1.05 μm for *D. subulatum,* sect. Aporum, 1.09 μm for *D. leonis*, sect. Aporum, were obviously shorter than that of the other taxa. The chromosomes of three sections, Calyptochilus, Oxygenianthe and Pedilonum, were longer than those of the other sections, and the five sections, Aporum, Grastidium, Stachyobium, Dendrocoryne and Oxyglossum, were shorter than those of the other sections.

Symmetry of the mitotic metaphase chromosomes due to arm ratio were examined in *Dendrobium*. Among the 82 taxa studied, 80 taxa showed the symmetric karyotype and the other two taxa showed intermediate karyotype between the symmetric and the asymmetric karyotype due to arm ratio (Fig. 84).

II. Cytotaxonomical investigations in *Dendrobium*

Systematic classification of the genus *Dendrobium* was first studied by Kränzlin (1910). He divided 492 taxa into eight sections and 27 subsections and also listed five closely related genera; *i.e. Callista, Inobulbon, Sarcopodium, Diplocaulobium* and *Desmotrichum*. Then, Schlechter (1912) divided 256 taxa of *Dendrobium* into 41 sections, four subgenera. Schlechter's system placed five closely related genera in sectional ranks and also four subsections of Kränzlin's system in sectional ranks resulting additional 24 sections. Thus, the Schlechter's classification of the genus *Dendrobium* is widely adopted today. Of course, there are some objection to his classification which could change combinations and ranks of sections to certain genera. Recently, Brieger (1981) has divided subtribe Dendrobiinae into 44 genera and 44 sections, including some neighbouring genera, *i.e. Eria.*

It is necessary to revise the taxa of *Dendrobium* which consisted of over 1,000 taxa and induced heavily, morphological complex. Thus, more satisfied classification of the genus *Dendrobium* is lacking today. The karyomorphological relationships among the 82 taxa in 24 sections in four subgenera following the Schlechter's system were discussed as follows:

1. Subgenus Athecebium

(1) Section Desmotrichum

The chromosome numbers of the two taxa studied were 2n=38, and the karyotypes of resting stage were the complex chromocenter type. The chromosomes of mitotic metaphasc showed the homogeneous and gradual karyotype due to chromosome length and the symmetric karyotype due to arm ratio. Following the resting nuclei in the Orchidaceae mainly classified into five types by Tanaka (1971), the chromosomes at resting stage of this section were determined: They were conspicuous, because of most of the 82 taxa studied showed the intermediate type between the simple chromocenter type and the complex chromocenter type.

Thus, the author's cytotaxonomic study supported that the taxonomic treatment by Kränzlin (1910) and Brieger (1981) was reasonable for this section.

(2) Section Rhizobium

The chromosome numbers of the six taxa studied were found to be 2n=38. The morphology of chromosomes at resting stage and the mitotic metaphase of these taxa were different from each other and could be divided into four types. Namely, three taxa, *D. beckleri, D. pugioniforme* and *D. rigidum,* had the homogeneous and gradual karyotype due to chromosome length and the symmetric karyotype due to arm ratio. One taxon, *D. cucumerinum,* had the complex chromocenter type at resting stage and the heterogeneous, bimodal and symmetric karyotype at mitotic metaphase. Two taxa, *D. linguiforme* and *D. wassellii,* had the prochromosome type at resting stage commonly but the former taxon had the heterogeneous and bimodal karyotype while the latter taxon had the homogeneous and gradual karyotype due to chromosome length at mitotic metaphase. Degree of symmetry of these two taxa was categorized to be of highly symmetric types.

Thus, the six taxa were cytotaxonomically divided into four types and this results supported partially Brieger's system (1981).

(3) Section Sarcopodium

The chromosome numbers of the four taxa studied were 2n=40 and could be grouped into two types by the studies of morphological characteristics of resting stage, prophase and metaphase chromosomes. Namely, the chromosomes of the two taxa, *D. acuminatum* and *D. cymbidioides,* were the complex chromocenter type at resting stage and the heterogeneous and bimodal karyotype due to chromosome length and the symmetric karyotype due to arm ratio at mitotic metaphase. The chromosomes of the other two taxa, *D. coelogyne* and *D. nakaharaei,* were the intermediate type between the simple chromocenter type and the complex chromocenter type at resting stage and also at mitotic metaphase the homogeneous and gradual karyotype due to chromosome length and the symmetric karyotype due to arm ratio.

Thus, those four taxa were divided into two groups and had conspicuous karyotypes in the genus *Dendrobium*. Accordingly the treatment as two different genera of this section proposed by Brieger (1981) was supported cytotaxonomically.

(4) Section Dendrocoryne

The chromosome numbers of the four taxa studied were 2n=38, and the karyotypes at resting stage were all intermediate type between the simple chromocenter type and the complex chromocenter type. However, chromosomes at mitotic metaphase could be divided into two groups: The first group was characterized by the homogeneous and gradual karyotype due to chromosome length and the symmetric karyotype due to arm ratio shown in two taxa, *D. aemulum* and *D. ruppianum*. The second group was characterized by the heterogeneous and bimodal karyotype due to chromosome length and the symmetric karyotype due to arm ratio shown in the other two taxa, *D. monophyllum* and *D. schneiderae*.

Thus, the karyomorphological differences in the sect. Dendrocoryne were not so large as those of the three sections mentioned above. Accordingly the treatment as two separate sections proposed by Dockrill (1965) was supported cytotaxonomically.

(5) Section Latourea

The chromosome numbers of the three taxa studied were; 2n=36 for *D. engae*, 38 for *D. macrophyllum* and 40 for *D. finisterrae*, and those chromosomes at resting stage were uniformly prochromosome type. The karyotypes at mitotic metaphase of these three taxa divided into two groups: *D. engae* and *D. finisterrae* were characterized by heterogeneous, bimodal and symmetric karyotype and *D. macrophyllum* was characterized by homogeneous, gradual and symmetric karyotype. The chromosome number of *D. finisterrae* was previously reported as 2n=38+2B (Jones *et al.* 1982) but in the materials used in this paper any B chromosome was not confirmed. The chromosome number of 2n=36 was conspicuous and determined only in other two taxa, *D. engae* of sect. Latourea and *D. insigne* of sect. Dichopus.

Since those three taxa were cytotaxonomically different from each other, they could be suitable to be divided as different genera.

(6) Section Callista

The chromosome numbers of the six taxa studied were; 2n=38 for *D. aggregatum* var. *majus* and *D. chrysotoxum*, 2n=40+1f for *D. densiflorum*, 2n=40+2f for *D. dixanthum*, and 2n=40 for *D. palpebrae* and *D. sulcatum*. Chromosome morphology at resting stage of these six taxa were considered to be the intermediate type between the simple chromocenter type and the complex chromocenter type proposed by Tanaka (1971). The karyotypes at mitotic metaphase were divided into two different types: The first type for five taxa, *D. aggregatum* var. *majus* and *D. chrysotoxum* carrying 2n=38, *D. sulcatum* carrying 2n=40, *D. densiflorum* carrying $2n = 40 + 1f$ and *D. dixanthum* carrying $2n = 40 + 2f$, showed homogeneous and gradual karyotype due to chromosome length and the symmetric karyotype due to arm ratio, the second type for *D. palpebrae* carrying $2n = 40$ showed heterogeneous, bimodal and symmetric karyotype.

Thus, there were karyomorphologically some different taxa within this section. Many more data are necessary to justify the classification of this section and to clarify species relationships.

2. Subgenus Eu-Dendrobium

(1) Section Eugenanthe

The chromosome number of *D. albo-sanguineum* of this section was $2n = 40$ and of the other 15 taxa was $2n = 38$. According to the morphology of the chromosomes at resting stage and mitotic metaphase, 15 taxa were divided into four groups: The first group for eight taxa, *D. brymerianum, D. candidum, D. crassinode, D. friedricksianum, D. heterocarpum, D. monile, D. moschatum* and *D. wardianum,* showed the intermediate type at resting stage and homogeneous, gradual and symmetric karyotypes at mitotic metaphase. The second group for three taxa, *D. falconeri, D. findleyanum* and *D. nobile,* showed the simple chromocenter type at resting stage and homogeneous, gradual and symmetric karyotypes at mitotic metaphase. The third group for one taxon, *D. tortile* showed the intermediate type at resting stage and heterogeneous, bimodal and symmetric karyotypes at mitotic metaphase. The fourth group for the other three taxa, *D. parishii, D. pierardii* and *D. superbum* var.*album,* showed the prochromosome type at resting stage and heterogeneous, bimodal and symmetric karyotypes at mitotic metaphase.

Thus, there were karyomorphologically different taxa within this section. Many more data are necessary to justify the classification of this section and to clarify species relationships.

(2) Section Pedilonum

The chromosome numbers of three taxa, *D. amethystoglossum, D. ramosii* and *D. secundum,* were $2n = 40$ and those of the other four taxa, *D. bullenianum, D. capituliflorum, D. miyakei* and *D. smilliae,* were $2n = 38$. According to the morphology of the chromosomes at resting stage and mitotic metaphase, these seven taxa were divided into five groups: Two taxa carrying $2n = 40$, *D. amethystoglossum* and *D. secundum,* showed the prochromosome type at resting stage and heterogeneous, bimodal and symmetric karyotype at mitotic metaphase. One taxon carrying $2n = 40$, *D. ramosii*, showed the complex chromocenter type at resting stage and heterogeneous, bimodal and symmetric karyotype at mitotic metaphase. Two taxa carrying $2n = 38$, *D. bullenianum* and *D. miyakei,* showed the prochromosome type at resting stage and heterogeneous, bimodal and symmetric karyotypes at mitotic metaphase. One taxon carrying $2n = 38$, *D. capituliflorum*, showed the intermediate type at resting stage and homogeneous, gradual and symmetric karyotypes at mitotic metaphase. The last one taxon carrying 2n=38, *D. smilliae*, showed the intermediate type at resting stage and heterogeneous, bimodal and symmetric karyotypes at mitotic metaphase.

Thus, there were karyomorphologically different taxa within this section. Many more data are necessary to justify the classification of this section and to clarify species relationships.

(3) Section Oxygenianthe

This section was formerly named as section Nigrohirsutae. The chromosome numbers of four of the five taxa investigated were 2n=38 and that of the other taxon, *D. sanderae,* was 2n = 40. The average length of the chromosomes of this section were longer than those of others.

The morphology of the chromosomes at resting stage in all taxa of this section studied was classified into the intermediate type between the simple chromocenter type and the complex chromocenter type. The five taxa indicated different morphology of the chromosomes at mitotic metaphase: Four taxa carrying 2n = 38, *D. formosum* var. *giganteum, D. infundibulum, D. scabrilingue* and *D. sutepense*, showed the heterogeneous, bimodal and symmetric karyotypes. The one taxon carrying 2n = 40, *D. sanderae*, showed the heterogeneous, bimodal and symmetric karyotypes.

Thus, there were karyomorphologically different taxa within this section. Many more data are necessary to justify the classification of this section and to clarify species relationships.

(4) Other sections

Among the other ten sections of this subgenus studied, three sections, Platycaulon (one taxon), Stachyobium (three taxa) and Distichophyllum (one taxon), had the chromosome number of 2n = 40, while the seven sections, Calyptochilus (one taxon), Cuthbertosonia (one taxon), Oxyglossum (one taxon), Brachyanthe (two taxa), Phalaenanthe (one taxon), Eleutheroglossum (one taxon) and Ceratobium (two taxa), had the chromosome number of 2n=38.

Among the 17 taxa of these ten sections, two taxa in two sections showed conspicuous chromosome morphology differed from those of the other 15 taxa. *Dendrobium platygastrium* of sect. Platycaulon carrying the chromosome number of 2n=40 showed the complex chromocenter type at resting stage and the homogeneous, gradual and symmetric karyotype at mitotic metaphase. *Dendrobium canaliculatum* of sect. Eleutheroglossum carrying the chromosome number of 2n = 38 showed the prochromosome type at resting stage and the heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Thus, the karyomorphological studies suggested that these two sections could be recombined into three sections, Eugenanthe, Pedilonum and Oxygenianthe in this subgenus. The other eight sections, Calyptochilus, Cuthbertosonia, Oxyglossum, Brachyanthe, Stachyobium, Phalaenanthe, Ceratobium and Distichophyllum in this subgenus showed consistence of the taxa in each sections. Schlechter's system (1912) was cytotaxonomically supported.

3. Subgenera Rhopalobium and Xerobium

Among the five sections in the two subgenera studied, the three sections, Grastidium, Dichopus and Monanthos, were karyomorphologically conspicuous and differed from the other sections in this genus. Namely, *Dendrobium bambusiaefolium* in sect. Grastidium carrying the chromosome number of $2n=38$ showed the prochromosome type at resting stage and the heterogeneous, bimodal and symmetric karyotype at mitotic metaphase. Similarly, *Dendrobium insigne* in sect. Dichopus carrying the chromosome number of $2n=36+2f$ showed the prochromosome type at resting stage and the heterogeneous, bimodal and symmetric karyotype at mitotic metapahse. *Dendrobium agrostophyllum* in sect. Monanthos carrying the chromosome number of $2n=38$ showed the prochromosome type at resting stage and the heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Thus, these three sections showed conspicuous karyotypes within the genus. Accordingly, the treatment as three different genera changed in ranking from those sections proposed by Brieger (1981) could be supported cytotaxonomically.

Similarly, the eight taxa carrying the chromosome number of $2n=38$ in the other sections, Rhopalanthe and Aporum, were karyomorphologically divided into two groups: The first group consisted of *Dendrobium crumenatum* in sect. Rhopalanthe which showed the prochromosome type at resting stage and the second group consisted of the other seven taxa, *D. clavator* and *D. equitans* in sect. Rhopalanthe and *D. acinanciforme, D. distichum, D. leonis, D. mannii* and *D. subulatum* in sect. Aporum, which showed the intermediate type.

Thus, there were karyomorphologically some different taxa within these sections. Many more data are necessary to justify the classification of subgenera Rhopalobium and Xerobium.

As a conclusion of karyomorphological analyses in numerous taxa of *Dendrobium,* morphological comparisons of the resting nuclei and the prophase and metaphase chromosomes are useful for validation of not only taxa but also sectioning of the genus.

Summary

1. Karyomorphological observations were carried out in 82 taxa in 24 sections in four subgenera in *Dendrobium*.
2. The chromosome numbers in the 82 taxa were; $2n=36$ in one taxon, $2n=36+2f$ in one taxon, $2n=38$ in 60 taxa, $2n=39$ in one taxon, $2n=40$ in 17 taxa, $2n=40+1f$ in one taxon and $2n=40+2f$ in one taxon.

3. The chromosome numbers of six taxa, *D. albo-sanguineum* 2n=40, *D. williamsianum* 2n=38, *D. uniflorum* 2n=40, *D. clavator* 2n=38, *D. mannii* 2n=38 and *D. subulatum* 2n=38, were reported here for the first time. The chromosome numbers of 27 taxa reported previously as the author's original counts and 15 taxa redocumented previously by the author (Hashimoto 1981, 1982) were reconfirmed in this paper.
4. Four different types of resting nuclei were found in the 82 taxa: The simple chromocenter type in four taxa, the intermediate type between the simple chromocenter type and the complex chromocenter type in 51 taxa, the complex chromocenter type in ten taxa and the prochromosome type in 17 taxa.
5. According to alignment of chromosome lengths in respective chromosome set, gradual karyotype and two types of bimodal karyotypes, one having some extremely long chromosomes and the other having some extremely short chromosomes, were found in 82 taxa; the gradual karyotypes in 44 taxa, the bimodal karyotype having some extremely long chromosomes in 35 taxa and the other bimodal karyotype in three taxa.
6. According to degree of symmetry calculated by arm ratio of chromosome, 80 out of 82 taxa indicated symmetric karyotype, but the other two taxa indicated intermediate karyotypes between the symmetric and the asymmetric karyotypes.
7. The chromosomes at mitotic metaphase of *D. scabrilingue*, included the longest chromosomes, varied from 3.2–1.2 μm in length, while those of *D. equitans*, included the shortest chromosomes, varied from 1.8–0.8 μm in length. Thus, the chromosomes of most of the taxa studied varied from 2.4–1.0 μm in length.
8. Differences of average chromosome length at mitotic metapahse might be due to differences of sections: Average chromosome lengths of three sections, 1.75 μm of Calyptochilus, 1.62 μm of Oxygenianthe and 1.51 μm of Pedilonum, were clearly longer than those of the others, while those of five sections, 1.20 μm of Aporum, 1.22 μm of Grastidium, 1.25 μm of Stachyobium, 1.27 μm of Dendrocoryne and 1.28 μm of Oxyglossum, were shorter than those of the others.
9. The 82 taxa studied could be grouped into the following 14 types with certain key characters listed as follows:

Type A. represented by *D. engae* and *D. insigne*: 2n =36; prochromosome type at resting stage; heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Type B. represented by *D. falconeri, D. findleyanum, D. nobile* and *D. quinquecostatum*: 2n = 38; simple chromocenter type at resting stage; homogeneous, gradual and symmetric karyotype at mitotic metaphase.

Type C. represented by *D. aemulum, D. ruppianum, D. aggregatum* var. *majus, D. chrysotoxum, D. brymerianum, D. candidum, D. crassinode, D. friedricksianum, D. heterocarpum, D. monile, D. moschatum, D. wardianum, D. capituliflorum, D. phlox, D. sophronites, D. aduncum, D. bigibbum* var. *compactum, D. dicuphum, D. clavator, D. acinaciforme, D. distichum, D. leonis, D. subulatum*: 2n = 38; intermediate type at resting stage; homogeneous, gradual and symmetric karyotype at mitotic metaphase.

Type D. represented by *D. monophyllum, D. schneiderae, D. tortile, D. smilliae, D. stuposum, D. phalaenopsis, D. superbiens, D. williamsianum, D. gouldii, D. lasianthera,* *D. formosum* var. *giganteum*, *D. infundibulum*, *D. scabrilingue*, *D. sutepense*, *D. equitans*, *D. mannii*: 2n = 38; intermediate type at resting stage; heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Type E. represented by *D. macraei*, *D. scopa*, *D. beckleri*, *D. pugioniforme* and *D. rigidum*: 2n=38; complex chromocenter type at resting stage; homogeneous, gradual and symmetric karyotype at mitotic metaphase.

Type F. represented by *D. cucumerinum*: 2n=38; complex chromocenter type at resting stage; heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Type G. represented by *D. wassellii*, *D. macrophyllum* and *D. crumenatum*: 2n=38; prochromosome type at resting stage; homogeneous, gradual and symmetric karyotype at mitotic metaphase.

Type H. represented by *D. linguiforme*, *D. parishii*, *D. pierardii*, *D. superbum* var. *album*, *D. bullenianum*, *D. miyakei*, *D. canaliculatum*, *D. bambusiaefolium* and *D. agrostophyllum*: 2n=38; prochromosome type at resting stage; heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Type I. represented by *D. coelogyne*, *D. nakaharaei*, *D. densiflorum*, *D. dixanthum*, *D. sulcatum*, *D. ciliatum*, *D. compactum* and *D. denudans*: 2n=40; intermediate type at resting stage; homogeneous, gradual and symmetric karyotype at mitotic metaphase.

Type J. represented by *D. palpebrae*, *D. albo-sanguineum*, *D. uniflorum* and *D. sanderae*: 2n=40; intermediate type at resting stage; heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Type K. represented by *D. platygastrium*: 2n=40; complex chromocenter type at resting stage; homogeneous, gradual and symmetric karyotype at mitotic metaphase.

Type L. represented by *D. ramosii*: 2n=40; complex chromocenter type at resting stage; heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

Type M. represented by *D. acuminatum* and *D. cymbidioides*: 2n=40; complex chromocenter type at resting stage; heterogeneous, bimodal and intermediate type between the symmetric and asymmetric at mitotic metaphase.

Type N. represented by *D. finisterrae*, *D. amethystoglossum* and *D. secundum*: 2n=40; prochromosome type at resting stage; heterogeneous, bimodal and symmetric karyotype at mitotic metaphase.

10. The karyomorphological 14 types described above were discussed in relation to Schlechter's taxonomical system of *Dendrobium* as follows:

Type A. Two taxa, *D. engae* and *D. insigne* of Type A, were placed taxonomically in sections of Latourea and Dichopus, respectively, according to Schlechter's system (1912). Thus, the taxonomic treatment of Schlechter's system were not clarified cytotaxonomically.

Type B. Four taxa of Type B were placed taxonomically in two sections; *D. falconeri*, *D. findleyanum* and *D. nobile* in sect. Eugenanthe and *D. quinquecostatum* in sect. Oxyglossum. Thus, the taxonomic treatment of Schlechter's system were not supported cytotaxonomically.

Type C. Twenty-three taxa of Type C were classified into the following sections according to Schlechter's system: *D. aemulum* and *D. ruppianum* in sect. Dendrocoryne, *D.*

aggregatum var. *majus* and *D. chrysotoxum* in sect. Callista, *D. brymerianum, D. candidum, D. crassinode, D. friedricksianum, D. heterocarpum, D. monile, D. moschatum* and *D. wardianum* in sect. Eugenanthe, *D. capituliflorum* in sect. Pedilonum, *D. phlox* in sect. Calyptochilus,*D. sophronites* in sect. Cuthbertosonia, *D. aduncum* in sect. Brachyanthe, *D. biggibum* var. *compactum* and *D. dicuphum* in sect. Phalaenanthe, *D. clavator* in sect. Rhopalanthe, *D. acinaciforme, D. distichum, D. leonis* and *D. subulatum* in sect. Aporum. However, my cytotaxonomic phenomena did not support the taxonomic treatment of ten sections by Schlechter's system.

Type D. Sixteen taxa of Type D were classified into the following nine sections according to Schlechter's system: *D. monophyllum* and *D. schneiderae* in sect. Dendrocoryne, *D. tortile* in sect. Eugenanthe, *D. smilliae* in sect. Pedilonum, *D. stuposum* in sect. Brachyanthe, *D. phalaenopsis, D. superbiens* and *D. williamsianum* in sect. Phalaenanthe, *D. gouldii* and *D. lasianthera* in sect. Ceratobium, *D. formosum* var. *giganteum, D. scabrilingue, D. infundibulum* and *D. sutepense* in sect. Oxygenianthe, *D. equitans* in sect. Rhopalanthe, and *D. mannii* in sect. Aporum. Thus, the cytotaxonomic Type D did not support Schlechter's system except for the taxonomic treatment of sect. Ceratobium, but supported the taxonomic treatment by Dockrill (1969) which separated *D. aemulum* and *D. ruppianum* of sect. Dendrocoryne and *D. monophyllum* and *D. schneiderae* of sect. Monophylleae.

Type E. Five taxa of Type E were classified into two sections according to Schlechter's system; *D. macraei* and *D. scopa* in sect. Desmotrichum and *D. beckleri, D. pugioniforme* and *D. rigidum* in sect. Rhizobium. Thus, the cytotaxonomic classification of Type E did not support the taxonomic treatment by Schlechter except for the taxonomic treatment of sect. Desmotrichum. Moreover, the fact that *D. beckleri, D. pugioniforme* and *D. rigidum* among the six taxa of the sect. Rhizobium clarified by Brieger (1981) were characterized cytotaxonomically as closely related with each other with respect to Type E.

Type F. Cytotaxonomic Type F was found in *D. cucumerinum,* a member of sect. Rhizobium of Schlechter's system in which the other members were placed in another three cytotaxonomic Types.

Type G. Three taxa of Type G were placed taxonomically in three sections; *D. wassellii* in sect. Rhizobium, *D. macrophyllum* in sect. Latourea and *D. crumenatum* in sect. Rhopalanthe. Thus, the taxonomic treatment of Schlechter's system were not clarified cytotaxonomically.

Type H. Nine taxa of Type H were placed taxonomically in six sections; *D. linguiforme* in sect. Rhizobium, *D. parishii, D. pierardii* and *D. superbum* var. *album* in sect. Eugenanthe, *D. bullenianum* and *D. miyakei* in sect. Pedilonum, *D. canaliculatum* in sect. Eleutheroglossum, *D. bambusiaefolium* in sect. Grastidium and *D. agrostophyllum* in sect. Monanthos. However, my cytotaxonomic phenomena did not support the taxonomic treatment of six sections by Schlechter's system.

Type I. Eight taxa of Type I were classified into the following sections according to Schlechter's system: *D. coelogyne* and *D. nakaharaei* in sect. Sarcopodium, *D. densiflorum, D. dixanthum* and *D. sulcatum* in sect. Callista and *D. ciliatum, D. compactum* and *D. denudans* in sect. Stachyobium. Thus, the cytotaxonomic classification of Type I did not support the taxonomic treatment by Schlechter.

Type J. Four taxa of Type J were placed taxonomically in four sections; *D. palpebrae* in sect. Callista, *D. albo-sanguineum* in sect. Eugenanthe, *D. uniflorum* in sect. Distichophyllum and *D. sanderae* in sect. Oxygenianthe. Thus, Schlechter's system for these taxa was not clarified by my cytotaxonomy.

Type K. Cytotaxonomic Type K supported the taxonomic treatment of sect. Platycaulon of Schlechter's system with respect to only one sample of *D. platygastrium* out of approximately four species of the section.

Type L. Cytotaxonomic Type L was found in *D. ramosii* a member of sect. Pedilonum of Schlechter's system in which the other members were placed in another four cytotaxonomic Types.

Type M. Two taxa, *D. acuminatum* and *D. cymbidioides* of Type M, were placed taxonomically in sect. Sarcopodium according to Schlechter's system but the other two taxa, *D. coelogyne* and *D. nakaharaei* of Type I, were also placed in same section. Thus, the cytotaxonomic classification of Type M and Type I supported the taxonomic treatment of Brieger (1981) which treated those taxa as another two different genera *Epigeneium* and *Katherinea*.

Type N. Three taxa of Type N were classified into two sections according to Schlechter's system; *D. finisterrae* in sect. Latourea and *D. amethystoglossum* and *D. secundum* in sect. Pedilonum. Thus, the cytotaxonomic classification of Type N did not support the taxonomic treatment by Schlechter.

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The Hiroshima Botanical Garden

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Table 2. Measurements of somatic chromosomes of *Dendrobium macraei* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.0=2.0	4.1	1.0	m
2	1.0+1.0=2.0	4.1	1.0	m
3	0.8+1.2=2.0	4.1	1.5	m
4	0.8+1.2=2.0	4.1	1.5	m
5	0.9+1.0=1.9	3.9	1.1	m
6	0.9+1.0=1.9	3.9	1.1	m
7	0.8+1.0=1.8	3.7	1.3	m
8	0.8+0.9=1.7	3.5	1.1	m
9	0.6+0.9=1.5	3.1	1.5	m
10	0.6+0.9=1.5	3.1	1.5	m
11	0.7+0.7=1.4	2.9	1.0	m
12	0.6+0.7=1.3	2.7	1.2	m
13	0.6+0.7=1.3	2.7	1.2	m
14	0.6+0.7=1.3	2.7	1.2	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.5+0.7=1.2	2.4	1.4	m
18	0.5+0.7=1.2	2.4	1.4	m
19	0.5+0.7=1.2	2.4	1.4	m
20	0.5+0.7=1.2	2.4	1.4	m
21	0.5+0.6=1.1	2.2	1.2	m
22	0.5+0.6=1.1	2.2	1.2	m
23	0.5+0.6=1.1	2.2	1.2	m
24	0.5+0.6=1.1	2.2	1.2	m
25	0.5+0.6=1.1	2.2	1.2	m
26	0.5+0.6=1.1	2.2	1.2	m
27	0.4+0.7=1.1	2.2	1.8	sm
28	0.4+0.7=1.1	2.2	1.8	sm
29	0.4+0.6=1.0	2.0	1.5	m
30	0.4+0.6=1.0	2.0	1.5	m
31	0.4+0.6=1.0	2.0	1.5	m
32	0.4+0.6=1.0	2.0	1.5	m
33	0.4+0.5=0.9	1.8	1.3	m
34	0.4+0.5=0.9	1.8	1.3	m
35	0.3+0.6=0.9	1.8	2.0	sm
36	0.3+0.6=0.9	1.8	2.0	sm
37	0.4+0.4=0.8	1.6	1.0	m
38	0.4+0.4=0.8	1.6	1.0	m

Table 3. Measurements of somatic chromosomes of *Dendrobium scopa* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.2=2.1	3.7	1.3	m
2	0.8+1.2=2.0	3.5	1.5	m
3	0.9+1.0=1.9	3.3	1.1	m
4	0.8+1.1=1.9	3.3	1.4	m
5	0.8+1.0=1.8	3.2	1.3	m
6	0.8+1.0=1.8	3.2	1.3	m
7	0.8+1.0=1.8	3.2	1.3	m
8	0.8+1.0=1.8	3.2	1.3	m
9	0.8+0.9=1.7	3.0	1.1	m
10	0.8+0.9=1.7	3.0	1.1	m
11	0.7+1.0=1.7	3.0	1.4	m
12	0.7+1.0=1.7	3.0	1.4	m
13	0.8+0.8=1.6	2.8	1.0	m
14	0.8+0.8=1.6	2.8	1.0	m
15	0.7+0.9=1.6	2.8	1.3	m
16	0.7+0.9=1.6	2.8	1.3	m
17	0.6+1.0=1.6	2.8	1.7	m
18	0.6+1.0=1.6	2.8	1.7	m
19	0.7+0.8=0.5	2.6	1.1	m
20	0.7+0.8=1.5	2.6	1.1	m
21	0.7+0.8=1.5	2.6	1.1	m
22	0.7+0.8=1.5	2.6	1.1	m
23	0.6+0.8=1.4	2.5	1.3	m
24	0.6+0.8=1.4	2.5	1.3	m
25	0.3+0.8=1.3	2.3	1.6	m
26	0.3+0.8=1.3	2.3	1.6	m
27	0.4+0.9=1.3	2.3	2.3	sm
28	0.4+0.9=1.3	2.3	2.3	sm
29	0.4+0.4+0.5=1.3*	2.3	2.3	sm
30	0.4+0.4+0.5=1.3*	2.3	2.3	sm
31	0.4+0.8=1.2	2.1	2.0	sm
32	0.4+0.8=1.2	2.1	2.0	sm
33	0.5+0.6=1.1	1.9	1.2	m
34	0.5+0.6=1.1	1.9	1.2	m
35	0.5+0.6=1.1	1.9	1.2	m
36	0.5+0.6=1.1	1.9	1.2	m
37	0.4+0.6=1.0	1.8	1.5	m
38	0.4+0.6=1.0	1.8	1.5	m

* : Chromosome with secondary constriction

Table 4. Measurements of somatic chromosomes of *Dendrobium beckleri* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.1=2.0	3.8	1.2	m
2	0.9+1.1=2.0	3.8	1.2	m
3	0.8+1.2=2.0	3.8	1.5	m
4	0.8+1.2=2.0	3.8	1.5	m
5	0.7+1.2=1.9	3.6	1.7	m
6	0.7+1.2=1.9	3.6	1.7	m
7	0.8+1.0=1.8	3.4	1.3	m
8	0.8+1.0=1.8	3.4	1.3	m
9	0.8+1.0=1.8	3.4	1.3	m
10	0.8+0.9=1.7	3.2	1.1	m
11	0.7+0.9=1.6	3.0	1.3	m
12	0.6+0.9=1.5	2.8	1.5	m
13	0.6+0.9=1.5	2.8	1.5	m
14	0.6+0.9=1.5	2.8	1.5	m
15	0.6+0.8=1.4	2.6	1.3	m
16	0.6+0.8=1.4	2.6	1.3	m
17	0.6+0.8=1.4	2.6	1.3	m
18	0.6+0.7=1.3	2.5	1.2	m
19	0.6+0.7=1.3	2.5	1.2	m
20	0.6+0.7=1.3	2.5	1.2	m
21	0.6+0.7=1.3	2.5	1.2	m
22	0.4+0.9=1.3	2.5	2.3	sm
23	0.4+0.9=1.3	2.5	2.3	sm
24	0.6+0.6=1.2	2.3	1.0	m
25	0.6+0.6=1.2	2.3	1.0	m
26	0.6+0.6=1.2	2.3	1.0	m
27	0.6+0.6=1.2	2.3	1.0	m
28	0.6+0.6=1.2	2.3	1.0	m
29	0.6+0.6=1.2	2.3	1.0	m
30	0.6+0.6=1.2	2.3	1.0	m
31	0.5+0.6=1.1	2.1	1.2	m
32	0.5+0.6=1.1	2.1	1.2	m
33	0.4+0.6=1.0	1.9	1.5	m
34	0.4+0.5=0.9	1.7	1.3	m
35	0.4+0.5=0.9	1.7	1.3	m
36	0.4+0.5=0.9	1.7	1.3	m
37	0.4+0.4=0.8	1.5	1.0	m
38	0.4+0.4=0.8	1.5	1.0	m

Table 5. Measurements of somatic chromosomes of *Dendrobium cucumerinum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.3=2.3	3.8	1.3	m
2	1.0+1.3=2.3	3.8	1.3	m
3	1.0+1.3=2.3	3.8	1.3	m
4	1.0+1.3=2.3	3.8	1.3	m
5	0.8+1.2=2.0	3.3	1.5	m
6	0.8+1.2=2.0	3.3	1.5	m
7	0.9+1.0=1.9	3.2	1.1	m
8	0.9+1.0=1.9	3.2	1.1	m
9	0.9+1.0=1.9	3.2	1.1	m
10	0.9+1.0=1.9	3.2	1.1	m
11	0.8+1.0=1.8	3.0	1.3	m
12	0.8+1.0=1.8	3.0	1.3	m
13	0.8+0.9=1.7	2.8	1.1	m
14	0.7+0.9=1.6	2.7	1.3	m
15	0.7+0.9=1.6	2.7	1.3	m
16	0.7+0.9=1.6	2.7	1.3	m
17	0.6+1.0=1.6	2.7	1.7	m
18	0.6+1.0=1.6	2.7	1.7	m
19	0.7+0.4+0.5=1.6*	2.7	1.4	m
20	0.7+0.4+0.5=1.6*	2.7	1.4	m
21	0.6+0.9=1.5	2.5	1.5	m
22	0.6+0.8=1.4	2.3	1.3	m
23	0.6+0.8=1.4	2.3	1.3	m
24	0.6+0.8=1.4	2.3	1.3	m
25	0.5+0.9=1.4	2.3	1.8	sm
26	0.5+0.9=1.4	2.3	1.8	sm
27	0.6+0.7=1.3	2.2	1.2	m
28	0.6+0.7=1.3	2.2	1.2	m
29	0.5+0.8=1.3	2.2	1.6	m
30	0.5+0.8=1.3	2.2	1.6	m
31	0.5+0.8=1.3	2.2	1.6	m
32	0.5+0.8=1.3	2.2	1.6	m
33	0.4+0.8=1.2	2.0	2.0	sm
34	0.4+0.8=1.2	2.0	2.0	sm
35	0.4+0.7=1.1	1.8	1.8	sm
36	0.4+0.7=1.1	1.8	1.8	sm
37	0.4+0.5=0.9	1.5	1.3	m
38	0.4+0.5=0.9	1.5	1.3	m

* : Chromosome with secondary constriction

Table 6. Measurements of somatic chromosomes of *Dendrobium linguiforme* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.2=2.2	4.5	1.2	m
2	1.0+1.2=2.2	4.5	1.2	m
3	0.8+1.2=2.0	4.1	1.5	m
4	0.8+1.2=2.0	4.1	1.5	m
5	0.8+1.0=1.8	3.7	1.3	m
6	0.8+1.0=1.8	3.7	1.3	m
7	0.7+0.8=1.5	3.1	1.1	m
8	0.7+0.8=1.5	3.1	1.1	m
9	0.6+0.8=1.4	2.9	1.3	m
10	0.6+0.8=1.4	2.9	1.3	m
11	0.4+0.9=1.3	2.7	2.3	sm
12	0.4+0.9=1.3	2.7	2.3	sm
13	0.5+0.7=1.2	2.5	1.4	m
14	0.5+0.7=1.2	2.5	1.4	m
15	0.5+0.7=1.2	2.5	1.4	m
16	0.5+0.7=1.2	2.5	1.4	m
17	0.5+0.7=1.2	2.5	1.4	m
18	0.5+0.7=1.2	2.5	1.4	m
19	0.5+0.7=1.2	2.5	1.4	m
20	0.5+0.7=1.2	2.5	1.4	m
21	0.5+0.6=1.1	2.3	1.2	m
22	0.5+0.6=1.1	2.3	1.2	m
23	0.5+0.6=1.1	2.3	1.2	m
24	0.5+0.6=1.1	2.3	1.2	m
25	0.5+0.6=1.1	2.3	1.2	m
26	0.5+0.6=1.1	2.3	1.2	m
27	0.4+0.7=1.1	2.3	1.8	sm
28	0.4+0.7=1.1	2.3	1.8	sm
29	0.4+0.7=1.1	2.3	1.8	sm
30	0.4+0.7=1.1	2.3	1.8	sm
31	0.4+0.7=1.1	2.3	1.8	sm
32	0.4+0.7=1.1	2.3	1.8	sm
33	0.4+0.6=1.0	2.0	1.5	m
34	0.4+0.6=1.0	2.0	1.5	m
35	0.4+0.5=0.9	1.8	1.3	m
36	0.4+0.5=0.9	1.8	1.3	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.5=0.9	1.8	1.3	m

Table 7. Measurements of somatic chromosomes of *Dendrobium pugioniforme* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.4=2.3	4.5	1.6	m
2	1.0+1.2=2.2	4.3	1.2	m
3	1.0+1.2=2.2	4.3	1.2	m
4	1.0+1.0=2.0	3.9	1.0	m
5	0.8+1.0=1.8	3.5	1.3	m
6	0.8+1.0=1.8	3.5	1.3	m
7	0.7+1.0=1.7	3.3	1.4	m
8	0.7+1.0=1.7	3.3	1.4	m
9	0.7+1.0=1.7	3.3	1.4	m
10	0.7+1.0=1.7	3.3	1.4	m
11	0.7+0.9=1.6	3.1	1.3	m
12	0.7+0.9=1.6	3.1	1.3	m
13	0.7+0.8=1.5	2.9	1.1	m
14	0.7+0.8=1.5	2.9	1.1	m
15	0.6+0.8=1.4	2.7	1.3	m
16	0.6+0.8=1.4	2.7	1.3	m
17	0.6+0.8=1.4	2.7	1.3	m
18	0.6+0.8=1.4	2.7	1.3	m
19	0.5+0.8=1.3	2.5	1.6	m
20	0.5+0.8=1.3	2.5	1.6	m
21	0.5+0.8=1.3	2.5	1.6	m
22	0.5+0.8=1.3	2.5	1.6	m
23	0.5+0.8=1.3	2.5	1.6	m
24	0.5+0.8=1.3	2.5	1.6	m
25	0.5+0.6=1.1	2.1	1.2	m
26	0.5+0.6=1.1	2.1	1.2	m
27	0.4+0.7=1.1	2.1	1.8	sm
28	0.4+0.7=1.1	2.1	1.8	sm
29	0.4+0.7=1.1	2.1	1.8	sm
30	0.4+0.7=1.1	2.1	1.8	sm
31	0.3+0.5=0.8	1.6	1.7	m
32	0.3+0.5=0.8	1.6	1.7	m
33	0.3+0.5=0.8	1.6	1.7	m
34	0.3+0.5=0.8	1.6	1.7	m
35	0.3+0.4=0.7	1.4	1.3	m
36	0.3+0.4=0.7	1.4	1.3	m
37	0.3+0.4=0.7	1.4	1.3	m
38	0.3+0.4=0.7	1.4	1.3	m

Table 8. Measurements of somatic chromosomes of *Dendrobium rigidum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.1=2.0	3.5	1.2	m
2	0.9+1.1=2.0	3.5	1.2	m
3	0.7+1.2=1.9	3.3	1.7	m
4	0.7+1.2=1.9	3.3	1.7	m
5	0.8+1.0=1.8	3.1	1.3	m
6	0.8+1.0=1.8	3.1	1.3	m
7	0.6+1.1=1.7	3.0	1.8	sm
8	0.6+1.1=1.7	3.0	1.8	sm
9	0.7+1.0=1.7	3.0	1.4	m
10	0.7+1.0=1.7	3.0	1.4	m
11	0.8+0.9=1.7	3.0	1.1	m
12	0.8+0.9=1.7	3.0	1.1	m
13	0.6+1.0=1.6	2.8	1.7	m
14	0.5+1.1=1.6	2.8	2.2	sm
15	0.5+1.1=1.6	2.8	2.2	sm
16	0.5+1.1=1.6	2.8	2.2	sm
17	0.5+1.1=1.6	2.8	2.2	sm
18	0.5+1.1=1.6	2.8	2.2	sm
19	0.6+0.9=1.5	2.6	1.5	m
20	0.6+0.9=1.5	2.6	1.5	m
21	0.7+0.8=1.5	2.6	1.1	m
22	0.7+0.8=1.5	2.6	1.1	m
23	0.6+0.8=1.4	2.4	1.3	m
24	0.6+0.8=1.4	2.4	1.3	m
25	0.6+0.8=1.4	2.4	1.3	m
26	0.6+0.8=1.4	2.4	1.3	m
27	0.6+0.7=1.3	2.3	1.2	m
28	0.6+0.7=1.3	2.3	1.2	m
29	0.6+0.7=1.3	2.3	1.2	m
30	0.6+0.7=1.3	2.3	1.2	m
31	0.5+0.7=1.2	2.1	1.4	m
32	0.5+0.7=1.2	2.1	1.4	m
33	0.5+0.7=1.2	2.1	1.4	m
34	0.5+0.7=1.2	2.1	1.4	m
35	0.4+0.8=1.2	2.1	2.0	sm
36	0.4+0.8=1.2	2.1	2.0	sm
37	0.5+0.6=1.1	1.9	1.2	m
38	0.5+0.5=1.0	1.7	1.0	m

Table 9. Measurements of somatic chromosomes of *Dendrobium wassellii* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.4=2.3	3.5	1.6	m
2	0.9+1.4=2.3	3.5	1.6	m
3	0.9+1.4=2.3	3.5	1.6	m
4	1.0+1.2=2.2	3.4	1.2	m
5	1.0+1.1=2.1	3.2	1.1	m
6	1.0+1.1=2.1	3.2	1.1	m
7	1.0+1.0=2.0	3.1	1.0	m
8	1.0+1.0=2.0	3.1	1.0	m
9	0.9+1.1=2.0	3.1	1.2	m
10	0.9+1.1=2.0	3.1	1.2	m
11	0.5+1.4=1.9	2.9	2.8	sm
12	0.5+1.4=1.9	2.9	2.8	sm
13	0.8+1.0=1.8	2.8	1.3	m
14	0.8+1.0=1.8	2.8	1.3	m
15	0.8+0.9=1.7	2.6	1.1	m
16	0.8+0.9=1.7	2.6	1.1	m
17	0.8+0.9=1.7	2.6	1.1	m
18	0.8+0.9=1.7	2.6	1.1	m
19	0.5+1.2=1.7	2.6	2.4	sm
20	0.5+1.2=1.7	2.6	2.4	sm
21	0.6+1.0=1.6	2.5	1.7	m
22	0.6+1.0=1.6	2.5	1.7	m
23	0.6+1.0=1.6	2.5	1.7	m
24	0.6+1.0=1.6	2.5	1.7	m
25	0.5+1.1=1.6	2.5	2.2	sm
26	0.5+1.1=1.6	2.5	2.2	sm
27	0.5+1.1=1.6	2.5	2.2	sm
28	0.5+1.1=1.6	2.5	2.2	sm
29	0.7+0.8=1.5	2.3	1.1	m
30	0.7+0.8=1.5	2.3	1.1	m
31	0.7+0.8=1.5	2.3	1.1	m
32	0.7+0.8=1.5	2.3	1.1	m
33	0.5+0.8=1.3	2.0	1.6	m
34	0.5+0.8=1.3	2.0	1.6	m
35	0.5+0.7=1.2	1.8	1.4	m
36	0.5+0.7=1.2	1.8	1.4	m
37	0.5+0.7=1.2	1.8	1.4	m
38	0.5+0.7=1.2	1.8	1.4	m

Table 10. Measurements of somatic chromosomes of *Dendrobium acuminatum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.3+0.6+0.9+0.4=2.2*	4.3	6.3	st
2	0.3+0.6+0.7+0.3=1.9*	3.7	5.3	st
3	0.5+1.4=1.9	3.7	2.8	sm
4	0.5+1.3=1.8	3.5	2.6	sm
5	0.8+1.0=1.8	3.5	1.3	m
6	0.7+1.0=1.7	3.3	1.4	m
7	0.6+1.1=1.7	3.3	1.8	sm
8	0.5+1.2=1.7	3.3	2.4	sm
9	0.3+0.5+0.9=1.7*	3.3	4.7	st
10	0.3+0.5+0.9=1.7*	3.3	4.7	st
11	0.7+0.9=1.6	3.1	1.3	m
12	0.7+0.9=1.6	3.1	1.3	m
13	0.6+1.0=1.6	3.1	1.7	m
14	0.6+1.0=1.6	3.1	1.7	m
15	0.3+0.5+0.7=1.5*	2.9	4.7	st
16	0.3+0.5+0.7=1.5*	2.9	4.7	st
17	0.7+0.7=1.4	2.7	1.0	m
18	0.6+0.8=1.4	2.7	1.3	m
19	0.6+0.7=1.3	2.5	1.2	m
20	0.6+0.7=1.3	2.5	1.2	m
21	0.5+0.8=1.3	2.5	1.6	m
22	0.5+0.8=1.3	2.5	1.6	m
23	0.6+0.6=1.2	2.3	1.0	m
24	0.6+0.6=1.2	2.3	1.0	m
25	0.5+0.7=1.2	2.3	1.4	m
26	0.5+0.7=1.2	2.3	1.4	m
27	0.5+0.7=1.2	2.3	1.4	m
28	0.5+0.7=1.2	2.3	1.4	m
29	0.4+0.7=1.1	2.1	1.8	sm
30	0.4+0.7=1.1	2.1	1.8	sm
31	0.3+0.4=0.7	1.4	1.3	m
32	0.3+0.4=0.7	1.4	1.3	m
33	d+0.7=0.7	1.4	<∞	t
34	d+0.7=0.7	1.4	<∞	t
35	d+0.7=0.7	1.4	<∞	t
36	d+0.7=0.7	1.4	<∞	t
37	d+0.7=0.7	1.4	<∞	t
38	d+0.7=0.7	1.4	<∞	t
39	d+0.6=0.6	1.2	<∞	t
40	d+0.5=0.5	1.0	<∞	t

* : Chromosome with secondary constriction
d : dot

Table 11. Measurements of somatic chromosomes of *Dendrobium coelogyne* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+1.2=1.8	3.6	2.0	sm
2	0.6+1.2=1.8	3.6	2.0	sm
3	0.7+1.0=1.7	3.4	1.4	m
4	0.7+1.0=1.7	3.4	1.4	m
5	0.7+1.0=1.7	3.4	1.4	m
6	0.5+1.2=1.7	3.4	2.4	sm
7	0.6+0.9=1.5	3.0	1.5	m
8	0.6+0.9=1.5	3.0	1.5	m
9	0.5+0.9=1.4	2.8	1.8	sm
10	0.5+0.9=1.4	2.8	1.8	sm
11	0.5+0.9=1.4	2.8	1.8	sm
12	0.5+0.9=1.4	2.8	1.8	sm
13	0.4+0.9=1.3	2.6	2.3	sm
14	0.4+0.9=1.3	2.6	2.3	sm
15	0.4+0.9=1.3	2.6	2.3	sm
16	0.4+0.9=1.3	2.6	2.3	sm
17	0.4+0.8=1.2	2.4	2.0	sm
18	0.4+0.8=1.2	2.4	2.0	sm
19	0.4+0.8=1.2	2.4	2.0	sm
20	0.4+0.8=1.2	2.4	2.0	sm
21	0.4+0.8=1.2	2.4	2.0	sm
22	0.4+0.8=1.2	2.4	2.0	sm
23	0.4+0.8=1.2	2.4	2.0	sm
24	0.4+0.8=1.2	2.4	2.0	sm
25	0.4+0.8=1.2	2.4	2.0	sm
26	0.4+0.8=1.2	2.4	2.0	sm
27	0.4+0.7=1.1	2.2	1.8	sm
28	0.4+0.7=1.1	2.2	1.8	sm
29	0.4+0.7=1.1	2.2	1.8	sm
30	0.4+0.7=1.1	2.2	1.8	sm
31	0.4+0.7=1.1	2.2	1.8	sm
32	0.4+0.7=1.1	2.2	1.8	sm
33	0.4+0.6=1.0	2.0	1.5	m
34	0.4+0.6=1.0	2.0	1.5	m
35	0.4+0.6=1.0	2.0	1.5	m
36	0.4+0.6=1.0	2.0	1.5	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.5=0.9	1.8	1.3	m
39	0.3+0.5=0.8	1.6	1.7	m
40	0.3+0.5=0.8	1.6	1.7	m

Table 12. Measurements of somatic chromosomes of *Dendrobium cymbidiodes* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.3+0.8+1.1=2.2*	3.7	6.3	st
2	0.3+0.8+1.1=2.2*	3.7	6.3	st
3	0.3+0.8+1.1=2.2*	3.7	6.3	st
4	0.3+0.8+1.1=2.2*	3.7	6.3	st
5	0.7+1.4=2.1	3.6	2.0	sm
6	0.7+1.4=2.1	3.6	2.0	sm
7	0.3+0.7+0.7+0.3=2.0*	3.4	5.7	st
8	0.3+0.7+0.7+0.3=2.0*	3.4	5.7	st
9	0.5+1.4=1.9	3.2	2.8	sm
10	0.5+1.4=1.9	3.2	2.8	sm
11	0.5+1.4=1.9	3.2	2.8	sm
12	0.5+1.4=1.9	3.2	2.8	sm
13	0.8+1.1=1.9	3.2	1.4	m
14	0.8+1.1=1.9	3.2	1.4	m
15	0.9+0.9=1.8	3.1	1.0	m
16	0.9+0.9=1.8	3.1	1.0	m
17	0.3+0.5+0.9=1.7*	2.9	4.7	st
18	0.3+0.5+0.9=1.7*	2.9	4.7	st
19	0.6+1.0=1.6	2.7	1.7	m
20	0.6+1.0=1.6	2.7	1.7	m
21	0.7+0.7=1.4	2.4	1.0	m
22	0.7+0.7=1.4	2.4	1.0	m
23	0.7+0.7=1.4	2.4	1.0	m
24	0.5+0.9=1.4	2.4	1.8	sm
25	0.5+0.9=1.4	2.4	1.8	sm
26	0.5+0.9=1.4	2.4	1.8	sm
27	0.5+0.9=1.4	2.4	1.8	sm
28	0.3+1.1=1.4	2.4	3.7	st
29	0.6+0.6=1.2	2.0	1.0	m
30	0.6+0.6=1.2	2.0	1.0	m
31	0.5+0.5=1.0	1.7	1.0	m
32	0.5+0.5=1.0	1.7	1.0	m
33	d+0.6=0.6	1.0	$<\infty$	t
34	d+0.6=0.6	1.0	$<\infty$	t
35	d+0.6=0.6	1.0	$<\infty$	t
36	d+0.6=0.6	1.0	$<\infty$	t
37	d+0.6=0.6	1.0	$<\infty$	t
38	d+0.6=0.6	1.0	$<\infty$	t
39	d+0.6=0.6	1.0	$<\infty$	t
40	d+0.6=0.6	1.0	$<\infty$	t

* : Chromosome with secondary constriction
d : dot

Table 13. Measurements of somatic chromosomes of *Dendrobium nakaharaei* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.2=2.0	4.1	1.5	m
2	0.8+1.1=1.9	3.9	1.4	m
3	0.7+1.0=1.7	3.5	1.4	m
4	0.7+1.0=1.7	3.5	1.4	m
5	0.5+1.2=1.7	3.5	2.4	sm
6	0.5+1.2=1.7	3.5	2.4	sm
7	0.5+1.1=1.6	3.3	2.2	sm
8	0.5+1.1=1.6	3.3	2.2	sm
9	0.5+1.0=1.5	3.1	2.0	sm
10	0.5+1.0=1.5	3.1	2.0	sm
11	0.4+1.1=1.5	3.1	2.8	sm
12	0.4+1.1=1.5	3.1	2.8	sm
13	0.6+0.8=1.4	2.9	1.3	m
14	0.6+0.8=1.4	2.9	1.3	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.4+0.9=1.3	2.7	2.3	sm
18	0.4+0.9=1.3	2.7	2.3	sm
19	0.5+0.7=1.2	2.5	1.4	m
20	0.5+0.7=1.2	2.5	1.4	m
21	0.4+0.8=1.2	2.5	2.0	sm
22	0.4+0.8=1.2	2.5	2.0	sm
23	0.4+0.7=1.1	2.3	1.8	sm
24	0.4+0.7=1.1	2.3	1.8	sm
25	0.4+0.6=1.1	2.1	1.5	m
26	0.4+0.6=1.1	2.1	1.5	m
27	0.4+0.5=0.9	1.9	1.3	m
28	0.4+0.5=0.9	1.9	1.3	m
29	0.4+0.5=0.9	1.9	1.3	m
30	0.4+0.5=0.9	1.9	1.3	m
31	0.4+0.5=0.9	1.9	1.3	m
32	0.4+0.5=0.9	1.9	1.3	m
33	0.4+0.4=0.8	1.6	1.0	m
34	0.4+0.4=0.8	1.6	1.0	m
35	0.4+0.4=0.8	1.6	1.0	m
36	0.4+0.4=0.8	1.6	1.0	m
37	0.4+0.4=0.8	1.6	1.0	m
38	0.4+0.4=0.8	1.6	1.0	m
39	0.3+0.4=0.7	1.4	1.3	m
40	0.3+0.4=0.7	1.4	1.3	m

Table 14. Measurements of somatic chromosomes of *Dendrobium aemulum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.0=1.7	3.8	1.4	m
2	0.7+1.0=1.7	3.8	1.4	m
3	0.7+1.0=1.7	3.8	1.4	m
4	0.7+1.0=1.7	3.8	1.4	m
5	0.6+1.1=1.7	3.8	1.8	sm
6	0.6+1.1=1.7	3.8	1.8	sm
7	0.6+0.9=1.5	3.3	1.5	m
8	0.6+0.9=1.5	3.3	1.5	m
9	0.6+0.9=1.5	3.3	1.5	m
10	0.6+0.9=1.5	3.3	1.5	m
11	0.6+0.8=1.4	3.1	1.3	m
12	0.6+0.8=1.4	3.1	1.3	m
13	0.5+0.8=1.3	2.9	1.6	m
14	0.5+0.8=1.3	2.9	1.6	m
15	0.5+0.8=1.3	2.9	1.6	m
16	0.5+0.8=1.3	2.9	1.6	m
17	0.5+0.8=1.3	2.9	1.6	m
18	0.5+0.6=1.1	2.4	1.2	m
19	0.5+0.6=1.1	2.4	1.2	m
20	0.5+0.6=1.1	2.4	1.2	m
21	0.4+0.7=1.1	2.4	1.8	sm
22	0.4+0.7=1.1	2.4	1.8	sm
23	0.4+0.7=1.1	2.4	1.8	sm
24	0.4+0.6=1.0	2.2	1.5	m
25	0.4+0.6=1.0	2.2	1.5	m
26	0.4+0.6=1.0	2.2	1.5	m
27	0.4+0.6=1.0	2.2	1.5	m
28	0.4+0.6=1.0	2.2	1.5	m
29	0.4+0.5=0.9	2.0	1.3	m
30	0.4+0.5=0.9	2.0	1.3	m
31	0.4+0.5=0.9	2.0	1.3	m
32	0.4+0.5=0.9	2.0	1.3	m
33	0.4+0.5=0.9	2.0	1.3	m
34	0.4+0.5=0.9	2.0	1.3	m
35	0.3+0.4=0.7	1.5	1.3	m
36	0.3+0.4=0.7	1.5	1.3	m
37	0.3+0.4=0.7	1.5	1.3	m
38	0.3+0.4=0.7	1.5	1.3	m

Table 15. Measurements of somatic chromosomes of *Dendrobium monophyllum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.3=2.2	4.2	1.4	m
2	0.9+1.3=2.2	4.2	1.4	m
3	0.7+1.3=2.0	3.8	1.6	m
4	0.9+1.0=1.9	3.6	1.0	m
5	0.8+1.0=1.8	3.4	1.3	m
6	0.8+1.0=1.8	3.4	1.3	m
7	0.8+1.0=1.8	3.4	1.3	m
8	0.8+1.0=1.8	3.4	1.3	m
9	0.7+0.9=1.6	3.0	1.3	m
10	0.7+0.9=1.6	3.0	1.3	m
11	0.6+1.0=1.6	3.0	1.7	m
12	0.6+1.0=1.6	3.0	1.7	m
13	0.5+1.1=1.6	3.0	2.2	sm
14	0.5+1.1=1.6	3.0	2.2	sm
15	0.6+0.9=1.5	2.8	1.5	m
16	0.6+0.9=1.5	2.8	1.5	m
17	0.5+0.9=1.4	2.6	1.8	sm
18	0.5+0.9=1.4	2.6	1.8	sm
19	0.5+0.8=1.3	2.5	1.6	m
20	0.5+0.8=1.3	2.5	1.6	m
21	0.4+0.9=1.3	2.5	2.3	sm
22	0.4+0.9=1.3	2.5	2.3	sm
23	0.5+0.7=1.2	2.3	1.4	m
24	0.5+0.7=1.2	2.3	1.4	m
25	0.5+0.7=1.2	2.3	1.4	m
26	0.5+0.7=1.2	2.3	1.4	m
27	0.5+0.6=1.1	2.1	1.2	m
28	0.5+0.6=1.1	2.1	1.2	m
29	0.5+0.6=1.1	2.1	1.2	m
30	0.5+0.6=1.1	2.1	1.2	m
31	0.5+0.5=1.0	1.9	1.0	m
32	0.5+0.5=1.0	1.9	1.0	m
33	0.5+0.5=1.0	1.9	1.0	m
34	0.5+0.5=1.0	1.9	1.0	m
35	0.4+0.4=0.8	1.5	1.0	m
36	0.4+0.4=0.8	1.5	1.0	m
37	0.4+0.4=0.8	1.5	1.0	m
38	0.4+0.4=0.8	1.5	1.0	m

Table 16. Measurements of somatic chromosomes of *Dendrobium ruppianum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+1.2=1.8	3.8	2.0	sm
2	0.6+1.2=1.8	3.8	2.0	sm
3	0.9+0.9=1.8	3.8	1.0	m
4	0.9+0.9=1.8	3.8	1.0	m
5	0.8+0.9=1.7	3.6	1.1	m
6	0.8+0.9=1.7	3.6	1.1	m
7	0.6+1.1=1.7	3.6	1.8	sm
8	0.6+1.0=1.6	3.3	1.7	m
9	0.6+1.0=1.6	3.3	1.7	m
10	0.6+1.0=1.6	3.3	1.7	m
11	0.5+1.0=1.5	3.1	2.0	sm
12	0.5+1.0=1.5	3.1	2.0	sm
13	0.5+0.8=1.3	2.7	1.6	m
14	0.5+0.8=1.3	2.7	1.6	m
15	0.5+0.8=1.3	2.7	1.6	m
16	0.5+0.8=1.3	2.7	1.6	m
17	0.5+0.8=1.3	2.7	1.6	m
18	0.5+0.8=1.3	2.7	1.6	m
19	0.5+0.8=1.3	2.7	1.6	m
20	0.5+0.8=1.3	2.7	1.6	m
21	0.6+0.6=1.2	2.5	1.0	m
22	0.6+0.6=1.2	2.5	1.0	m
23	0.4+0.7=1.1	2.3	1.8	sm
24	0.4+0.7=1.1	2.3	1.8	sm
25	0.4+0.6=1.0	2.1	1.5	m
26	0.4+0.6=1.0	2.1	1.5	m
27	0.4+0.6=1.0	2.1	1.5	m
28	0.4+0.5=0.9	1.9	1.3	m
29	0.4+0.5=0.9	1.9	1.3	m
30	0.4+0.5=0.9	1.9	1.3	m
31	0.4+0.5=0.9	1.9	1.3	m
32	0.4+0.5=0.9	1.9	1.3	m
33	0.4+0.5=0.9	1.9	1.3	m
34	0.4+0.5=0.9	1.9	1.3	m
35	0.4+0.5=0.9	1.9	1.3	m
36	0.4+0.5=0.9	1.9	1.3	m
37	0.4+0.4=0.8	1.7	1.0	m
38	0.4+0.4=0.8	1.7	1.0	m

Table 17. Measurements of somatic chromosomes of *Dendrobium schneiderae* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.3=2.0	4.2	1.9	sm
2	0.7+1.3=2.0	4.2	1.9	sm
3	0.7+1.0=1.7	3.6	1.4	m
4	0.7+1.0=1.7	3.6	1.4	m
5	0.7+0.9=1.6	3.3	1.3	m
6	0.7+0.9=1.6	3.3	1.3	m
7	0.6+0.9=1.5	3.1	1.5	m
8	0.6+0.9=1.5	3.1	1.5	m
9	0.6+0.9=1.5	3.1	1.5	m
10	0.6+0.9=1.5	3.1	1.5	m
11	0.6+0.8=1.4	2.9	1.3	m
12	0.6+0.8=1.4	2.9	1.3	m
13	0.6+0.8=1.4	2.9	1.3	m
14	0.6+0.8=1.4	2.9	1.3	m
15	0.5+0.7=1.2	2.5	1.4	m
16	0.5+0.7=1.2	2.5	1.4	m
17	0.5+0.7=1.2	2.5	1.4	m
18	0.5+0.7=1.2	2.5	1.4	m
19	0.5+0.7=1.2	2.5	1.4	m
20	0.5+0.7=1.2	2.5	1.4	m
21	0.5+0.6=1.1	2.3	1.2	m
22	0.5+0.6=1.1	2.3	1.2	m
23	0.5+0.6=1.1	2.3	1.2	m
24	0.5+0.6=1.1	2.3	1.2	m
25	0.5+0.6=1.1	2.3	1.2	m
26	0.5+0.6=1.1	2.3	1.2	m
27	0.3+0.8=1.1	2.3	2.7	sm
28	0.3+0.8=1.1	2.3	2.7	sm
29	0.3+0.8=1.1	2.3	2.7	sm
30	0.3+0.8=1.1	2.3	2.7	sm
31	0.3+0.8=1.1	2.3	2.7	sm
32	0.3+0.8=1.1	2.3	2.7	sm
33	0.4+0.6=1.0	2.1	1.5	m
34	0.4+0.6=1.0	2.1	1.5	m
35	0.4+0.4=0.8	1.7	1.0	m
36	0.4+0.4=0.8	1.7	1.0	m
37	0.4+0.4=0.8	1.7	1.0	m
38	0.4+0.4+0.8	1.7	1.0	m

Table 18. Measurements of somatic chromosomes of *Dendrobium engae* at mitotic metaphase, 2n=36

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.3+0.6+1.8=2.7*	5.2	2.0	sm
2	0.3+0.6+1.8=2.7*	5.2	2.0	sm
3	0.9+1.0=1.9	3.6	1.1	m
4	0.9+1.0=1.9	3.6	1.1	m
5	0.9+1.0=1.9	3.6	1.1	m
6	0.9+1.0=1.9	3.6	1.1	m
7	0.7+1.2=1.9	3.6	1.7	m
8	0.7+1.2=1.9	3.6	1.7	m
9	0.6+1.2=1.8	3.4	2.0	sm
10	0.6+1.2=1.8	3.4	2.0	sm
11	0.8+0.9=1.7	3.3	1.1	m
12	0.8+0.9=1.7	3.3	1.1	m
13	0.7+1.0=1.7	3.3	1.4	m
14	0.8+0.8=1.6	3.1	1.0	m
15	0.7+0.9=1.6	3.1	1.3	m
16	0.7+0.8=1.5	2.9	1.1	m
17	0.6+0.8=1.4	2.7	1.3	m
18	0.6+0.8=1.4	2.7	1.3	m
19	0.5+0.9=1.4	2.7	1.8	sm
20	0.5+0.9=1.4	2.7	1.8	sm
21	0.5+0.7=1.2	2.3	1.4	m
22	0.5+0.7=1.2	2.3	1.4	m
23	0.5+0.6=1.1	2.1	1.2	m
24	0.5+0.6=1.1	2.1	1.2	m
25	0.3+0.8=1.1	2.1	2.7	sm
26	0.3+0.8=1.1	2.1	2.7	sm
27	0.3+0.8=1.1	2.1	2.7	sm
28	0.3+0.8=1.1	2.1	2.7	sm
29	0.5+0.5=1.0	1.9	1.0	m
30	0.5+0.5=1.0	1.9	1.0	m
31	0.3+0.7=1.0	1.9	2.3	sm
32	0.3+0.7=1.0	1.9	2.3	sm
33	0.4+0.5=0.9	1.7	1.3	m
34	0.4+0.5=0.9	1.7	1.3	m
35	0.3+0.5=0.8	1.5	1.7	m
36	0.3+0.5=0.8	1.5	1.7	m

* : Chromosome with secondary constriction

Table 19. Measurements of somatic chromosomes of *Dendrobium finisterrae* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.5+0.6+1.5=2.6*	4.1	4.2	st
2	0.5+0.6+1.5=2.6*	4.1	4.2	st
3	0.7+0.5+1.3=2.5*	3.9	2.6	sm
4	0.6+0.5+1.3=2.4*	3.8	3.0	sm
5	0.6+1.6=2.2	3.5	2.7	sm
6	0.6+1.6=2.2	3.5	2.7	sm
7	0.8+1.0=1.8	2.8	1.3	m
8	0.8+1.0=1.8	2.8	1.3	m
9	0.8+1.0=1.8	2.8	1.3	m
10	0.8+1.0=1.8	2.8	1.3	m
11	0.7+1.0=1.7	2.7	1.4	m
12	0.7+1.0=1.7	2.7	1.4	m
13	0.7+0.9=1.6	2.5	1.3	m
14	0.7+0.9=1.6	2.5	1.3	m
15	0.5+1.1=1.6	2.5	2.2	sm
16	0.5+1.1=1.6	2.5	2.2	sm
17	0.7+0.8=1.5	2.4	1.1	m
18	0.7+0.8-1.5	2.4	1.1	m
19	0.7+0.8=1.5	2.4	1.1	m
20	0.7+0.6=1.5	2.4	1.1	m
21	0.4+1.1=1.5	2.4	2.8	sm
22	0.4+1.1=1.5	2.4	2.8	sm
23	0.4+1.1=1.5	2.4	2.8	sm
24	0.4+1.1=1.5	2.4	2.8	sm
25	0.6+0.8=1.4	2.2	1.3	m
26	0.6+0.8=1.4	2.2	1.3	m
27	0.6+0.7=1.3	2.1	1.2	sm
28	0.6+0.7=1.3	2.1	1.2	m
29	0.6+0.7=1.3	2.1	1.2	m
30	0.6+0.7=1.3	2.1	1.2	m
31	0.5+0.8=1.3	2.1	1.2	m
32	0.5+0.8=1.3	2.1	1.6	m
33	0.5+0.8=1.3	2.1	1.6	m
34	0.5+0.8=1.3	2.1	1.6	m
35	0.5+0.7=1.2	1.9	1.4	m
36	0.5+0.7=1.2	1.9	1.4	m
37	0.5+0.6=1.1	1.7	1.2	m
38	0.5+0.6=1.1	1.7	1.2	m
39	0.4+0.6=1.0	1.6	1.5	m
40	0.4+0.6=1.0	1.6	1.5	m

* : Chromosome with secondary constriction

Table 20. Measurements of somatic chromosomes of *Dendrobium macrophyllum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.5+1.5=2.0	3.7	3.0	sm
2	0.5+1.5=2.0	3.7	3.0	sm
3	0.6+1.3=1.9	3.5	2.3	sm
4	0.6+1.3=1.9	3.5	2.3	sm
5	0.6+1.2=1.8	3.3	2.3	sm
6	0.6+1.2=1.8	3.3	2.3	sm
7	0.6+1.2=1.8	3.3	2.3	sm
8	0.6+1.2=1.8	3.3	2.3	sm
9	0.7+1.0=1.7	3.1	1.4	m
10	0.7+1.0=1.7	3.1	1.4	m
11	0.7+0.9=1.6	2.9	1.3	m
12	0.7+0.9=1.6	2.9	1.3	m
13	0.4+1.2=1.6	2.9	3.0	sm
14	0.4+1.2=1.6	2.9	3.0	sm
15	0.7+0.8=1.5	2.8	1.1	m
16	0.7+0.8=1.5	2.8	1.1	m
17	0.6+0.9=1.5	2.8	1.5	m
18	0.6+0.9=1.5	2.8	1.5	m
19	0.7+0.7=1.4	2.6	1.0	m
20	0.7+0.7=1.4	2.6	1.0	m
21	0.7+0.7=1.4	2.6	1.0	m
22	0.6+0.7=1.3	2.4	1.2	m
23	0.6+0.7=1.3	2.4	1.2	m
24	0.5+0.8=1.3	2.4	1.6	m
25	0.6+0.6=1.2	2.2	1.0	m
26	0.6+0.6=1.2	2.2	1.0	m
27	0.6+0.6=1.2	2.2	1.0	m
28	0.5+0.7=1.2	2.2	1.4	m
29	0.5+0.7=1.2	2.2	1.4	m
30	0.5+0.7=1.2	2.2	1.4	m
31	0.5+0.7=1.2	2.2	1.4	m
32	0.5+0.7=1.2	2.2	1.4	m
33	0.4+0.7=1.1	2.0	1.8	sm
34	0.4+0.7=1.1	2.0	1.8	sm
35	0.4+0.6=1.0	1.8	1.5	m
36	0.4+0.6=1.0	1.8	1.5	m
37	0.4+0.5=0.9	1.7	1.3	m
38	0.4+0.5=0.9	1.7	1.3	m

Table 21. Measurements of somatic chromosomes of *Dendrobium aggregatum* var. *majus* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.1=1.9	4.0	1.4	m
2	0.8+1.1=1.9	4.0	1.4	m
3	0.8+0.9=1.7	3.5	1.1	m
4	0.8+0.9=1.7	3.5	1.1	m
5	0.7+0.9=1.6	3.3	1.3	m
6	0.7+0.9=1.6	3.3	1.3	m
7	0.6+1.0=1.6	3.3	1.7	m
8	0.6+1.0=1.6	3.3	1.7	m
9	0.7+0.8=1.5	3.1	1.1	m
10	0.7+0.8=1.5	3.1	1.1	m
11	0.5+1.0=1.5	3.1	2.0	sm
12	0.5+1.0=1.5	3.1	2.0	sm
13	0.6+0.8=1.4	2.9	1.3	m
14	0.6+0.8=1.4	2.9	1.3	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.6+0.7=1.3	2.7	1.2	m
18	0.6+0.7=1.3	2.7	1.2	m
19	0.6+0.7=1.3	2.7	1.2	m
20	0.6+0.7=1.3	2.7	1.2	m
21	0.6+0.6=1.2	2.5	1.0	m
22	0.6+0.6=1.2	2.5	1.0	m
23	0.6+0.6=1.2	2.5	1.0	m
24	0.6+0.6=1.2	2.5	1.0	m
25	0.5+0.7=1.2	2.5	1.4	m
26	0.5+0.7=1.2	2.5	1.4	m
27	0.5+0.6=1.1	2.3	1.2	m
28	0.5+0.6=1.1	2.3	1.2	m
29	0.5+0.6=1.1	2.3	1.2	m
30	0.5+0.6=1.1	2.3	1.2	m
31	0.5+0.6=1.1	2.3	1.2	m
32	0.5+0.6=1.1	2.3	1.2	m
33	0.4+0.5=0.9	1.9	1.3	m
34	0.4+0.5=0.9	1.9	1.3	m
35	0.4+0.5=0.9	1.9	1.3	m
36	0.4+0.5=0.9	1.9	1.3	m
37	0.4+0.4=0.8	1.7	1.0	m
38	0.4+0.4=0.8	1.7	1.0	m

Table 22. Measurements of somatic chromosomes of *Dendrobium chrysotoxum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relativc length	Arm ratio	Position of centromere
1	1.2+1.3=2.5	3.9	1.1	m
2	1.1+1.4=2.5	3.9	1.3	m
3	1.1+1.3=2.4	3.8	1.2	m
4	1.1+1.2=2.3	3.6	1.1	m
5	1.1+1.2=2.3	3.6	1.1	m
6	1.0+1.3=2.3	3.6	1.3	m
7	1.1+1.1=2.2	3.5	1.0	m
8	1.1+1.1=2.2	3.5	1.0	m
9	0.9+1.2=2.1	3.3	1.3	m
10	0.9+1.2=2.1	3.3	1.3	m
11	0.9+1.2=2.1	3.3	1.3	m
12	0.9+1.2=2.1	3.3	1.3	m
13	0.9+1.0=1.9	3.0	1.1	m
14	0.8+1.1=1.9	3.0	1.4	m
15	0.8+1.0=1.8	2.8	1.3	m
16	0.7+1.1=1.8	2.8	1.6	m
17	0.7+1.0=1.7	2.7	1.4	m
18	0.7+1.0=1.7	2.7	1.4	m
19	0.4+1.2=1.6	2.5	3.0	sm
20	0.4+1.2=1.6	2.5	3.0	sm
21	0.7+0.8=1.5	2.4	1.1	m
22	0.7+0.8=1.5	2.4	1.1	m
23	0.7+0.7=1.4	2.2	1.0	m
24	0.6+0.8=1.4	2.2	1.3	m
25	0.6+0.7=1.3	2.0	1.2	m
26	0.6+0.7=1.3	2.0	1.2	m
27	0.4+0.9=1.3	2.0	2.3	sm
28	0.4+0.9=1.3	2.0	2.3	sm
29	0.4+0.9=1.3	2.0	2.3	sm
30	0.4+0.9=1.3	2.0	2.3	sm
31	0.4+0.9=1.3	2.0	2.3	sm
32	0.4+0.9=1.3	2.0	2.3	sm
33	0.6+0.6=1.2	1.9	1.0	m
34	0.6+0.6=1.2	1.9	1.0	m
35	0.3+0.8=1.1	1.7	2.7	sm
36	0.3+0.8=1.1	1.7	2.7	sm
37	0.4+0.5=0.9	1.4	1.3	m
38	0.4+0.5=0.9	1.4	1.3	m

Table 23. Measurements of somatic chromosomes of *Dendrobium densiflorum* at mitotic metaphase, 2n=40+1f

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.2=2.0	3.8	1.3	m
2	0.8+1.2=2.0	3.8	1.3	m
3	0.7+1.1=1.8	3.5	1.6	m
4	0.7+1.1=1.8	3.5	1.6	m
5	0.9+0.9=1.8	3.5	1.0	m
6	0.9+0.9=1.8	3.5	1.0	m
7	0.6+1.1=1.7	3.3	1.8	sm
8	0.6+1.1=1.7	3.3	1.8	sm
9	0.6+1.0=1.6	3.1	1.7	m
10	0.6+1.0=1.6	3.1	1.7	m
11	0.6+1.0=1.6	3.1	1.7	m
12	0.6+1.0=1.6	3.1	1.7	m
13	0.6+0.8=1.4	2.7	1.3	m
14	0.6+0.8=1.4	2.7	1.3	m
15	0.4+1.0=1.4	2.7	2.5	sm
16	0.4+1.0=1.4	2.7	2.5	sm
17	0.6+0.7=1.3	2.5	1.2	m
18	0.6+0.7=1.3	2.5	1.2	m
19	0.3+0.3+0.7=1.3*	2.5	1.2	m
20	0.3+0.3+0.7=1.3*	2.5	1.2	m
21	0.5+0.7=1.2	2.3	1.4	m
22	0.5+0.7=1.2	2.3	1.4	m
23	0.5+0.7=1.2	2.3	1.4	m
24	0.5+0.7=1.2	2.3	1.4	m
25	0.5+0.6=1.1	2.1	1.2	m
26	0.5+0.6=1.1	2.1	1.2	m
27	0.4+0.6=1.0	1.9	1.5	m
28	0.4+0.6=1.0	1.9	1.5	m
29	0.4+0.6=1.0	1.9	1.5	m
30	0.4+0.6=1.0	1.9	1.5	m
31	0.4+0.6=1.0	1.9	1.5	m
32	0.4+0.6=1.0	1.9	1.5	m
33	0.4+0.5=0.9	1.7	1.3	m
34	0.4+0.5=0.9	1.7	1.3	m
35	0.4+0.4=0.8	1.5	1.0	m
36	0.4+0.4=0.8	1.5	1.0	m
37	0.3+0.5=0.8	1.5	1.7	m
38	0.3+0.5=0.8	1.5	1.7	m
39	0.3+0.5=0.8	1.5	1.7	m
40	0.3+0.5=0.8	1.5	1.7	m
41	0.3+0.3=0.6	1.1	1.0	m

* : Chromosome with secondary constriction

Table 24. Measurements of somatic chromosomes of *Dendrobium dixanthum* at mitotic metaphase, 2n=40+2f

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.5=2.2	3.3	2.1	sm
2	0.7+1.5=2.2	3.3	2.1	sm
3	0.5+1.7=2.2	3.3	3.4	st
4	0.5+1.7=2.2	3.3	3.4	st
5	0.9+1.2=2.1	3.2	1.3	m
6	0.9+1.2=2.1	3.2	1.3	m
7	0.9+1.1=2.0	3.0	1.2	m
8	0.9+1.1=2.0	3.0	1.2	m
9	0.5+1.5=2.0	3.0	3.0	sm
10	0.5+1.5=2.0	3.0	3.0	sm
11	0.7+1.1=1.8	2.7	1.6	m
12	0.7+1.1=1.8	2.7	1.6	m
13	0.7+1.0=1.7	2.6	1.4	m
14	0.7+1.0=1.7	2.6	1.4	m
15	0.6+1.1=1.7	2.6	1.8	sm
16	0.6+1.1=1.7	2.6	1.8	sm
17	0.8+0.8=1.6	2.4	1.0	m
18	0.8+0.8=1.6	2.4	1.0	m
19	0.5+1.1=1.6	2.4	2.2	sm
20	0.5+1.1=1.6	2.4	2.2	sm
21	0.5+1.1=1.6	2.4	2.2	sm
22	0.7+0.8=1.5	2.3	1.1	m
23	0.7+0.8=1.5	2.3	1.1	m
24	0.7+0.8=1.5	2.3	1.1	m
25	0.5+1.0=1.5	2.3	2.0	sm
26	0.5+1.0=1.5	2.3	2.0	sm
27	0.7+0.7=1.4	2.1	1.0	m
28	0.7+0.7=1.4	2.1	1.0	m
29	0.6+0.8=1.4	2.1	1.3	m
30	0.6+0.8=1.4	2.1	1.3	m
31	0.6+0.7=1.3	2.0	1.2	m
32	0.6+0.7=1.3	2.0	1.2	m
33	0.6+0.7=1.3	2.0	1.2	m
34	0.6+0.7=1.3	2.0	1.2	m
35	0.5+0.8=1.3	2.0	1.6	m
36	0.5+0.8=1.3	2.0	1.6	m
37	0.6+0.6=1.2	1.8	1.0	m
38	0.6+0.6=1.2	1.8	1.0	m
39	0.4+0.8=1.2	1.8	2.0	sm
40	0.4+0.8=1.2	1.8	2.0	sm
41	0.4+0.5=0.9	1.4	1.3	m
42	0.4+0.4=0.8	1.2	1.0	m

Table 25. Measurements of somatic chromosomes of *Dendrobium palpebrae* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.1+1.3=2.4	4.8	1.2	m
2	1.1+1.2=2.3	4.6	1.1	m
3	0.7+1.1=1.8	3.6	1.6	m
4	0.7+1.1=1.8	3.6	1.6	m
5	0.6+1.1=1.7	3.4	1.8	sm
6	0.6+1.1=1.7	3.4	1.8	sm
7	0.7+0.9=1.6	3.2	1.3	m
8	0.7+0.8=1.5	3.0	1.1	m
9	0.7+0.8=1.5	3.0	1.1	m
10	0.6+0.8=1.4	2.8	1.3	m
11	0.6+0.8=1.4	2.8	1.3	m
12	0.6+0.8=1.4	2.8	1.3	m
13	0.6+0.7=1.3	2.6	1.2	m
14	0.6+0.7=1.3	2.6	1.2	m
15	0.6+0.7=1.3	2.6	1.2	m
16	0.6+0.7=1.3	2.6	1.2	m
17	0.4+0.9=1.3	2.6	2.2	sm
18	0.4+0.9=1.3	2.6	2.2	sm
19	0.4+0.9=1.3	2.6	2.2	sm
20	0.4+0.9=1.3	2.6	2.2	sm
21	0.5+0.6=1.1	2.2	1.2	m
22	0.5+0.6=1.1	2.2	1.2	m
23	0.4+0.7=1.1	2.2	1.8	sm
24	0.4+0.7=1.1	2.2	1.8	sm
25	0.5+0.5=1.0	2.0	1.0	m
26	0.5+0.5=1.0	2.0	1.0	m
27	0.4+0.6=1.0	2.0	1.5	m
28	0.4+0.6=1.0	2.0	1.5	m
29	0.4+0.6=1.0	2.0	1.5	m
30	0.4+0.6=1.0	2.0	1.5	m
31	0.4+0.5=0.9	1.8	1.3	m
32	0.4+0.5=0.9	1.8	1.3	m
33	0.3+0.6=0.9	1.8	2.0	sm
34	0.3+0.6=0.9	1.8	2.0	sm
35	0.4+0.4=0.8	1.6	1.0	m
36	0.4+0.4=0.8	1.6	1.0	m
37	0.3+0.5=0.8	1.6	1.7	m
38	0.3+0.5=0.8	1.6	1.7	m
39	0.3+0.4=0.7	1.4	1.3	m
40	0.3+0.4=0.7	1.4	1.3	m

Table 26. Measurements of somatic chromosomes of *Dendrobium sulcatum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+0.9=1.6	3.4	1.3	m
2	0.7+0.9=1.6	3.4	1.3	m
3	0.6+1.0=1.6	3.4	1.7	m
4	0.6+1.0=1.6	3.4	1.7	m
5	0.7+0.8=1.5	3.2	1.1	m
6	0.7+0.8=1.5	3.2	1.1	m
7	0.5+1.0=1.5	3.2	2.0	sm
8	0.5+1.0=1.5	3.2	2.0	sm
9	0.5+0.9=1.4	3.0	1.8	sm
10	0.5+0.9=1.4	3.0	1.8	sm
11	0.6+0.7=1.3	2.8	1.2	m
12	0.6+0.7=1.3	2.8	1.2	m
13	0.4+0.9=1.3	2.8	2.3	sm
14	0.4+0.9=1.3	2.8	2.3	sm
15	0.6+0.6=1.2	2.5	1.0	m
16	0.6+0.6=1.2	2.5	1.0	m
17	0.5+0.7=1.2	2.5	1.4	m
18	0.5+0.7=1.2	2.5	1.4	m
19	0.5+0.7=1.2	2.5	1.4	m
20	0.5+0.7=1.2	2.5	1.4	m
21	0.5+0.6=1.1	2.3	1.2	m
22	0.5+0.6=1.1	2.3	1.2	m
23	0.5+0.6=1.1	2.3	1.2	m
24	0.5+0.6=1.1	2.3	1.2	m
25	0.4+0.7=1.1	2.3	1.8	sm
26	0.4+0.7=1.1	2.3	1.8	sm
27	0.4+0.7=1.1	2.3	1.8	sm
28	0.5+0.5=1.0	2.1	1.0	m
29	0.5+0.5=1.0	2.1	1.0	m
30	0.4+0.6=1.0	2.1	1.5	m
31	0.4+0.6=1.0	2.1	1.5	m
32	0.4+0.6=1.0	2.1	1.5	m
33	0.4+0.5=0.9	1.9	1.3	m
34	0.4+0.5=0.9	1.9	1.3	m
35	0.4+0.5=0.9	1.9	1.3	m
36	0.4+0.5=0.9	1.9	1.3	m
37	0.3+0.5=0.8	1.7	1.7	m
38	0.3+0.5=0.8	1.7	1.7	m
39	0.3+0.5=0.8	1.7	1.7	m
40	0.3+0.5=0.8	1.7	1.7	m

Table 27. Measurements of somatic chromosomes of *Dendrobium albo-sanguineum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.3=2.1	4.9	1.6	m
2	0.9+1.0=1.9	4.4	1.1	m
3	0.7+1.1=1.8	4.2	1.6	m
4	0.7+1.1=1.8	4.2	1.6	m
5	0.6+1.0=1.6	3.7	1.7	m
6	0.6+0.9=1.5	3.5	1.5	m
7	0.5+0.9=1.4	3.2	1.8	sm
8	0.5+0.9=1.4	3.2	1.8	sm
9	0.6+0.7=1.3	3.0	1.2	m
10	0.6+0.7=1.3	3.0	1.2	m
11	0.6+0.7=1.3	3.0	1.2	m
12	0.6+0.7=1.3	3.0	1.2	m
13	0.5+0.6=1.1	2.6	1.2	m
14	0.5+0.6=1.1	2.6	1.2	m
15	0.5+0.6=1.1	2.6	1.2	m
16	0.5+0.6=1.1	2.6	1.2	m
17	0.4+0.7=1.1	2.6	1.8	sm
18	0.4+0.7=1.1	2.6	1.8	sm
19	0.4+0.7=1.1	2.6	1.8	sm
20	0.4+0.7=1.1	2.6	1.8	sm
21	0.4+0.6=1.0	2.3	1.5	m
22	0.4+0.6=1.0	2.3	1.5	m
23	0.4+0.6=1.0	2.3	1.5	m
24	0.4+0.6=1.0	2.3	1.5	m
25	0.4+0.6=1.0	2.3	1.5	m
26	0.4+0.6=1.0	2.3	1.5	m
27	0.3+0.6=0.9	2.1	2.0	sm
28	0.3+0.6=0.9	2.1	2.0	sm
29	0.3+0.6=0.9	2.1	2.0	sm
30	0.3+0.6=0.9	2.1	2.0	sm
31	0.4+0.4=0.8	1.9	1.0	m
32	0.4+0.4=0.8	1.9	1.0	m
33	0.4+0.4=0.8	1.9	1.0	m
34	0.4+0.4=0.8	1.9	1.0	m
35	0.3+0.4=0.7	1.6	1.3	m
36	0.3+0.4=0.7	1.6	1.3	m
37	0.3+0.4=0.7	1.6	1.3	m
38	0.3+0.4=0.7	1.6	1.3	m
39	0.3+0.4=0.7	1.6	1.3	m
40	0.3+0.4=0.7	1.6	1.3	m

Table 28. Measurements of somatic chromosomes of *Dendrobium brymerianum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.2=1.9	3.8	1.6	m
2	0.7+1.2=1.9	3.8	1.6	m
3	0.6+1.3=1.9	3.8	2.2	sm
4	0.7+1.1=1.8	3.6	1.6	m
5	0.5+1.3=1.8	3.6	2.6	sm
6	0.8+0.9=1.7	3.4	1.1	m
7	0.8+0.9=1.7	3.4	1.1	m
8	0.8+0.8=1.6	3.2	1.0	m
9	0.6+0.9=1.5	3.0	1.5	m
10	0.6+0.9=1.5	3.0	1.5	m
11	0.6+0.9=1.5	3.0	1.5	m
12	0.6+0.9=1.5	3.0	1.5	m
13	0.6+0.8=1.4	2.8	1.3	m
14	0.6+0.8=1.4	2.8	1.3	m
15	0.6+0.8=1.4	2.8	1.3	m
16	0.6+0.8=1.4	2.8	1.3	m
17	0.5+0.8=1.3	2.6	1.6	m
18	0.5+0.8=1.3	2.6	1.6	m
19	0.5+0.8=1.3	2.6	1.6	m
20	0.5+0.8=1.3	2.6	1.6	m
21	0.4+0.8=1.2	2.4	2.0	sm
22	0.4+0.8=1.2	2.4	2.0	sm
23	0.4+0.7=1.1	2.2	1.8	sm
24	0.4+0.7=1.1	2.2	1.8	sm
25	0.3+0.8=1.1	2.2	2.7	sm
26	0.3+0.8=1.1	2.2	2.7	sm
27	0.4+0.6=1.0	2.0	1.5	m
28	0.4+0.6=1.0	2.0	1.5	m
29	0.4+0.6=1.0	2.0	1.5	m
30	0.4+0.6=1.0	2.0	1.5	m
31	0.4+0.6=1.0	2.0	1.5	m
32	0.4+0.6=1.0	2.0	1.5	m
33	0.3+0.7=1.0	2.0	2.3	sm
34	0.3+0.7=1.0	2.0	2.3	sm
35	0.3+0.7=1.0	2.0	2.3	sm
36	0.3+0.7=1.0	2.0	2.3	sm
37	0.4+0.4=0.8	1.6	1.0	m
38	0.4+0.4=0.8	1.6	1.0	m

Table 29. Measurements of somatic chromosomes of *Dendrobium candidum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.0=1.8	3.6	1.3	m
2	0.8+1.0=1.8	3.6	1.3	m
3	0.7+1.0=1.7	3.4	1.4	m
4	0.7+1.0=1.7	3.4	1.4	m
5	0.7+1.0=1.7	3.4	1.4	m
6	0.5+1.2=1.7	3.4	2.4	sm
7	0.5+1.1=1.6	3.2	2.2	sm
8	0.8+0.8=1.6	3.2	1.0	m
9	0.8+0.8=1.6	3.2	1.0	m
10	0.6+0.8=1.4	2.8	1.3	m
11	0.6+0.8=1.4	2.8	1.3	m
12	0.6+0.8=1.4	2.8	1.3	m
13	0.5+0.9=1.4	2.8	1.8	sm
14	0.5+0.9=1.4	2.8	1.8	sm
15	0.5+0.9=1.4	2.8	1.8	sm
16	0.5+0.9=1.4	2.8	1.8	sm
17	0.6+0.7=1.3	2.6	1.2	m
18	0.6+0.7=1.3	2.6	1.2	m
19	0.6+0.7=1.3	2.6	1.2	m
20	0.6+0.7=1.3	2.6	1.2	m
21	0.6+0.7=1.3	2.6	1.2	m
22	0.6+0.7=1.3	2.6	1.2	m
23	0.5+0.8=1.3	2.6	1.6	m
24	0.5+0.8=1.3	2.6	1.6	m
25	0.4+0.8=1.2	2.4	2.0	sm
26	0.4+0.8=1.2	2.4	2.0	sm
27	0.4+0.8=1.2	2.0	2.0	sm
28	0.4+0.8=1.2	2.4	2.0	sm
29	0.4+0.7=1.1	2.2	1.8	sm
30	0.4+0.7=1.1	2.2	1.8	sm
31	0.4+0.6=1.0	2.0	1.5	m
32	0.4+0.6=1.0	2.0	1.5	m
33	0.4+0.6=1.0	2.0	1.5	m
34	0.4+0.6=1.0	2.0	1.5	m
35	0.4+0.5=0.9	1.8	1.3	m
36	0.4+0.5=0.9	1.8	1.3	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.5=0.9	1.8	1.3	m

Table 30. Measurements of somatic chromosomes of *Dendrobium crassinode* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.0=1.8	3.7	1.3	m
2	0.8+1.0=1.8	3.7	1.3	m
3	0.8+0.9=1.7	3.5	1.1	m
4	0.8+0.9=1.7	3.5	1.1	m
5	0.8+0.9=1.7	3.5	1.1	m
6	0.8+0.9=1.7	3.5	1.1	m
7	0.7+0.9=1.6	3.3	1.3	m
8	0.7+0.9=1.6	3.3	1.3	m
9	0.7+0.8=1.5	3.0	1.1	m
10	0.7+0.8=1.5	3.0	1.1	m
11	0.7+0.8=1.5	3.0	1.1	m
12	0.7+0.8=1.5	3.0	1.1	m
13	0.6+0.8=1.4	2.8	1.3	m
14	0.6+0.8=1.4	2.8	1.3	m
15	0.6+0.8=1.4	2.8	1.3	m
16	0.6+0.8=1.4	2.8	1.3	m
17	0.5+0.8=1.3	2.6	1.6	m
18	0.5+0.8=1.3	2.6	1.6	m
19	0.4+0.9=1.3	2.6	2.3	sm
20	0.4+0.9=1.3	2.6	2.3	sm
21	0.6+0.6=1.2	2.4	1.0	m
22	0.6+0.6=1.2	2.4	1.0	m
23	0.5+0.7=1.2	2.4	1.4	m
24	0.5+0.7=1.2	2.4	1.4	m
25	0.4+0.8=1.2	2.4	2.0	sm
26	0.4+0.8=1.2	2.4	2.0	sm
27	0.4+0.8=1.2	2.4	2.0	sm
28	0.4+0.8=1.2	2.4	2.0	sm
29	0.4+0.7=1.1	2.2	1.8	sm
30	0.4+0.7=1.1	2.2	1.8	sm
31	0.4+0.6=1.0	2.0	1.5	m
32	0.4+0.6=1.0	2.0	1.5	m
33	0.3+0.6=0.9	1.8	2.0	sm
34	0.3+0.6=0.9	1.8	2.0	sm
35	0.3+0.5=0.8	1.6	1.7	m
36	0.3+0.5=0.8	1.6	1.7	m
37	0.3+0.5=0.8	1.6	1.7	m
38	0.3+0.5=0.8	1.6	1.7	m

Table 31. Measurements of somatic chromosomes of *Dendrobium falconeri* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.0=2.0	3.7	1.0	m
2	0.9+1.1=2.0	3.7	1.2	m
3	0.6+0.6+1.7=1.9*	3.5	2.2	sm
4	0.6+0.6+1.7=1.9*	3.5	2.2	sm
5	0.9+1.0=1.9	3.5	1.1	m
6	0.8+1.0=1.8	3.3	1.3	m
7	0.7+1.1=1.8	3.3	1.6	m
8	0.7+1.1=1.8	3.3	1.6	m
9	0.5+1.2=1.7	3.1	2.4	sm
10	0.5+1.2=1.7	3.1	2.4	sm
11	0.7+0.9=1.6	3.0	1.3	m
12	0.7+0.9=1.6	3.0	1.3	m
13	0.7+0.9=1.6	3.0	1.3	m
14	0.7+0.9=1.6	3.0	1.3	m
15	0.3+0.3+0.9=1.5*	2.8	1.5	m
16	0.3+0.3+0.9=1.5*	2.8	1.5	m
17	0.6+0.8=1.4	2.6	1.3	m
18	0.6+0.8=1.4	2.6	1.3	m
19	0.6+0.8=1.4	2.6	1.3	m
20	0.6+0.8=1.4	2.6	1.3	m
21	0.6+0.7=1.3	2.4	1.2	m
22	0.6+0.7=1.3	2.4	1.2	m
23	0.5+0.8=1.3	2.4	1.6	m
24	0.5+0.8=1.3	2.4	1.6	m
25	0.5+0.8=1.3	2.4	1.6	m
26	0.5+0.8=1.3	2.4	1.6	m
27	0.5+0.8=1.3	2.4	1.6	m
28	0.5+0.8=1.3	2.4	1.6	m
29	0.5+0.7=1.2	2.2	1.4	m
30	0.5+0.7=1.2	2.2	1.4	m
31	0.5+0.6=1.1	2.0	1.2	m
32	0.5+0.6=1.1	2.0	1.2	m
33	0.4+0.6=1.0	1.8	1.5	m
34	0.4+0.6=1.0	1.8	1.5	m
35	0.4+0.5=0.9	1.7	1.3	m
36	0.4+0.5=0.9	1.7	1.3	m
37	0.4+0.5=0.9	1.7	1.3	m
38	0.4+0.5=0.9	1.7	1.3	m

* : Chromosome with secondary constriction

Table 32. Measurements of somatic chromosomes of *Dendrobium findleyanum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.0=1.8	3.7	1.3	m
2	0.8+0.8=1.6	3.3	1.0	m
3	0.7+0.9=1.6	3.3	1.3	m
4	0.7+0.9=1.6	3.3	1.3	m
5	0.7+0.9=1.6	3.3	1.3	m
6	0.7+0.9=1.6	3.3	1.3	m
7	0.7+0.9=1.6	3.3	1.3	m
8	0.7+0.9=1.6	3.3	1.3	m
9	0.7+0.8=1.5	3.1	1.1	m
10	0.7+0.8=1.5	3.1	1.1	m
11	0.6+0.8=1.4	2.9	1.3	m
12	0.6+0.8=1.4	2.9	1.3	m
13	0.5+0.9=1.4	2.9	1.8	sm
14	0.5+0.9=1.4	2.9	1.8	sm
15	0.5+0.9=1.4	2.9	1.8	sm
16	0.5+0.9=1.4	2.9	1.8	sm
17	0.6+0.7=1.3	2.7	1.2	m
18	0.6+0.7=1.3	2.7	1.2	m
19	0.6+0.7=1.3	2.7	1.2	m
20	0.6+0.7=1.3	2.7	1.2	m
21	0.6+0.6=1.2	2.5	1.0	m
22	0.6+0.6=1.2	2.5	1.0	m
23	0.5+0.7=1.2	2.5	1.4	m
24	0.5+0.7=1.2	2.5	1.4	m
25	0.5+0.7=1.2	2.5	1.4	m
26	0.5+0.7=1.2	2.5	1.4	m
27	0.5+0.6=1.1	2.3	1.2	m
28	0.5+0.6=1.1	2.3	1.2	m
29	0.4+0.7=1.1	2.3	1.8	sm
30	0.4+0.7=1.1	2.3	1.8	sm
31	0.4+0.6=1.0	2.0	1.5	m
32	0.4+0.6=1.0	2.0	1.5	m
33	0.4+0.6=1.0	2.0	1.5	m
34	0.4+0.6=1.0	2.0	1.5	m
35	0.4+0.5=0.9	1.8	1.3	m
36	0.4+0.5=0.9	1.8	1.3	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.5=0.9	1.8	1.3	m

Table 33. Measurements of somatic chromosomes of *Dendrobium friedricksianum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.2=2.1	4.2	1.3	m
2	0.9+1.1=2.0	3.9	1.2	m
3	1.0+1.0=2.0	3.9	1.0	m
4	0.9+0.9=1.8	3.6	1.0	m
5	0.8+1.0=1.8	3.6	1.3	m
6	0.7+1.0=1.7	3.4	1.4	m
7	0.6+1.1=1.7	3.4	1.8	sm
8	0.5+1.1=1.6	3.2	2.2	sm
9	0.5+1.1=1.6	3.2	2.2	sm
10	0.7+0.9=1.6	3.2	1.3	m
11	0.7+0.9=1.6	3.2	1.3	m
12	0.7+0.8=1.5	3.0	1.1	m
13	0.7+0.8=1.5	3.0	1.1	m
14	0.7+0.8=1.5	3.0	1.1	m
15	0.7+0.7=1.4	2.8	1.0	m
16	0.6+0.8=1.4	2.8	1.3	m
17	0.6+0.8=1.4	2.8	1.3	m
18	0.6+0.8=1.4	2.8	1.3	m
19	0.6+0.7=1.3	2.6	1.2	m
20	0.6+0.7=1.3	2.6	1.2	m
21	0.5+0.7=1.2	2.4	1.4	m
22	0.5+0.7=1.2	2.4	1.4	m
23	0.4+0.8=1.2	2.4	2.0	sm
24	0.4+0.8=1.2	2.4	2.0	sm
25	0.4+0.8=1.2	2.4	2.0	sm
26	0.4+0.8=1.2	2.4	2.0	sm
27	0.5+0.6=1.1	2.2	1.2	m
28	0.5+0.6=1.1	2.2	1.2	m
29	0.4+0.7=1.1	2.2	1.8	sm
30	0.4+0.7=1.1	2.2	1.8	sm
31	0.4+0.6=1.0	2.0	1.5	m
32	0.4+0.6=1.0	2.0	1.5	m
33	0.4+0.6=1.0	2.0	1.5	m
34	0.4+0.6=1.0	2.0	1.5	m
35	0.4+0.5=0.9	1.8	1.3	m
36	0.4+0.5=0.9	1.8	1.3	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.5=0.9	1.8	1.3	m

Table 34. Measurements of somatic chromosomes of *Dendrobium heterocarpum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.0=1.9	3.8	1.1	m
2	0.9+0.9=1.8	3.6	1.0	m
3	0.8+1.0=1.8	3.6	1.3	m
4	0.8+1.0=1.8	3.6	1.3	m
5	0.8+0.9=1.7	3.4	1.1	m
6	0.7+0.9=1.6	3.2	1.3	m
7	0.7+0.9=1.6	3.2	1.3	m
8	0.6+0.8=1.4	2.8	1.3	m
9	0.6+0.8=1.4	2.8	1.3	m
10	0.6+0.8=1.4	2.8	1.3	m
11	0.5+0.9=1.4	2.8	1.8	sm
12	0.5+0.9=1.4	2.8	1.8	sm
13	0.6+0.7=1.3	2.6	1.2	m
14	0.6+0.7=1.3	2.6	1.2	m
15	0.6+0.7=1.3	2.6	1.2	m
16	0.6+0.7=1.3	2.6	1.2	m
17	0.4+0.9=1.3	2.6	2.3	sm
18	0.4+0.9=1.3	2.6	2.3	sm
19	0.4+0.9=1.3	2.6	2.3	sm
20	0.4+0.9=1.3	2.6	2.3	sm
21	0.6+0.6=1.2	2.4	1.0	m
22	0.6+0.6=1.2	2.4	1.0	m
23	0.6+0.6=1.2	2.4	1.0	m
24	0.6+0.6=1.2	2.4	1.0	m
25	0.5+0.6=1.1	2.2	1.2	m
26	0.5+0.6=1.1	2.2	1.2	m
27	0.5+0.6=1.1	2.2	1.2	m
28	0.5+0.6=1.1	2.2	1.2	m
29	0.5+0.6=1.1	2.2	1.2	m
30	0.5+0.6=1.1	2.2	1.2	m
31	0.5+0.6=1.1	2.2	1.2	m
32	0.5+0.6=1.1	2.2	1.2	m
33	0.5+0.6=1.1	2.2	1.2	m
34	0.5+0.6=1.1	2.2	1.2	m
35	0.4+0.7=1.1	2.2	1.8	sm
36	0.4+0.7=1.1	2.2	1.8	sm
37	0.4+0.6=1.0	2.0	1.5	m
38	0.4+0.6=1.0	2.0	1.5	m

Table 35. Measurements of somatic chromosomes of *Dendrobium monile* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+0.9=1.8	3.3	1.0	m
2	0.9+0.9=1.8	3.3	1.0	m
3	0.8+1.0=1.8	3.3	1.3	m
4	0.8+1.0=1.8	3.3	1.3	m
5	0.8+0.9=1.7	3.1	1.1	m
6	0.8+0.9=1.7	3.1	1.1	m
7	0.8+0.9=1.7	3.1	1.1	m
8	0.8+0.9=1.7	3.1	1.1	m
9	0.8+0.8=1.6	2.9	1.0	m
10	0.8+0.8=1.6	2.9	1.0	m
11	0.8+0.8=1.6	2.9	1.0	m
12	0.8+0.8=1.6	2.9	1.0	m
13	0.7+0.9=1.6	2.9	1.3	m
14	0.7+0.9=1.6	2.9	1.3	m
15	0.7+0.8=1.5	2.7	1.1	m
16	0.7+0.8=1.5	2.7	1.1	m
17	0.7+0.8=1.5	2.7	1.1	m
18	0.7+0.8=1.5	2.7	1.1	m
19	0.3+0.4+0.8=1.5*	2.7	1.1	m
20	0.3+0.4+0.8=1.5*	2.7	1.1	m
21	0.6+0.8=1.4	2.6	1.3	m
22	0.6+0.8=1.4	2.6	1.3	m
23	0.5+0.9=1.4	2.6	1.8	sm
24	0.5+0.9=1.4	2.6	1.8	sm
25	0.6+0.7=1.3	2.4	1.2	m
26	0.6+0.7=1.3	2.4	1.2	m
27	0.5+0.8=1.3	2.4	1.6	m
28	0.5+0.8=1.3	2.4	1.6	m
29	0.5+0.8=1.3	2.4	1.6	m
30	0.5+0.8=1.3	2.4	1.6	m
31	0.4+0.8=1.2	2.2	2.0	sm
32	0.4+0.8=1.2	2.2	2.0	sm
33	0.5+0.6=1.1	2.0	1.2	m
34	0.5+0.6=1.1	2.0	1.2	m
35	0.5+0.6=1.1	2.0	1.2	m
36	0.4+0.7=1.1	2.0	1.8	sm
37	0.3+0.7=1.0	1.8	2.3	sm
38	0.3+0.7=1.0	1.8	2.3	sm

* : Chromosome with secondary constriction

Table 36. Measurements of somatic chromosomes of *Dendrobium moschatum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+1.3=1.9	3.8	2.2	sm
2	0.7+1.1=1.8	3.6	1.6	m
3	0.7+1.1=1.8	3.6	1.6	m
4	0.7+1.0=1.7	3.4	1.4	m
5	0.8+0.8=1.6	3.2	1.0	m
6	0.8+0.8=1.6	3.2	1.0	m
7	0.8+0.8=1.6	3.2	1.0	m
8	0.8+0.8=1.6	3.2	1.0	m
9	0.6+0.9=1.5	3.0	1.5	m
10	0.6+0.9=1.5	3.0	1.5	m
11	0.6+0.9=1.5	3.0	1.5	m
12	0.6+0.9=1.5	3.0	1.5	m
13	0.6+0.8=1.4	2.8	1.3	m
14	0.6+0.8=1.4	2.8	1.3	m
15	0.5+0.9=1.4	2.8	1.8	sm
16	0.5+0.9=1.4	2.8	1.8	sm
17	0.6+0.7=1.3	2.6	1.2	m
18	0.6+0.7=1.3	2.6	1.2	m
19	0.5+0.8=1.3	2.6	1.6	m
20	0.5+0.8=1.3	2.6	1.6	m
21	0.6+0.6=1.2	2.4	1.0	m
22	0.6+0.6=1.2	2.4	1.0	m
23	0.4+0.8=1.2	2.4	2.0	sm
24	0.4+0.8=1.2	2.4	2.0	sm
25	0.5+0.6=1.1	2.2	1.2	m
26	0.5+0.6=1.1	2.2	1.2	m
27	0.5+0.6=1.1	2.2	1.2	m
28	0.5+0.6=1.1	2.2	1.2	m
29	0.4+0.7=1.1	2.2	1.8	sm
30	0.5+0.5=1.0	2.0	1.0	m
31	0.5+0.5=1.0	2.0	1.0	m
32	0.4+0.6=1.0	2.0	1.5	m
33	0.4+0.6=1.0	2.0	1.5	m
34	0.4+0.6=1.0	2.0	1.5	m
35	0.4+0.6=1.0	2.0	1.5	m
36	0.4+0.6=1.0	2.0	1.5	m
37	0.4+0.6=1.0	2.0	1.5	m
38	0.4+0.5=0.9	1.8	1.2	m

Table 37. Measurements of somatic chromosomes of *Dendrobium nobile* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.5=2.5	3.8	1.5	m
2	1.0+1.3=2.3	3.5	1.3	m
3	1.0+1.3=2.3	3.5	1.3	m
4	1.0+1.3=2.3	3.5	1.3	m
5	1.0+1.1=2.1	3.2	1.1	m
6	1.0+1.1=2.1	3.2	1.1	m
7	0.7+1.4=2.1	3.2	2.0	sm
8	0.7+1.3=2.0	3.0	1.9	sm
9	0.9+0.5+0.5=1.9*	2.9	1.1	m
10	0.8+0.7+0.8=2.3*	3.5	1.9	sm
11	0.8+1.1=1.9	2.9	1.4	m
12	0.8+1.1=1.9	2.9	1.4	m
13	0.7+1.2=1.9	2.9	1.7	m
14	0.7+1.2=1.9	2.9	1.7	m
15	0.6+1.3=1.9	2.9	2.2	sm
16	0.6+1.3=1.9	2.9	2.2	sm
17	0.8+1.0=1.8	2.7	1.3	m
18	0.7+1.1=1.8	2.7	1.6	m
19	0.6+1.2=1.8	2.7	2.0	sm
20	0.6+1.2=1.8	2.7	2.0	sm
21	0.8+0.9=1.7	2.6	1.1	m
22	0.8+0.9=1.7	2.6	1.1	m
23	0.6+1.0=1.6	2.4	1.7	m
24	0.7+0.8=1.5	2.3	1.1	m
25	0.7+0.8=1.5	2.3	1.1	m
26	0.7+0.8=1.5	2.3	1.1	m
27	0.6+0.9=1.5	2.3	1.5	m
28	0.5+1.0=1.5	2.3	2.0	sm
29	0.6+0.8=1.4	2.1	1.3	m
30	0.6+0.8=1.4	2.1	1.3	m
31	0.6+0.7=1.3	2.0	1.2	m
32	0.6+0.7=1.3	2.0	1.2	m
33	0.5+0.8=1.3	2.0	1.6	m
34	0.4+0.9=1.3	2.0	2.3	sm
35	0.5+0.7=1.2	1.8	1.4	m
36	0.5+0.7=1.2	1.8	1.4	m
37	0.5+0.7=1.2	1.8	1.4	m
38	0.5+0.7=1.2	1.8	1.4	m

* : Chromosome with secondary constriction

Table 38. Measurements of somatic chromosomes of *Dendrobium parishii* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.2+1.4=2.6	4.1	1.2	m
2	1.2+1.2=2.4	3.8	1.0	m
3	1.1+1.3=2.4	3.8	1.2	m
4	1.0+1.4=2.4	3.8	1.4	m
5	1.0+1.4=2.4	3.8	1.4	m
6	0.9+1.5=2.4	3.8	1.7	m
7	0.9+1.2=2.1	3.3	1.3	m
8	0.9+1.1=2.0	3.1	1.2	m
9	0.6+1.4=2.0	3.1	2.3	sm
10	0.8+1.1=1.9	3.0	1.4	m
11	0.6+1.2=1.8	2.8	2.0	sm
12	0.7+1.0=1.7	2.7	1.4	m
13	0.7+1.0=1.7	2.7	1.4	m
14	0.7+0.9=1.6	2.5	1.3	m
15	0.7+0.9=1.6	2.5	1.3	m
16	0.7+0.9=1.6	2.5	1.3	m
17	0.6+1.0=1.6	2.5	1.7	m
18	0.6+1.0=1.6	2.5	1.7	m
19	0.6+1.0=1.6	2.5	1.7	m
20	0.6+1.0=1.6	2.5	1.7	m
21	0.7+0.8=1.5	2.4	1.1	m
22	0.7+0.8=1.5	2.4	1.1	m
23	0.6+0.9=1.5	2.4	1.5	m
24	0.6+0.9=1.5	2.4	1.5	m
25	0.6+0.9=1.5	2.4	1.5	m
26	0.6+0.9=1.5	2.4	1.5	m
27	0.6+0.8=1.4	2.2	1.3	m
28	0.6+0.8=1.4	2.2	1.3	m
29	0.6+0.8=1.4	2.2	1.3	m
30	0.6+0.8=1.4	2.2	1.3	m
31	0.5+0.9=1.4	2.2	1.8	sm
32	0.5+0.9=1.4	2.2	1.8	sm
33	0.5+0.9=1.4	2.2	1.8	sm
34	0.5+0.9=1.4	2.2	1.8	sm
35	0.5+0.8=1.3	2.0	1.6	m
36	0.4+0.6=1.0	1.4	1.3	m
37	0.4+0.6=1.0	1.4	1.3	m
38	0.4+0.5=0.9	1.4	1.3	m

Table 39. Measurements of somatic chromosomes of *Dendrobium pierardii* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.1=2.0	4.2	1.2	m
2	0.9+1.0=1.9	4.0	1.1	m
3	0.8+1.0=1.8	3.8	1.3	m
4	0.8+1.0=1.8	3.8	1.3	m
5	0.7+0.9=1.6	3.4	1.3	m
6	0.6+0.8=1.4	3.0	1.3	m
7	0.7+0.7=1.4	3.0	1.0	m
8	0.7+0.7=1.4	3.0	1.0	m
9	0.4+1.0=1.4	3.0	2.5	sm
10	0.4+1.0=1.4	3.0	2.5	sm
11	0.6+0.7=1.3	2.8	1.2	m
12	0.6+0.7=1.3	2.8	1.2	m
13	0.5+0.7=1.2	2.5	1.4	m
14	0.5+0.7=1.2	2.5	1.4	m
15	0.5+0.7=1.2	2.5	1.4	m
16	0.5+0.7=1.2	2.5	1.4	m
17	0.6+0.6=1.2	2.5	1.0	m
18	0.6+0.6=1.2	2.5	1.0	m
19	0.4+0.8=1.2	2.5	2.0	sm
20	0.4+0.8=1.2	2.5	2.0	sm
21	0.5+0.6=1.1	2.3	1.2	m
22	0.5+0.6=1.1	2.3	1.2	m
23	0.5+0.6=1.1	2.3	1.2	m
24	0.5+0.6=1.1	2.3	1.2	m
25	0.5+0.6=1.1	2.3	1.2	m
26	0.5+0.6=1.1	2.3	1.2	m
27	0.5+0.6=1.1	2.3	1.2	m
28	0.5+0.6=1.1	2.3	1.2	m
29	0.5+0.6=1.1	2.3	1.2	m
30	0.5+0.6=1.1	2.3	1.2	m
31	0.4+0.6=1.0	2.1	1.5	m
32	0.4+0.6=1.0	2.1	1.5	m
33	0.4+0.6=1.0	2.1	1.5	m
34	0.4+0.6=1.0	2.1	1.5	m
35	0.4+0.6=1.0	2.1	1.5	m
36	0.4+0.6=1.0	2.1	1.5	m
37	0.4+0.5=0.9	1.9	1.3	m
38	0.4+0.5=0.9	1.9	1.3	m

Table 40. Measurements of somatic chromosomes of *Dendrobium superbum* var. *album* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.4+1.5=2.9	4.3	1.1	m
2	1.1+1.4=2.5	3.7	1.3	m
3	1.0+1.3=2.3	3.4	1.3	m
4	1.0+1.3=2.3	3.4	1.3	m
5	1.0+1.3=2.3	3.4	1.3	m
6	0.9+1.3=2.2	3.3	1.4	m
7	0.8+1.3=2.1	3.1	1.6	m
8	0.8+1.3=2.1	3.1	1.6	m
9	0.8+1.2=2.0	3.0	1.5	m
10	0.7+1.2=1.9	2.8	1.7	m
11	0.7+1.1=1.8	2.7	1.6	m
12	0.7+1.1=1.8	2.7	1.6	m
13	0.7+1.1=1.8	2.7	1.6	m
14	0.7+1.1=1.8	2.7	1.6	m
15	0.7+1.0=1.7	2.5	1.4	m
16	0.7+1.0=1.7	2.5	1.4	m
17	0.7+1.0=1.7	2.5	1.4	m
18	0.7+1.0=1.7	2.5	1.4	m
19	0.7+1.0=1.7	2.5	1.4	m
20	0.7+1.0=1.7	2.5	1.4	m
21	0.7+1.0=1.7	2.5	1.4	m
22	0.7+1.0=1.7	2.5	1.4	m
23	0.7+0.9=1.6	2.4	1.3	m
24	0.7+0.9=1.6	2.4	1.3	m
25	0.7+0.9=1.6	2.4	1.3	m
26	0.7+0.9=1.6	2.4	1.3	m
27	0.7+0.9=1.6	2.4	1.3	m
28	0.7+0.9=1.6	2.4	1.3	m
29	0.6+0.9=1.5	2.2	1.5	m
30	0.6+0.9=1.5	2.2	1.5	m
31	0.5+1.0=1.5	2.2	2.0	sm
32	0.5+1.0=1.5	2.2	2.0	sm
33	0.7+0.7=1.4	2.1	1.0	m
34	0.7+0.7=1.4	2.1	1.0	m
35	0.6+0.8=1.4	2.1	1.3	m
36	0.6+0.6=1.2	1.8	1.0	m
37	0.6+0.6=1.2	1.8	1.0	m
38	0.6+0.6=1.2	1.8	1.0	m

Table 41. Measurements of somatic chromosomes of *Dendrobium tortile* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.3=2.2	4.2	1.4	m
2	0.9+1.3=2.2	4.2	1.4	m
3	0.9+1.1=2.0	3.8	1.2	m
4	0.9+1.1=2.0	3.8	1.2	m
5	0.5+1.2=1.7	3.2	2.4	sm
6	0.5+1.2=1.7	3.2	2.4	sm
7	0.6+1.0=1.6	3.0	1.7	m
8	0.6+1.0=1.6	3.0	1.7	m
9	0.7+0.8=1.5	2.8	1.1	m
10	0.7+0.8=1.5	2.8	1.1	m
11	0.7+0.8=1.5	2.8	1.1	m
12	0.7+0.8=1.5	2.8	1.1	m
13	0.6+0.9=1.5	2.8	1.5	m
14	0.6+0.9=1.5	2.8	1.5	m
15	0.6+0.9=1.5	2.8	1.5	m
16	0.6+0.9=1.5	2.8	1.5	m
17	0.7+0.7=1.4	2.7	1.0	m
18	0.6+0.8=1.4	2.7	1.3	m
19	0.5+0.9=1.4	2.7	1.8	sm
20	0.5+0.9=1.4	2.7	1.8	sm
21	0.5+0.8=1.3	2.5	1.6	m
22	0.4+0.9=1.3	2.5	2.3	sm
23	0.4+0.9=1.3	2.5	2.3	sm
24	0.5+0.7=1.2	2.3	1.4	m
25	0.5+0.7=1.2	2.3	1.4	m
26	0.5+0.7=1.2	2.3	1.4	m
27	0.5+0.7=1.2	2.3	1.4	m
28	0.5+0.7=1.2	2.3	1.4	m
29	0.4+0.7=1.1	2.1	1.8	sm
30	0.4+0.7=1.1	2.1	1.8	sm
31	0.4+0.7=1.1	2.1	1.8	sm
32	0.4+0.7=1.1	2.1	1.8	sm
33	0.5+0.6=1.1	2.1	1.2	m
34	0.4+0.6=1.0	1.9	1.5	m
35	0.5+0.5=1.0	1.9	1.5	m
36	0.5+0.5=1.0	1.9	1.5	m
37	0.4+0.5=0.9	1.7	1.3	m
38	0.4+0.5=0.9	1.7	1.3	m

Table 42. Measurements of somatic chromosomes of *Dendrobium wardianum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.0=1.9	3.9	1.1	m
2	0.9+1.0=1.9	3.9	1.1	m
3	0.8+0.9=1.7	3.5	1.1	m
4	0.8+0.9=1.7	3.5	1.1	m
5	0.7+0.8=1.5	3.1	1.1	m
6	0.7+0.8=1.5	3.1	1.1	m
7	0.6+0.9=1.5	3.1	1.5	m
8	0.6+0.9=1.5	3.1	1.5	m
9	0.6+0.8=1.4	2.9	1.3	m
10	0.6+0.8=1.4	2.9	1.3	m
11	0.6+0.8=1.4	2.9	1.3	m
12	0.6+0.8=1.4	2.9	1.3	m
13	0.6+0.7=1.3	2.7	1.2	m
14	0.6+0.7=1.3	2.7	1.2	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.6+0.7=1.3	2.7	1.2	m
18	0.6+0.7=1.3	2.7	1.2	m
19	0.6+0.7=1.3	2.7	1.2	m
20	0.6+0.7=1.3	2.7	1.2	m
21	0.6+0.6=1.2	2.5	1.0	m
22	0.6+0.6=1.2	2.5	1.0	m
23	0.5+0.7=1.2	2.5	1.4	m
24	0.5+0.7=1.2	2.5	1.4	m
25	0.5+0.6=1.1	2.3	1.2	m
26	0.5+0.6=1.1	2.3	1.2	m
27	0.5+0.6=1.1	2.3	1.2	m
28	0.5+0.6=1.1	2.3	1.2	m
29	0.5+0.6=1.1	2.3	1.2	m
30	0.5+0.6=1.1	2.3	1.2	m
31	0.4+0.7=1.1	2.3	1.8	sm
32	0.4+0.7=1.1	2.3	1.8	sm
33	0.5+0.5=1.0	2.1	1.0	m
34	0.5+0.5=1.0	2.1	1.0	m
35	0.4+0.6=1.0	2.1	1.5	m
36	0.4+0.6=1.0	2.1	1.5	m
37	0.4+0.5=0.9	1.9	1.3	m
38	0.4+0.4=0.8	1.6	1.0	m

Table 43. Measurements of somatic chromosomes of *Dendrobium platygastrium* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.1=1.9	3.3	1.4	m
2	0.8+1.1=1.9	3.3	1.4	m
3	0.8+1.0=1.8	3.2	1.3	m
4	0.8+1.0=1.8	3.2	1.3	m
5	0.6+1.1=1.7	3.0	1.8	sm
6	0.6+1.1=1.7	3.0	1.8	sm
7	0.6+1.1=1.7	3.0	1.8	sm
8	0.5+1.1=1.6	2.8	2.2	sm
9	0.6+0.9=1.5	2.6	1.5	m
10	0.6+0.9=1.5	2.6	1.5	m
11	0.6+0.9=1.5	2.6	1.5	m
12	0.6+0.9=1.5	2.6	1.5	m
13	0.6+0.9=1.5	2.6	1.5	m
14	0.6+0.9=1.5	2.6	1.5	m
15	0.6+0.9=1.5	2.6	1.5	m
16	0.6+0.9=1.5	2.6	1.5	m
17	0.5+1.0=1.5	2.6	2.0	sm
18	0.5+1.0=1.5	2.6	2.0	sm
19	0.5+0.9=1.4	2.5	1.8	sm
20	0.5+0.9=1.4	2.5	1.8	sm
21	0.5+0.9=1.4	2.5	1.8	sm
22	0.5+0.9=1.4	2.5	1.8	sm
23	0.5+0.9=1.4	2.5	1.8	sm
24	0.5+0.9=1.4	2.5	1.8	sm
25	0.5+0.8=1.3	2.3	1.6	m
26	0.5+0.8=1.3	2.3	1.6	m
27	0.5+0.8=1.3	2.3	1.6	m
28	0.5+0.8=1.3	2.3	1.6	m
29	0.5+0.7=1.2	2.1	1.4	m
30	0.5+0.7=1.2	2.1	1.4	m
31	0.5+0.7=1.2	2.1	1.4	m
32	0.5+0.7=1.2	2.1	1.4	m
33	0.4+0.8=1.2	2.1	2.0	sm
34	0.4+0.8=1.2	2.1	2.0	sm
35	0.4+0.8=1.2	2.1	2.0	sm
36	0.4+0.8=1.2	2.1	2.0	sm
37	0.4+0.8=1.2	2.1	2.0	sm
38	0.4+0.8=1.2	2.1	2.0	sm
39	0.4+0.7=1.1	1.9	1.8	sm
40	0.4+0.7=1.1	1.9	1.8	sm

Table 44. Measurements of somatic chromosomes of *Dendrobium amethystoglossum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.4+1.4=2.8	4.0	1.0	m
2	1.3+1.4=2.7	3.9	1.1	m
3	1.2+1.4=2.6	3.8	1.2	m
4	1.2+1.4=2.6	3.8	1.2	m
5	1.2+1.3=2.5	3.6	1.1	m
6	1.0+1.5=2.5	3.6	1.5	m
7	1.0+1.5=2.5	3.6	1.5	m
8	1.0+1.5=2.5	3.6	1.5	m
9	1.0+1.2=2.2	3.2	1.2	m
10	1.0+1.2=2.2	3.2	1.2	m
11	0.7+0.9+0.3=1.9*	2.8	1.7	m
12	0.7+0.9+0.3=1.9*	2.8	1.7	m
13	0.2+0.7+0.1=1.9*	2.8	1.1	m
14	0.3+0.6+0.1=1.9*	2.8	1.1	m
15	0.2+0.7+0.9=1.8*	2.6	1.0	m
16	0.2+0.7+0.9=1.8*	2.6	1.0	m
17	0.8+0.9=1.7	2.5	1.1	m
18	0.8+0.9=1.7	2.5	1.1	m
19	0.8+0.9=1.7	2.5	1.1	m
20	0.8+0.9=1.7	2.5	1.1	m
21	0.5+1.2=1.7	2.5	2.4	sm
22	0.5+1.2=1.7	2.5	2.4	sm
23	0.7+0.9=1.6	2.3	1.3	m
24	0.7+0.9=1.6	2.3	1.3	m
25	0.4+1.2=1.6	2.3	3.0	sm
26	0.4+1.2=1.6	2.3	3.0	sm
27	0.5+1.1=1.6	2.3	2.2	sm
28	0.5+1.0=1.5	2.2	2.0	sm
29	0.5+0.9=1.4	2.0	1.8	sm
30	0.6+0.7=1.3	1.9	1.2	m
31	0.6+0.7=1.3	1.9	1.2	m
32	0.4+0.8=1.2	1.7	2.0	sm
33	0.4+0.7=1.1	1.6	1.8	sm
34	0.4+0.7=1.1	1.6	1.8	sm
35	0.5+0.6=1.1	1.6	1.2	m
36	0.5+0.6=1.1	1.6	1.2	m
37	0.4+0.5=0.9	1.3	1.3	m
38	0.4+0.5=0.9	1.3	1.3	m
39	0.4+0.5=0.9	1.3	1.3	m
40	0.4+0.5=0.9	1.3	1.3	m

* : Chromosome with secondary constriction

Table 45. Measurements of somatic chromosomes of *Dendrobium bullenianum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.2=1.9	3.9	1.7	m
2	0.8+1.0=1.8	3.7	1.3	m
3	0.9+0.9=1.8	3.7	1.0	m
4	0.7+0.9=1.6	3.3	1.3	m
5	0.7+0.8=1.5	3.1	1.1	m
6	0.7+0.8=1.5	3.1	1.1	m
7	0.7+0.8=1.5	3.1	1.1	m
8	0.7+0.8=1.5	3.1	1.1	m
9	0.6+0.9=1.5	3.1	1.5	m
10	0.5+1.0=1.5	3.1	2.0	sm
11	0.5+0.9=1.4	2.9	1.8	sm
12	0.5+0.9=1.4	2.9	1.8	sm
13	0.6+0.7=1.3	2.7	1.2	m
14	0.6+0.7=1.3	2.7	1.2	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.5+0.7=1.2	2.5	1.4	m
18	0.5+0.7=1.2	2.5	1.4	m
19	0.5+0.7=1.2	2.5	1.4	m
20	0.5+0.7=1.2	2.5	1.4	m
21	0.4+0.8=1.2	2.5	2.0	sm
22	0.4+0.8=1.2	2.5	2.0	sm
23	0.4+0.8=1.2	2.5	2.0	sm
24	0.5+0.6=1.1	2.3	1.2	m
25	0.5+0.6=1.1	2.3	1.2	m
26	0.5+0.6=1.1	2.3	1.2	m
27	0.5+0.6=1.1	2.3	1.2	m
28	0.5+0.6=1.1	2.3	1.2	m
29	0.5+0.6=1.1	2.3	1.2	m
30	0.5+0.6=1.1	2.3	1.2	m
31	0.5+0.6=1.1	2.3	1.2	m
32	0.5+0.6=1.1	2.3	1.2	m
33	0.5+0.6=1.1	2.3	1.2	m
34	0.5+0.6=1.1	2.3	1.2	m
35	0.4+0.6=1.0	2.1	1.5	m
36	0.4+0.6=1.0	2.1	1.5	m
37	0.4+0.6=1.0	2.1	1.5	m
38	0.4+0.6=1.0	2.1	1.5	m

Table 46. Measurements of somatic chromosomes of *Dendrobium capituliflorum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.1=2.1	3.4	1.1	m
2	1.0+1.1=2.1	3.4	1.1	m
3	1.0+1.0=2.0	3.3	1.0	m
4	1.0+1.0=2.0	3.3	1.0	m
5	0.9+1.1=2.0	3.3	1.2	m
6	0.9+1.1=2.0	3.3	1.2	m
7	0.8+1.1=1.9	3.1	1.4	m
8	0.8+1.1=1.9	3.1	1.4	m
9	0.9+1.0=1.9	3.1	1.1	m
10	0.8+1.0=1.8	2.9	1.3	m
11	0.5+1.3=1.8	2.9	2.6	sm
12	0.5+1.3=1.8	2.9	2.6	sm
13	0.7+1.0=1.7	2.8	1.4	m
14	0.7+1.0=1.7	2.8	1.4	m
15	0.4+1.3=1.7	2.8	3.3	st
16	0.4+1.3=1.7	2.8	3.3	st
17	0.8+0.9=1.7	2.8	1.1	m
18	0.7+0.9=1.6	2.6	1.3	m
19	0.6+1.0=1.6	2.6	1.7	m
20	0.6+1.0=1.6	2.6	1.7	m
21	0.7+0.8=1.5	2.4	1.1	m
22	0.7+0.8=1.5	2.4	1.1	m
23	0.7+0.8=1.5	2.4	1.1	m
24	0.7+0.8=1.5	2.4	1.1	m
25	0.5+1.0=1.5	2.4	2.0	sm
26	0.5+1.0=1.5	2.4	2.0	sm
27	0.6+0.8=1.4	2.3	1.3	m
28	0.6+0.8=1.4	2.3	1.3	m
29	0.6+0.8=1.4	2.3	1.3	m
30	0.6+0.8=1.4	2.3	1.3	m
31	0.4+0.9=1.3	2.1	2.3	sm
32	0.4+0.9=1.3	2.1	2.3	sm
33	0.4+0.9=1.3	2.1	2.3	sm
34	0.4+0.9=1.3	2.1	2.3	sm
35	0.6+0.7=1.3	2.1	1.2	m
36	0.6+0.7=1.3	2.1	1.2	m
37	0.5+0.7=1.2	2.0	1.4	m
38	0.5+0.7=1.2	2.0	1.4	m

Table 47. Measurements of somatic chromosomes of *Dendrobium miyakei* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+2.1=2.8	4.5	3.0	sm
2	0.7+2.1=2.8	4.5	3.0	sm
3	0.9+1.3=2.2	3.5	1.4	m
4	0.9+1.1=2.0	3.2	1.2	m
5	0.9+1.1=2.0	3.2	1.2	m
6	0.9+1.1=2.0	3.2	1.2	m
7	0.9+1.1=2.0	3.2	1.2	m
8	0.6+1.3=1.9	3.1	2.2	sm
9	0.5+1.3=1.8	2.9	2.6	sm
10	0.6+1.2=1.8	2.9	2.0	sm
11	0.8+0.9=1.7	2.7	1.1	m
12	0.8+0.9=1.7	2.7	1.1	m
13	0.6+1.1=1.7	2.7	1.8	sm
14	0.6+1.1=1.7	2.7	1.8	sm
15	0.6+1.1=1.7	2.7	1.8	sm
16	0.6+1.1=1.7	2.7	1.8	sm
17	0.5+1.1=1.6	2.6	2.2	sm
18	0.5+1.1=1.6	2.6	2.2	sm
19	0.7+0.9=1.6	2.6	1.3	m
20	0.7+0.9=1.6	2.6	1.3	m
21	0.7+0.8=1.5	2.4	1.1	m
22	0.7+0.8=1.5	2.4	1.1	m
23	0.6+0.9=1.5	2.4	1.5	m
24	0.6+0.9=1.5	2.4	1.5	m
25	0.6+0.8=1.4	2.3	1.3	m
26	0.5+0.9=1.4	2.3	1.8	sm
27	0.5+0.9=1.4	2.3	1.8	sm
28	0.6+0.8=1.4	2.3	1.3	m
29	0.6+0.8=1.4	2.3	1.3	m
30	0.4+1.0=1.4	2.3	2.5	sm
31	0.5+0.8=1.3	2.1	1.6	m
32	0.5+0.8=1.3	2.1	1.6	m
33	0.4+0.9=1.3	2.1	2.3	sm
34	0.4+0.9=1.3	2.1	2.3	sm
35	0.4+0.8=1.2	1.9	2.0	sm
36	0.4+0.8=1.2	1.9	2.0	sm
37	0.5+0.6=1.1	1.8	1.2	m
38	0.5+0.6=1.1	1.8	1.2	m

Table 48. Measurements of somatic chromosomes of *Dendrobium ramosii* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+2.0=2.6	5.0	3.3	st
2	0.6+1.9=2.5	4.8	3.2	st
3	0.5+1.7=2.2	4.2	3.4	st
4	0.5+1.7=2.2	4.2	3.4	st
5	0.5+1.3=1.8	3.4	2.6	sm
6	0.5+1.2=1.7	3.3	2.2	sm
7	0.5+1.1=1.6	3.1	2.2	sm
8	0.5+1.1=1.6	3.1	2.2	sm
9	0.4+1.0=1.4	2.7	2.5	sm
10	0.4+1.0=1.4	2.7	2.5	sm
11	0.4+1.0=1.4	2.7	2.5	sm
12	0.4+1.0=1.4	2.7	2.5	sm
13	0.4+1.0=1.4	2.7	2.5	sm
14	0.4+1.0=1.4	2.7	2.5	sm
15	0.6+0.7=1.3	2.5	1.2	m
16	0.6+0.7=1.3	2.5	1.2	m
17	0.4+0.9=1.3	2.5	1.2	m
18	0.4+0.9=1.3	2.5	1.2	m
19	0.6+0.6=1.2	2.3	1.0	m
20	0.6+0.6=1.2	2.3	1.0	m
21	0.5+0.7=1.2	2.3	1.4	m
22	0.5+0.7=1.2	2.3	1.4	m
23	0.5+0.6=1.1	2.1	1.2	m
24	0.5+0.6=1.1	2.1	1.2	m
25	0.4+0.7=1.1	2.1	1.8	sm
26	0.4+0.7=1.1	2.1	1.8	sm
27	0.5+0.5=1.0	1.9	1.0	m
28	0.5+0.5=1.0	1.9	1.0	m
29	0.4+0.6=1.0	1.9	1.5	m
30	0.4+0.6=1.0	1.9	1.5	m
31	0.4+0.6=1.0	1.9	1.5	m
32	0.4+0.6=1.0	1.9	1.5	m
33	0.4+0.6=1.0	1.9	1.5	m
34	0.4+0.6=1.0	1.9	1.5	m
35	0.4+0.5=0.9	1.7	1.3	m
36	0.4+0.5=0.9	1.7	1.3	m
37	0.4+0.5=0.9	1.7	1.3	m
38	0.4+0.5=0.9	1.7	1.3	m
39	0.4+0.4=0.8	1.5	1.0	m
40	0.4+0.4=0.8	1.5	1.0	m

Table 49. Measurements of somatic chromosomes of *Dendrobium secundum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.2+1.3=2.5	4.1	1.1	m
2	1.2+1.3=2.5	4.1	1.1	m
3	0.9+1.2=2.1	3.5	1.3	m
4	0.8+1.2=2.0	3.3	1.5	m
5	0.7+1.2=1.9	3.2	1.7	m
6	0.7+1.1=1.8	3.0	1.6	m
7	0.7+1.1=1.8	3.0	1.6	m
8	0.7+1.1=1.8	3.0	1.6	m
9	0.5+1.3=1.8	3.0	2.6	sm
10	0.5+1.2=1.7	2.8	2.4	sm
11	0.7+1.0=1.7	2.8	1.4	m
12	0.7+0.9=1.6	2.7	1.3	m
13	0.7+0.9=1.6	2.7	1.3	m
14	0.7+0.9=1.6	2.7	1.3	m
15	0.5+1.1=1.6	2.7	2.2	sm
16	0.5+1.0=1.5	2.5	2.0	sm
17	0.7+0.8=1.5	2.5	1.1	m
18	0.6+0.8–1.4	2.3	1.3	m
19	0.6+0.8=1.4	2.3	1.3	m
20	0.6+0.8=1.4	2.3	1.3	m
21	0.6+0.8=1.4	2.3	1.3	m
22	0.6+0.8=1.4	2.3	1.3	m
23	0.5+0.9=1.4	2.3	1.8	sm
24	0.5+0.9=1.4	2.3	1.8	sm
25	0.5+0.9=1.4	2.3	1.8	sm
26	0.6+0.7=1.3	2.2	1.2	m
27	0.5+0.8=1.3	2.2	1.6	m
28	0.5+0.8=1.3	2.2	1.6	m
29	0.5+0.8=1.3	2.2	1.6	m
30	0.5+0.8=1.3	2.2	1.6	m
31	0.4+0.8=1.2	2.0	2.0	sm
32	0.4+0.8=1.2	2.0	2.0	sm
33	0.4+0.8=1.2	2.0	2.0	sm
34	0.4+0.8=1.2	2.0	2.0	sm
35	0.4+0.8=1.2	2.0	2.0	sm
36	0.4+0.8=1.2	2.0	2.0	sm
37	0.5+0.7=1.2	2.0	1.4	m
38	0.5+0.7–1.2	2.0	1.4	m
39	0.5+0.5=1.0	1.7	1.0	m
40	0.4+0.6=1.0	1.7	1.5	m

Table 50. Measurements of somatic chromosomes of *Dendrobium smilliae* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.1=2.1	3.9	1.1	m
2	1.0+1.0=2.0	3.7	1.0	m
3	0.8+1.0=1.8	3.3	1.3	m
4	0.8+0.9=1.7	3.1	1.1	m
5	0.6+1.1=1.7	3.1	1.8	sm
6	0.6+1.1=1.7	3.1	1.8	sm
7	0.6+1.0=1.6	2.9	1.7	m
8	0.6+1.0=1.6	2.9	1.7	m
9	0.7+0.8=1.5	2.8	1.1	m
10	0.7+0.8=1.5	2.8	1.1	m
11	0.7+0.8=1.5	2.8	1.1	m
12	0.6+0.9=1.5	2.8	1.5	m
13	0.6+0.9=1.5	2.8	1.5	m
14	0.6+0.9=1.5	2.8	1.5	m
15	0.5+1.0=1.5	2.8	2.0	sm
16	0.5+1.0=1.5	2.8	2.0	sm
17	0.6+0.8=1.4	2.6	1.3	m
18	0.6+0.8=1.4	2.6	1.3	m
19	0.5+0.9=1.4	2.6	1.8	sm
20	0.5+0.9=1.4	2.6	1.8	sm
21	0.5+0.9=1.4	2.6	1.8	sm
22	0.5+0.9=1.4	2.6	1.8	sm
23	0.6+0.7=1.3	2.4	1.2	m
24	0.6+0.7=1.3	2.4	1.2	m
25	0.6+0.7=1.3	2.4	1.2	m
26	0.6+0.7=1.3	2.4	1.2	m
27	0.6+0.7=1.3	2.4	1.2	m
28	0.6+0.7=1.3	2.4	1.2	m
29	0.5+0.8=1.3	2.4	1.6	m
30	0.5+0.8=1.3	2.4	1.6	m
31	0.5+0.8=1.3	2.4	1.6	m
32	0.5+0.8=1.3	2.4	1.6	m
33	0.6+0.6=1.2	2.2	1.0	m
34	0.6+0.6=1.2	2.2	1.0	m
35	0.5+0.6=1.1	2.0	1.2	m
36	0.5+0.6=1.1	2.0	1.2	m
37	0.5+0.6=1.1	2.0	1.2	m
38	0.5+0.6=1.1	2.0	1.2	m

Table 51. Measurements of somatic chromosomes of *Dendrobium phlox* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.3+1.4=2.7	4.1	1.1	m
2	1.2+1.4=2.6	3.9	1.2	m
3	1.2+1.3=2.5	3.8	1.1	m
4	1.2+1.3=2.5	3.8	1.1	m
5	1.0+1.3=2.3	3.5	1.3	m
6	1.0+1.3=2.3	3.5	1.3	m
7	0.9+1.3=2.2	3.3	1.4	m
8	1.0+1.1=2.1	3.2	1.1	m
9	0.9+1.2=2.1	3.2	1.3	m
10	0.9+1.1=2.0	3.0	1.2	m
11	0.4+1.5=1.9	2.9	3.8	st
12	0.4+1.5=1.9	2.9	3.8	st
13	0.6+1.3=1.9	2.9	2.2	sm
14	0.6+1.3=1.9	2.9	2.2	sm
15	0.8+1.0=1.8	2.7	1.3	m
16	0.8+1.0=1.8	2.7	1.3	m
17	0.7+1.0=1.7	2.6	1.4	m
18	0.7+1.0=1.7	2.6	1.4	m
19	0.7+0.9=1.6	2.4	1.3	m
20	0.7+0.9=1.6	2.4	1.3	m
21	0.7+0.9=1.6	2.4	1.3	m
22	0.7+0.9=1.6	2.4	1.3	m
23	0.7+0.9=1.6	2.4	1.3	m
24	0.7+0.9=1.6	2.4	1.3	m
25	0.7+0.9=1.6	2.4	1.3	m
26	0.7+0.9=1.6	2.4	1.3	m
27	0.6+0.9=1.5	2.3	1.5	m
28	0.6+0.9=1.5	2.3	1.5	m
29	0.5+0.8=1.3	2.0	1.6	m
30	0.5+0.8=1.3	2.0	1.6	m
31	0.5+0.8=1.3	2.0	1.6	m
32	0.5+0.8=1.3	2.0	1.6	m
33	0.5+0.8=1.3	2.0	1.6	m
34	0.5+0.8=1.3	2.0	1.6	m
35	0.5+0.7=1.2	1.8	1.4	m
36	0.5+0.7=1.2	1.8	1.4	m
37	0.4+0.7=1.1	1.7	1.8	sm
38	0.4+0.7=1.1	1.7	1.8	sm

Table 52. Measurements of somatic chromosomes of *Dendrobium sophronites* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.0=1.9	3.5	1.1	m
2	0.9+1.0=1.9	3.5	1.1	m
3	0.9+1.0=1.9	3.5	1.1	m
4	0.9+1.0=1.9	3.5	1.1	m
5	0.7+1.1=1.8	3.3	1.6	m
6	0.7+1.1=1.8	3.3	1.6	m
7	0.8+0.9=1.7	3.1	1.1	m
8	0.8+0.9=1.7	3.1	1.1	m
9	0.7+0.9=1.6	2.9	1.3	m
10	0.7+0.9=1.6	2.9	1.3	m
11	0.6+1.0=1.6	2.9	1.7	m
12	0.6+1.0=1.6	2.9	1.7	m
13	0.6+1.0=1.6	2.9	1.7	m
14	0.6+1.0=1.6	2.9	1.7	m
15	0.7+0.8=1.5	2.8	1.1	m
16	0.7+0.8=1.5	2.8	1.1	m
17	0.7+0.8=1.5	2.8	1.1	m
18	0.7+0.8=1.5	2.8	1.1	m
19	0.5+1.0=1.5	2.8	2.0	sm
20	0.5+1.0=1.5	2.8	2.0	sm
21	0.6+0.8=1.4	2.6	1.3	m
22	0.6+0.8=1.4	2.6	1.3	m
23	0.6+0.8=1.4	2.6	1.3	m
24	0.6+0.8=1.4	2.6	1.3	m
25	0.6+0.7=1.3	2.4	1.2	m
26	0.6+0.7=1.3	2.4	1.2	m
27	0.4+0.8=1.2	2.2	2.0	sm
28	0.4+0.8=1.2	2.2	2.0	sm
29	0.5+0.7=1.2	2.2	1.4	m
30	0.5+0.7=1.2	2.2	1.4	m
31	0.5+0.7=1.2	2.2	1.4	m
32	0.5+0.6=1.1	2.0	1.2	m
33	0.4+0.7=1.1	2.0	1.8	sm
34	0.4+0.7=1.1	2.0	1.8	sm
35	0.4+0.6=1.0	1.8	1.5	m
36	0.4+0.6=1.0	1.8	1.5	m
37	0.4+0.5=0.9	1.7	1.3	m
38	0.4+0.5=0.9	1.7	1.3	m

Table 53. Measurements of somatic chromosomes of *Dendrobium quinquecostatum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.0=1.8	3.7	1.3	m
2	0.7+1.0=1.7	3.5	1.4	m
3	0.7+1.0=1.7	3.5	1.4	m
4	0.7+1.0=1.7	3.5	1.4	m
5	0.7+0.9=1.6	3.3	1.3	m
6	0.7+0.9=1.6	3.3	1.3	m
7	0.7+0.9+1.6	3.3	1.3	m
8	0.7+0.9=1.6	3.3	1.3	m
9	0.7+0.8=1.5	3.1	1.1	m
10	0.7+0.8=1.5	3.1	1.1	m
11	0.5+1.0=1.5	3.1	2.0	sm
12	0.5+1.0=1.5	3.1	2.0	sm
13	0.5+0.9=1.4	2.9	1.8	sm
14	0.5+0.8=1.3	2.7	1.6	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.6+0.7=1.3	2.7	1.2	m
18	0.6+0.7=1.3	2.7	1.2	m
19	0.5+0.7=1.2	2.5	1.4	m
20	0.5+0.7=1.2	2.5	1.4	m
21	0.5+0.7=1.2	2.5	1.4	m
22	0.5+0.7=1.2	2.5	1.4	m
23	0.5+0.7=1.2	2.5	1.4	m
24	0.5+0.7=1.2	2.5	1.4	m
25	0.5+0.7=1.2	2.5	1.4	m
26	0.5+0.7=1.2	2.5	1.4	m
27	0.5+0.7=1.2	2.5	1.4	m
28	0.5+0.7=1.2	2.5	1.4	m
29	0.5+0.6=1.1	2.3	1.2	m
30	0.5+0.6=1.1	2.3	1.2	m
31	0.4+0.6=1.0	2.1	1.5	m
32	0.4+0.6=1.0	2.1	1.5	m
33	0.4+0.5=0.9	1.8	1.3	m
34	0.4+0.5=0.9	1.8	1.3	m
35	0.4+0.5=0.9	1.8	1.3	m
36	0.4+0.5=0.9	1.8	1.3	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.4=0.8	1.6	1.0	m

Table 54. Measurements of somatic chromosomes of *Dendrobium aduncum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.5+1.4=1.9	4.1	2.8	sm
2	0.7+1.0=1.7	3.6	1.4	m
3	0.6+1.1=1.7	3.6	1.8	sm
4	0.7+0.9=1.6	3.4	1.3	m
5	0.7+0.9=1.6	3.4	1.3	m
6	0.6+0.9=1.5	3.2	1.5	m
7	0.6+0.9=1.5	3.2	1.5	m
8	0.7+0.7=1.4	3.0	1.0	m
9	0.7+0.7=1.4	3.0	1.0	m
10	0.4+1.0=1.4	3.0	2.5	sm
11	0.4+1.0=1.4	3.0	2.5	sm
12	0.5+0.8=1.3	2.8	1.6	m
13	0.5+0.8=1.3	2.8	1.6	m
14	0.5+0.8=1.3	2.8	1.6	m
15	0.4+0.9=1.3	2.8	2.3	sm
16	0.5+0.7=1.2	2.6	1.4	m
17	0.5+0.7=1.2	2.6	1.4	m
18	0.5+0.7=1.2	2.6	1.4	m
19	0.5+0.7=1.2	2.6	1.4	m
20	0.5+0.7=1.2	2.6	1.4	m
21	0.4+0.8=1.2	2.6	2.0	sm
22	0.4+0.8=1.2	2.6	2.0	sm
23	0.5+0.6=1.1	2.4	1.2	m
24	0.5+0.6=1.1	2.4	1.2	m
25	0.4+0.7=1.1	2.4	1.8	sm
26	0.4+0.7=1.1	2.4	1.8	sm
27	0.4+0.7=1.1	2.4	1.8	sm
28	0.4+0.7=1.1	2.4	1.8	sm
29	0.5+0.5=1.0	2.1	1.0	m
30	0.5+0.5=1.0	2.1	1.0	m
31	0.4+0.6=1.0	2.1	1.5	m
32	0.4+0.6=1.0	2.1	1.5	m
33	0.4+0.6=1.0	2.1	1.5	m
34	0.4+0.6=1.0	2.1	1.5	m
35	0.4+0.5=0.9	1.9	1.3	m
36	0.4+0.5=0.9	1.9	1.3	m
37	0.4+0.4=0.8	1.7	1.0	m
38	0.4+0.4=0.8	1.7	1.0	m

Table 55. Measurements of somatic chromosomes of *Dendrobium stuposum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.2+1.4=2.6	4.7	1.2	m
2	0.9+1.3=2.2	4.0	1.4	m
3	1.0+1.1=2.1	3.8	1.1	m
4	0.8+1.0=1.8	3.3	1.3	m
5	0.7+1.0=1.7	3.1	1.4	m
6	0.7+1.0=1.7	3.1	1.4	m
7	0.7+0.9=1.6	2.9	1.3	m
8	0.7+0.9=1.6	2.9	1.3	m
9	0.7+0.9=1.6	2.9	1.3	m
10	0.7+0.9=1.6	2.9	1.3	m
11	0.7+0.8=1.5	2.7	1.1	m
12	0.7+0.8=1.5	2.7	1.1	m
13	0.7+0.8=1.5	2.7	1.1	m
14	0.7+0.8=1.5	2.7	1.1	m
15	0.5+0.9=1.4	2.6	1.8	sm
16	0.5+0.9=1.4	2.6	1.8	sm
17	0.5+0.9=1.4	2.6	1.8	sm
18	0.5+0.9=1.4	2.6	1.8	sm
19	0.5+0.9=1.4	2.6	1.8	sm
20	0.5+0.9=1.4	2.6	1.8	sm
21	0.6+0.7=1.3	2.4	1.2	m
22	0.6+0.7=1.3	2.4	1.2	m
23	0.6+0.7=1.3	2.4	1.2	m
24	0.6+0.7=1.3	2.4	1.2	m
25	0.6+0.7=1.3	2.4	1.2	m
26	0.6+0.7=1.3	2.4	1.2	m
27	0.4+0.9=1.3	2.4	2.3	sm
28	0.4+0.9=1.3	2.4	2.3	sm
29	0.5+0.7=1.2	2.2	1.4	m
30	0.5+0.7=1.2	2.2	1.4	m
31	0.4+0.8=1.2	2.2	2.0	sm
32	0.4+0.8=1.2	2.2	2.0	sm
33	0.4+0.8=1.2	2.2	2.0	sm
34	0.4+0.8=1.2	2.2	2.0	sm
35	0.4+0.7=1.1	2.0	1.8	sm
36	0.4+0.7=1.1	2.0	1.8	sm
37	0.4+0.7=1.1	2.0	1.8	sm
38	0.4+0.7−1.1	2.0	1.8	sm

Table 56. Measurements of somatic chromosomes of *Dendrobium ciliatum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.0=1.8	3.4	1.3	m
2	0.8+1.0=1.8	3.4	1.3	m
3	0.7+1.1=1.8	3.4	1.6	m
4	0.7+1.1=1.8	3.4	1.6	m
5	0.6+1.1=1.7	3.2	1.8	sm
6	0.6+1.1=1.7	3.2	1.8	sm
7	0.3+0.5+0.9=1.7*	3.2	1.1	m
8	0.8+0.8=1.6	3.0	1.0	m
9	0.8+0.8=1.6	3.0	1.0	m
10	0.6+1.0=1.6	3.0	1.7	m
11	0.6+1.0=1.6	3.0	1.7	m
12	0.6+1.0=1.6	3.0	1.7	m
13	0.6+0.9=1.5	2.9	1.5	m
14	0.6+0.9=1.5	2.9	1.5	m
15	0.5+1.0=1.5	2.9	2.0	sm
16	0.5+1.0=1.5	2.9	2.0	sm
17	0.5+0.9=1.4	2.7	1.8	sm
18	0.5+0.9=1.4	2.7	1.8	sm
19	0.6+0.7=1.3	2.5	1.2	m
20	0.6+0.7=1.3	2.5	1.2	m
21	0.6+0.6=1.2	2.3	1.0	m
22	0.5+0.7=1.2	2.3	1.4	m
23	0.5+0.7=1.2	2.3	1.4	m
24	0.5+0.6=1.1	2.1	1.2	m
25	0.5+0.6=1.1	2.1	1.2	m
26	0.5+0.6=1.1	2.1	1.2	m
27	0.5+0.6=1.1	2.1	1.2	m
28	0.5+0.6=1.1	2.1	1.2	m
29	0.4+0.7=1.1	2.1	1.8	sm
30	0.4+0.7=1.1	2.1	1.8	sm
31	0.5+0.5=1.0	1.9	1.0	m
32	0.5+0.5=1.0	1.9	1.0	m
33	0.3+0.7=1.0	1.9	2.3	sm
34	0.3+0.7=1.0	1.9	2.3	sm
35	0.3+0.7=1.0	1.9	2.3	sm
36	0.3+0.7=1.0	1.9	2.3	sm
37	0.4+0.5=0.9	1.7	1.3	m
38	0.4+0.5=0.9	1.7	1.3	m
39	0.4+0.5=0.9	1.7	1.3	m
40	0.4+0.5=0.9	1.7	1.3	m

* : Chromosome with secondary constriction

Table 57. Measurements of somatic chromosomes of *Dendrobium compactum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+0.8=1.4	3.1	1.3	m
2	0.6+0.8=1.4	3.1	1.3	m
3	0.6+0.8=1.4	3.1	1.3	m
4	0.6+0.8=1.4	3.1	1.3	m
5	0.5+0.9=1.4	3.1	1.8	sm
6	0.5+0.9=1.4	3.1	1.8	sm
7	0.5+0.8=1.3	2.9	1.6	m
8	0.5+0.8=1.3	2.9	1.6	m
9	0.5+0.7=1.2	2.7	1.4	m
10	0.5+0.7=1.2	2.7	1.4	m
11	0.5+0.7=1.2	2.7	1.4	m
12	0.5+0.7=1.2	2.7	1.4	m
13	0.5+0.7=1.2	2.7	1.4	m
14	0.5+0.7=1.2	2.7	1.4	m
15	0.5+0.7=1.2	2.7	1.4	m
16	0.5+0.7=1.2	2.7	1.4	m
17	0.5+0.6=1.1	2.5	1.2	m
18	0.5+0.6=1.1	2.5	1.2	m
19	0.5+0.6=1.1	2.5	1.2	m
20	0.5+0.6=1.1	2.5	1.2	m
21	0.5+0.6=1.1	2.5	1.2	m
22	0.5+0.6=1.1	2.5	1.2	m
23	0.5+0.5=1.0	2.2	1.0	m
24	0.5+0.5=1.0	2.2	1.0	m
25	0.5+0.5=1.0	2.2	1.0	m
26	0.5+0.5=1.0	2.2	1.0	m
27	0.5+0.5=1.0	2.2	1.0	m
28	0.5+0.5=1.0	2.2	1.0	m
29	0.4+0.6=1.0	2.2	1.5	m
30	0.4+0.6=1.0	2.2	1.5	m
31	0.4+0.6=1.0	2.2	1.5	m
32	0.4+0.6=1.0	2.2	1.5	m
33	0.3+0.7=1.0	2.2	2.3	sm
34	0.3+0.7=1.0	2.2	2.3	sm
35	0.3+0.7=1.0	2.2	2.3	sm
36	0.3+0.7=1.0	2.2	2.3	sm
37	0.4+0.5=0.9	2.0	1.3	m
38	0.4+0.5=0.9	2.0	1.3	m
39	0.3+0.6=0.9	2.0	2.0	sm
40	0.3+0.6=0.9	2.0	2.0	sm

Table 58. Measurements of somatic chromosomes of *Dendrobium denudans* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+1.3=1.9	3.7	2.2	sm
2	0.6+1.2=1.8	3.5	2.0	sm
3	0.6+1.2=1.8	3.5	2.0	sm
4	0.6+1.1=1.7	3.3	1.8	sm
5	0.6+1.0=1.6	3.1	1.7	m
6	0.6+0.9=1.5	2.9	1.5	m
7	0.6+0.9=1.5	2.9	1.5	m
8	0.5+1.0=1.5	2.9	2.0	sm
9	0.5+1.0=1.5	2.9	2.0	sm
10	0.6+0.8=1.4	2.7	1.3	m
11	0.6+0.8=1.4	2.7	1.3	m
12	0.6+0.8=1.4	2.7	1.3	m
13	0.5+0.9=1.4	2.7	1.8	sm
14	0.5+0.9=1.4	2.7	1.8	sm
15	0.6+0.7=1.3	2.5	1.2	m
16	0.6+0.7=1.3	2.5	1.2	m
17	0.6+0.7=1.3	2.5	1.2	m
18	0.6+0.7=1.3	2.5	1.2	m
19	0.3+1.0=1.3	2.5	3.3	st
20	0.3+1.0=1.3	2.5	3.3	st
21	0.5+0.7=1.2	2.3	1.4	m
22	0.5+0.7=1.2	2.3	1.4	m
23	0.5+0.7=1.2	2.3	1.4	m
24	0.5+0.7=1.2	2.3	1.4	m
25	0.5+0.7=1.2	2.3	1.4	m
26	0.5+0.7=1.2	2.3	1.4	m
27	0.5+0.6=1.1	2.1	1.2	m
28	0.5+0.6=1.1	2.1	1.2	m
29	0.5+0.6=1.1	2.1	1.2	m
30	0.5+0.6=1.1	2.1	1.2	m
31	0.5+0.6=1.1	2.1	1.2	m
32	0.5+0.6=1.1	2.1	1.2	m
33	0.5+0.6=1.1	2.1	1.2	m
34	0.5+0.6=1.1	2.1	1.2	m
35	0.5+0.6=1.1	2.1	1.2	m
36	0.5+0.6=1.1	2.1	1.2	m
37	0.4+0.7=1.1	2.1	1.8	sm
38	0.4+0.7=1.1	2.1	1.8	sm
39	0.3+0.7=1.0	1.9	2.3	sm
40	0.3+0.7=1.0	1.9	2.3	sm

Table 59. Measurements of somatic chromosomes of *Dendrobium bigibbum* var. *compactum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+0.8=1.5	3.4	1.1	m
2	0.7+0.8=1.5	3.4	1.1	m
3	0.6+0.9=1.5	3.4	1.5	m
4	0.6+0.9=1.5	3.4	1.5	m
5	0.7+0.7=1.4	3.2	1.0	m
6	0.7+0.7=1.4	3.2	1.0	m
7	0.5+0.9=1.4	3.2	1.8	sm
8	0.5+0.9=1.4	3.2	1.8	sm
9	0.5+0.8=1.3	3.0	1.6	m
10	0.5+0.8=1.3	3.0	1.6	m
11	0.5+0.8=1.3	3.0	1.6	m
12	0.5+0.8=1.3	3.0	1.6	m
13	0.4+0.9=1.3	3.0	2.3	sm
14	0.4+0.9=1.3	3.0	2.3	sm
15	0.5+0.7=1.2	2.7	1.4	m
16	0.5+0.7=1.2	2.7	1.4	m
17	0.4+0.8=1.2	2.7	2.0	sm
18	0.4+0.8=1.2	2.7	2.0	sm
19	0.4+0.8=1.2	2.7	2.0	sm
20	0.4+0.8=1.2	2.7	2.0	sm
21	0.5+0.6=1.1	2.5	1.2	m
22	0.5+0.6=1.1	2.5	1.2	m
23	0.5+0.6=1.1	2.5	1.2	m
24	0.5+0.6=1.1	2.5	1.2	m
25	0.5+0.5=1.0	2.3	1.0	m
26	0.4+0.6=1.0	2.3	1.5	m
27	0.4+0.6=1.0	2.3	1.5	m
28	0.4+0.6=1.0	2.3	1.5	m
29	0.4+0.5=0.9	2.1	1.3	m
30	0.4+0.5=0.9	2.1	1.3	m
31	0.4+0.5=0.9	2.1	1.3	m
32	0.4+0.5=0.9	2.1	1.3	m
33	0.3+0.6=0.9	2.1	2.0	sm
34	0.3+0.6=0.9	2.1	2.0	sm
35	0.3+0.6=0.9	2.1	2.0	sm
36	0.3+0.6=0.9	2.1	2.0	sm
37	0.3+0.5=0.8	1.8	1.7	m
38	0.3+0.4=0.7	1.6	1.3	m

Table 60. Measurements of somatic chromosomes of *Dendrobium dicuphum* at mitotic metaphase, 2n=39

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+0.9=1.7	3.5	1.1	m
2	0.8+0.9=1.7	3.5	1.1	m
3	0.7+1.0=1.7	3.5	1.4	m
4	0.7+1.0=1.7	3.5	1.4	m
5	0.7+0.8=1.5	3.1	1.1	m
6	0.7+0.8=1.5	3.1	1.1	m
7	0.6+0.9=1.5	3.1	1.5	m
8	0.5+1.0=1.5	3.1	2.0	sm
9	0.5+1.0=1.5	3.1	2.0	sm
10	0.5+1.0=1.5	3.1	2.0	sm
11	0.6+0.8=1.4	2.9	1.3	m
12	0.6+0.8=1.4	2.9	1.3	m
13	0.5+0.8=1.3	2.7	1.6	m
14	0.5+0.8=1.3	2.7	1.6	m
15	0.5+0.8=1.3	2.7	1.6	m
16	0.5+0.8=1.3	2.7	1.6	m
17	0.6+0.6=1.2	2.5	1.0	m
18	0.6+0.6=1.2	2.5	1.0	m
19	0.5+0.7=1.2	2.5	1.4	m
20	0.5+0.7=1.2	2.5	1.4	m
21	0.5+0.7=1.2	2.5	1.4	m
22	0.5+0.7=1.2	2.5	1.4	m
23	0.4+0.8=1.2	2.5	2.0	sm
24	0.4+0.8=1.2	2.5	2.0	sm
25	0.5+0.6=1.1	2.3	1.2	m
26	0.5+0.6=1.1	2.3	1.2	m
27	0.4+0.7=1.1	2.3	1.8	sm
28	0.4+0.7=1.1	2.3	1.8	sm
29	0.4+0.7=1.1	2.3	1.8	sm
30	0.4+0.7=1.1	2.3	1.8	sm
31	0.4+0.7=1.1	2.3	1.8	sm
32	0.4+0.6=1.0	2.1	1.5	m
33	0.4+0.6=1.0	2.1	1.5	m
34	0.4+0.5=0.9	1.9	1.3	m
35	0.4+0.5=0.9	1.9	1.3	m
36	0.4+0.5=0.9	1.9	1.3	m
37	0.4+0.5=0.9	1.9	1.3	m
38	0.4+0.5=0.9	1.9	1.3	m
39	0.4+0.5=0.9	1.9	1.3	m

Table 61. Measurements of somatic chromosomes of *Dendrobium phalaenopsis* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+1.0+1.0=2.6*	4.0	3.3	st
2	0.6+1.0+1.0=2.6*	4.0	3.3	st
3	0.6+0.8+1.1=2.5*	3.8	3.2	st
4	0.6+0.7+1.1=2.4*	3.7	3.0	sm
5	1.1+1.2=2.3	3.5	1.1	m
6	1.1+1.2=2.3	3.5	1.1	m
7	0.6+1.6=2.2	3.4	2.7	sm
8	0.6+1.5=2.1	3.2	3.0	sm
9	0.9+1.2=2.1	3.2	1.3	m
10	1.0+1.1=2.1	3.2	1.1	m
11	0.9+1.1=2.0	3.0	1.2	m
12	0.9+1.1=2.0	3.8	1.2	m
13	0.8+1.1=1.9	2.9	1.4	m
14	0.8+1.0=1.8	2.7	1.3	m
15	0.8+1.0=1.8	2.7	1.3	m
16	0.8+1.0=1.8	2.7	1.3	m
17	0.8+0.9=1.7	2.6	1.1	m
18	0.8+0.9=1.7	2.6	1.1	m
19	0.5+1.2=1.7	2.6	2.4	sm
20	0.5+1.2=1.7	2.6	2.4	sm
21	0.5+1.2=1.7	2.6	2.4	sm
22	0.5+1.1=1.6	2.4	2.2	sm
23	0.4+1.2=1.6	2.4	3.0	sm
24	0.4+1.1=1.5	2.3	2.8	sm
25	0.7+0.8=1.5	2.3	1.1	m
26	0.7+0.7=1.4	2.1	1.0	m
27	0.5+0.9=1.4	2.1	1.8	sm
28	0.5+0.9=1.4	2.1	1.8	sm
29	0.5+0.8=1.3	2.0	1.6	m
30	0.5+0.8=1.3	2.0	1.6	m
31	0.5+0.8=1.3	2.0	1.6	m
32	0.5+0.8=1.3	2.0	1.6	m
33	0.5+0.8=1.3	2.0	1.6	m
34	0.5+0.8=1.3	2.0	1.6	m
35	0.5+0.7=1.2	1.8	1.4	m
36	0.5+0.7=1.2	1.8	1.4	m
37	0.5+0.5=1.0	1.8	1.4	m
38	0.5+0.5=1.0	1.8	1.4	m

* : Chromosome with secondary constriction

Table 62. Measurements of somatic chromosomes of *Dendrobium superbiens* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.5+2.4=2.9	5.1	4.8	st
2	1.1+1.2=2.3	4.1	1.1	m
3	0.8+1.2=2.0	3.5	1.5	m
4	0.9+1.1=2.0	3.5	1.2	m
5	0.9+1.1=2.0	3.5	1.2	m
6	0.9+1.0=1.9	3.4	1.1	m
7	0.9+1.0=1.9	3.4	1.1	m
8	0.9+1.0=1.9	3.4	1.1	m
9	0.9+0.9=1.8	3.2	1.0	m
10	0.7+1.0=1.7	3.0	1.4	m
11	0.8+0.8=1.6	2.8	1.0	m
12	0.7+0.9=1.6	2.8	1.3	m
13	0.7+0.9=1.6	2.8	1.3	m
14	0.7+0.9=1.6	2.8	1.3	m
15	0.7+0.8=1.5	2.6	1.1	m
16	0.6+0.9=1.5	2.6	1.5	m
17	0.5+1.0=1.5	2.6	2.0	sm
18	0.5+1.0=1.5	2.6	2.0	sm
19	0.6+0.8=1.4	2.5	1.3	m
20	0.6+0.8=1.4	2.5	1.3	m
21	0.6+0.8=1.4	2.5	1.3	m
22	0.6+0.8=1.4	2.5	1.3	m
23	0.5+0.9=1.4	2.5	1.8	sm
24	0.6+0.7=1.3	2.3	1.2	m
25	0.6+0.7=1.3	2.3	1.2	m
26	0.6+0.7=1.3	2.3	1.2	m
27	0.5+0.8=1.3	2.3	1.6	m
28	0.5+0.8=1.3	2.3	1.6	m
29	0.5+0.8=1.3	2.3	1.6	m
30	0.5+0.7=1.2	2.1	1.4	m
31	0.5+0.7=1.2	2.1	1.4	m
32	0.4+0.7=1.1	1.9	1.8	sm
33	0.4+0.7=1.1	1.9	1.8	sm
34	0.4+0.6=1.0	1.8	1.5	m
35	0.4+0.6=1.0	1.8	1.5	m
36	0.4+0.5=0.9	1.6	1.3	m
37	0.4+0.4=0.8	1.4	1.0	m
38	0.4+0.4=0.8	1.4	1.0	m

Table 63. Measurements of somatic chromosomes of *Dendrobium williamsianum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.8+2.0=3.8	7.9	1.1	m
2	1.8+2.0=3.8	7.9	1.1	m
3	0.7+0.9=1.6	3.3	1.3	m
4	0.7+0.9=1.6	3.3	1.3	m
5	0.7+0.9=1.6	3.3	1.3	m
6	0.7+0.9=1.6	3.3	1.3	m
7	0.6+0.8=1.4	2.9	1.3	m
8	0.6+0.8=1.4	2.9	1.3	m
9	0.5+0.8=1.3	2.7	1.6	m
10	0.5+0.8=1.3	2.7	1.6	m
11	0.4+0.9=1.3	2.7	2.3	sm
12	0.4+0.9=1.3	2.7	2.3	sm
13	0.4+0.9=1.3	2.7	2.3	sm
14	0.4+0.9=1.3	2.7	2.3	sm
15	0.5+0.7=1.2	2.5	1.4	m
16	0.5+0.7=1.2	2.5	1.4	m
17	0.5+0.7=1.2	2.5	1.4	m
18	0.5+0.7=1.2	2.5	1.4	m
19	0.4+0.7=1.1	2.3	1.8	sm
20	0.4+0.7=1.1	2.3	1.8	sm
21	0.4+0.7=1.1	2.3	1.8	sm
22	0.4+0.7=1.1	2.3	1.8	sm
23	0.4+0.6=1.0	2.1	1.5	m
24	0.4+0.6=1.0	2.1	1.5	m
25	0.4+0.6=1.0	2.1	1.5	m
26	0.4+0.6=1.0	2.1	1.5	m
27	0.4+0.5=0.9	1.9	1.3	m
28	0.4+0.5=0.9	1.9	1.3	m
29	0.4+0.5=0.9	1.9	1.3	m
30	0.4+0.5=0.9	1.9	1.3	m
31	0.3+0.6=0.9	1.9	2.0	sm
32	0.3+0.6=0.9	1.9	2.0	sm
33	0.3+0.5=0.8	1.7	1.7	m
34	0.3+0.5=0.8	1.7	1.7	m
35	0.3+0.5=0.8	1.7	1.7	m
36	0.3+0.5=0.8	1.7	1.7	m
37	0.3+0.5=0.8	1.7	1.7	m
38	0.3+0.5=0.8	1.7	1.7	m

Table 64. Measurements of somatic chromosomes of *Dendrobium canaliculatum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.7=2.4	4.7	2.4	sm
2	0.5+1.3=1.8	3.5	2.6	sm
3	0.7+1.0=1.7	3.3	1.4	m
4	0.5+1.1=1.6	3.1	2.2	sm
5	0.5+1.1=1.6	3.1	2.2	sm
6	0.6+0.9=1.5	2.9	1.5	m
7	0.6+0.9=1.5	2.9	1.5	m
8	0.6+0.9=1.5	2.9	1.5	m
9	0.6+0.9=1.5	2.9	1.5	m
10	0.6+0.9=1.5	2.9	1.5	m
11	0.6+0.8=1.4	2.7	1.3	m
12	0.6+0.8=1.4	2.7	1.3	m
13	0.6+0.8=1.4	2.7	1.3	m
14	0.6+0.8=1.4	2.7	1.3	m
15	0.6+0.7=1.3	2.5	1.2	m
16	0.6+0.7=1.3	2.5	1.2	m
17	0.6+0.7=1.3	2.5	1.2	m
18	0.6+0.7=1.3	2.5	1.2	m
19	0.5+0.8=1.3	2.5	1.6	m
20	0.5+0.8=1.3	2.5	1.6	m
21	0.5+0.8=1.3	2.5	1.6	m
22	0.5+0.8=1.3	2.5	1.6	m
23	0.5+0.8=1.3	2.5	1.6	m
24	0.5+0.8=1.3	2.5	1.6	m
25	0.6+0.6=1.2	2.3	1.0	m
26	0.6+0.6=1.2	2.3	1.0	m
27	0.5+0.7=1.2	2.3	1.4	m
28	0.5+0.7=1.2	2.3	1.4	m
29	0.5+0.7=1.2	2.3	1.4	m
30	0.5+0.7=1.2	2.3	1.4	m
31	0.4+0.8=1.2	2.3	2.0	sm
32	0.4+0.8=1.2	2.3	2.0	sm
33	0.5+0.6=1.1	2.1	1.2	m
34	0.5+0.6=1.1	2.1	1.2	m
35	0.5+0.6=1.1	2.1	1.2	m
36	0.5+0.6=1.1	2.1	1.2	m
37	0.4+0.6=1.0	1.9	1.5	m
38	0.4+0.6=1.0	1.9	1.5	m

Table 65. Measurements of somatic chromosomes of *Dendrobium gouldii* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.1+1.1=2.2	3.9	1.0	m
2	1.1+1.1=2.2	3.9	1.0	m
3	1.0+1.0=2.0	3.5	1.0	m
4	1.0+1.0=2.0	3.5	1.0	m
5	0.8+1.0=1.8	3.2	1.3	m
6	0.8+1.0=1.8	3.2	1.3	m
7	0.8+1.0=1.8	3.2	1.3	m
8	0.8+1.0=1.8	3.2	1.3	m
9	0.8+1.0=1.8	3.2	1.3	m
10	0.8+0.9=1.7	3.0	1.1	m
11	0.8+0.9=1.7	3.0	1.1	m
12	0.7+1.0=1.7	3.0	1.4	m
13	0.7+0.6+0.3=1.6*	2.8	1.3	m
14	0.7+0.6+0.3=1.6*	2.8	1.3	m
15	0.6+0.9=1.5	2.6	1.5	m
16	0.6+0.9=1.5	2.6	1.5	m
17	0.5+1.0=1.5	2.6	2.0	sm
18	0.5+1.0=1.5	2.6	2.0	sm
19	0.5+1.0=1.5	2.6	2.0	sm
20	0.5+1.0=1.5	2.6	2.0	sm
21	0.7+0.7=1.4	2.5	1.0	m
22	0.7+0.7=1.4	2.5	1.0	m
23	0.5+0.9=1.4	2.5	1.8	sm
24	0.5+0.9=1.4	2.5	1.8	sm
25	0.5+0.8=1.3	2.3	1.6	m
26	0.5+0.8=1.3	2.3	1.6	m
27	0.5+0.7=1.2	2.1	1.4	m
28	0.5+0.7=1.2	2.1	1.4	m
29	0.5+0.7=1.2	2.1	1.4	m
30	0.5+0.7=1.2	2.1	1.4	m
31	0.4+0.8=1.2	2.1	2.0	sm
32	0.4+0.8=1.2	2.1	2.0	sm
33	0.4+0.7=1.1	2.0	1.8	sm
34	0.4+0.7=1.1	2.0	1.8	sm
35	0.4+0.7=1.1	2.0	1.8	sm
36	0.4+0.6=1.0	1.8	1.5	m
37	0.4+0.5=0.9	1.6	1.3	m
38	0.4+0.5=0.9	1.6	1.3	m

* : Chromosome with secondary constriction

Table 66. Measurements of somatic chromosomes of *Dendrobium lasianthera* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.1+1.1=2.2	4.2	1.0	m
2	1.1+1.1=2.2	4.2	1.0	m
3	1.0+1.1=2.1	4.0	1.1	m
4	1.0+1.0=2.0	3.8	1.0	m
5	0.8+0.9=1.7	3.2	1.1	m
6	0.8+0.9=1.7	3.2	1.1	m
7	0.8+0.9=1.7	3.2	1.1	m
8	0.8+0.9=1.7	3.2	1.1	m
9	0.7+0.9=1.6	3.0	1.3	m
10	0.7+0.9=1.6	3.0	1.3	m
11	0.7+0.9=1.6	3.0	1.3	m
12	0.7+0.9=1.6	3.0	1.3	m
13	0.7+0.8=1.5	2.9	1.1	m
14	0.6+0.9=1.5	2.9	1.5	m
15	0.6+0.9=1.5	2.9	1.5	m
16	0.6+0.9=1.5	2.9	1.5	m
17	0.6+0.8=1.4	2.7	1.3	m
18	0.6+0.8=1.4	2.7	1.3	m
19	0.6+0.7=1.3	2.5	1.2	m
20	0.6+0.7=1.3	2.5	1.2	m
21	0.5+0.8=1.3	2.5	1.6	m
22	0.5+0.8=1.3	2.5	1.6	m
23	0.5+0.7=1.2	2.3	1.4	m
24	0.5+0.7=1.2	2.3	1.4	m
25	0.5+0.6=1.1	2.1	1.2	m
26	0.5+0.6=1.1	2.1	1.2	m
27	0.5+0.6=1.1	2.1	1.2	m
28	0.5+0.6=1.1	2.1	1.2	m
29	0.5+0.6=1.1	2.1	1.2	m
30	0.5+0.6=1.1	2.1	1.2	m
31	0.4+0.6=1.0	1.9	1.5	m
32	0.4+0.6=1.0	1.9	1.5	m
33	0.4+0.6=1.0	1.9	1.5	m
34	0.4+0.6=1.0	1.9	1.5	m
35	0.4+0.6=1.0	1.9	1.5	m
36	0.4+0.6=1.0	1.9	1.5	m
37	0.4+0.5=0.9	1.7	1.3	m
38	0.4+0.5=0.9	1.7	1.3	m

Table 67. Measurements of somatic chromosomes of *Dendrobium uniflorum* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.6+1.7=2.3	3.9	2.8	sm
2	0.7+1.6=2.3	3.9	2.3	sm
3	1.0+1.0+0.3=2.3*	3.9	1.3	m
4	1.0+1.0+0.3=2.3*	3.9	1.3	m
5	0.6+1.6=2.2	3.8	2.7	sm
6	0.6+1.5=2.1	3.6	2.5	sm
7	0.6+1.3=1.9	3.3	2.2	sm
8	0.6+1.3=1.9	3.3	2.2	sm
9	0.5+1.3=1.8	3.1	2.6	sm
10	0.5+1.3=1.8	3.1	2.6	sm
11	0.8+0.9=1.7	2.9	1.1	m
12	0.8+0.9=1.7	2.9	1.1	m
13	0.7+1.0=1.7	2.9	1.4	m
14	0.5+1.2=1.7	2.9	2.4	sm
15	0.5+1.2=1.7	2.9	2.4	sm
16	0.5+1.2=1.7	2.9	2.4	sm
17	0.5+1.1=1.6	2.7	2.2	sm
18	0.6+1.0=1.6	2.7	1.7	m
19	0.6+0.9=1.5	2.6	1.5	m
20	0.6+0.8=1.4	2.4	1.3	m
21	0.5+0.9=1.4	2.4	1.8	sm
22	0.4+1.0=1.4	2.4	2.5	sm
23	0.5+0.8=1.3	2.2	1.6	m
24	0.5+0.8=1.3	2.2	1.6	m
25	0.4+0.9=1.3	2.2	2.3	sm
26	0.5+0.7=1.2	2.1	1.4	m
27	0.5+0.6=1.1	1.9	1.2	m
28	0.4+0.7=1.1	1.9	1.8	sm
29	0.5+0.5=1.0	1.7	1.0	m
30	0.5+0.5=1.0	1.7	1.0	m
31	0.4+0.6=1.0	1.7	1.5	m
32	0.4+0.6=1.0	1.7	1.5	m
33	0.4+0.6=1.0	1.7	1.5	m
34	0.4+0.6=1.0	1.7	1.5	m
35	0.4+0.5=0.9	1.5	1.3	m
36	0.4+0.5=0.9	1.5	1.3	m
37	0.4+0.4=0.8	1.4	1.0	m
38	0.4+0.4=0.8	1.4	1.0	m
39	0.3+0.5=0.8	1.4	1.7	m
40	0.3+0.5=0.8	1.4	1.7	m

* : Chromosome with secondary constriction

Table 68. Measurements of somatic chromosomes of *Dendrobium formosum* var. *giganteum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.5=2.3	4.1	1.9	sm
2	0.8+1.5=2.3	4.1	1.9	sm
3	0.9+1.2=2.1	3.8	1.3	m
4	0.9+1.2=2.1	3.8	1.3	m
5	0.9+1.2=2.1	3.8	1.3	m
6	0.7+1.3=2.0	3.6	1.9	sm
7	0.7+1.3=2.0	3.6	1.9	sm
8	0.7+1.0=1.7	3.0	1.4	m
9	0.7+1.0=1.7	3.0	1.4	m
10	0.7+1.0=1.7	3.0	1.4	m
11	0.5+1.1=1.6	2.9	2.2	sm
12	0.5+1.1=1.6	2.9	2.2	sm
13	0.7+0.8=1.5	2.7	1.1	m
14	0.7+0.8=1.5	2.7	1.1	m
15	0.6+0.9=1.5	2.7	1.5	m
16	0.6+0.9=1.5	2.7	1.5	m
17	0.5+1.0=1.5	2.7	2.0	sm
18	0.5+1.0=1.5	2.7	2.0	sm
19	0.6+0.8=1.4	2.5	1.3	m
20	0.6+0.8=1.4	2.5	1.3	m
21	0.6+0.8=1.4	2.5	1.3	m
22	0.6+0.8=1.4	2.5	1.3	m
23	0.5+0.8=1.3	2.3	1.6	m
24	0.5+0.8=1.3	2.3	1.6	m
25	0.6+0.6=1.2	2.1	1.0	m
26	0.6+0.6=1.2	2.1	1.0	m
27	0.6+0.6=1.2	2.1	1.0	m
28	0.6+0.6=1.2	2.1	1.0	m
29	0.5+0.7=1.2	2.1	1.4	m
30	0.5+0.7=1.2	2.1	1.4	m
31	0.5+0.6=1.1	2.0	1.2	m
32	0.5+0.6=1.1	2.0	1.2	m
33	0.5+0.6=1.1	2.0	1.2	m
34	0.5+0.6=1.1	2.0	1.2	m
35	0.4+0.6=1.0	1.8	1.5	m
36	0.4+0.6=1.0	1.8	1.5	m
37	0.4+0.6=1.0	1.8	1.5	m
38	0.4+0.6=1.0	1.8	1.5	m

Table 69. Measurements of somatic chromosomes of *Dendrobium infundibulum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.1+1.5=2.6	4.2	1.4	m
2	1.0+1.3=2.3	3.7	1.3	m
3	1.1+1.1=2.2	3.6	1.0	m
4	0.9+1.3=2.2	3.6	1.4	m
5	0.9+1.3=2.2	3.6	1.4	m
6	0.9+1.3=2.2	3.6	1.4	m
7	0.9+1.2=2.1	3.4	1.3	m
8	0.9+1.2=2.1	3.4	1.3	m
9	0.8+1.3=2.1	3.4	1.6	m
10	0.8+1.3=2.1	3.4	1.6	m
11	0.8+1.2=2.0	3.2	1.5	m
12	0.9+0.9=1.8	2.9	1.0	m
13	0.9+0.9=1.8	2.9	1.0	m
14	0.7+0.9=1.6	2.6	1.3	m
15	0.6+1.0=1.6	2.6	1.7	m
16	0.6+0.9=1.5	2.4	1.5	m
17	0.6+0.9=1.5	2.4	1.5	m
18	0.5+1.0=1.5	2.4	2.0	sm
19	0.5+1.0=1.5	2.4	2.0	sm
20	0.5+1.0=1.5	2.4	2.0	sm
21	0.7+0.7=1.4	2.3	1.0	m
22	0.7+0.7=1.4	2.3	1.0	m
23	0.5+0.9=1.4	2.3	1.8	sm
24	0.4+1.0=1.4	2.3	2.5	sm
25	0.4+1.0=1.4	2.3	2.5	sm
26	0.6+0.7=1.3	2.1	1.2	m
27	0.5+0.8=1.3	2.1	1.6	m
28	0.5+0.8=1.3	2.1	1.6	m
29	0.5+0.8=1.3	2.1	1.6	m
30	0.5+0.8=1.3	2.1	1.6	m
31	0.4+0.9=1.3	2.1	2.3	sm
32	0.4+0.9=1.3	2.1	2.3	sm
33	0.6+0.6=1.2	1.9	1.0	m
34	0.6+0.6=1.2	1.9	1.0	m
35	0.4+0.8=1.2	1.9	2.0	sm
36	0.4+0.8=1.2	1.9	2.0	sm
37	0.4+0.8=1.2	1.9	2.0	sm
38	0.4+0.8=1.2	1.9	2.0	sm

Table 70. Measurements of somatic chromosomes of *Dendrobium sanderae* at mitotic metaphase, 2n=40

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.5+1.3=1.8	3.6	2.6	sm
2	0.5+1.3=1.8	3.6	2.6	sm
3	0.6+1.0=1.6	3.2	1.7	m
4	0.7+0.8=1.5	3.0	1.1	m
5	0.7+0.8=1.5	3.0	1.1	m
6	0.7+0.8=1.5	3.0	1.1	m
7	0.6+0.9=1.5	3.0	1.5	m
8	0.6+0.9=1.5	3.0	1.5	m
9	0.6+0.9=1.5	3.0	1.5	m
10	0.6+0.9=1.5	3.0	1.5	m
11	0.6+0.8=1.4	2.8	1.3	m
12	0.6+0.8=1.4	2.8	1.3	m
13	0.5+0.9=1.4	2.8	1.8	sm
14	0.5+0.9=1.4	2.8	1.8	sm
15	0.5+0.9=1.4	2.8	1.8	sm
16	0.5+0.9=1.4	2.8	1.8	sm
17	0.5+0.8=1.3	2.6	1.6	m
18	0.5+0.8=1.3	2.6	1.6	m
19	0.4+0.9=1.3	2.6	2.3	sm
20	0.4+0.9=1.3	2.6	2.3	sm
21	0.5+0.7=1.2	2.4	1.4	m
22	0.5+0.7=1.2	2.4	1.4	m
23	0.5+0.7=1.2	2.4	1.4	m
24	0.5+0.7=1.2	2.4	1.4	m
25	0.4+0.8=1.2	2.4	2.0	sm
26	0.4+0.8=1.2	2.4	2.0	sm
27	0.4+0.8=1.2	2.4	2.0	sm
28	0.4+0.8=1.2	2.4	2.0	sm
29	0.5+0.6=1.1	2.2	1.2	m
30	0.5+0.6=1.1	2.2	1.2	m
31	0.5+0.6=1.1	2.2	1.2	m
32	0.5+0.6=1.1	2.2	1.2	m
33	0.4+0.6=1.0	2.0	1.5	m
34	0.4+0.6=1.0	2.0	1.5	m
35	0.4+0.6=1.0	2.0	1.5	m
36	0.4+0.5=0.9	1.8	1.3	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.5=0.9	1.8	1.3	m
39	0.4+0.4=0.8	1.6	1.0	m
40	0.4+0.4=0.8	1.6	1.0	m

Table 71. Measurements of somatic chromosomes of *Dendrobium scabrilingue* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.5+1.7=3.2	4.3	1.1	m
2	1.4+1.6=3.0	4.0	1.1	m
3	1.4+1.5=2.9	3.9	1.1	m
4	1.4+1.5=2.9	3.9	1.1	m
5	1.2+1.6=2.8	3.8	1.3	m
6	1.2+1.6=2.8	3.8	1.3	m
7	1.1+1.5=2.6	3.5	1.4	m
8	1.1+1.5=2.6	3.5	1.4	m
9	0.9+1.7=2.6	3.5	1.9	sm
10	1.0+1.5=2.5	3.4	1.5	m
11	1.0+1.2=2.2	3.0	1.2	m
12	1.0+1.2=2.2	3.0	1.2	m
13	0.4+1.6=2.0	2.7	4.0	st
14	0.4+1.6=2.0	2.7	4.0	st
15	0.7+1.2=1.9	2.6	1.7	m
16	0.7+1.2=1.9	2.6	1.7	m
17	0.8+1.0=1.8	2.4	1.3	m
18	0.8+1.0=1.8	2.4	1.3	m
19	0.8+1.0=1.8	2.4	1.3	m
20	0.8+1.0=1.8	2.4	1.3	m
21	0.8+0.9=1.7	2.3	1.1	m
22	0.8+0.9=1.7	2.3	1.1	m
23	0.5+1.2=1.7	2.3	2.4	sm
24	0.5+1.2=1.7	2.3	2.4	sm
25	0.7+0.9=1.6	2.2	1.3	m
26	0.7+0.9=1.6	2.2	1.3	m
27	0.4+1.2=1.6	2.2	3.0	sm
28	0.4+1.2=1.6	2.2	3.0	sm
29	0.6+0.9=1.5	2.0	1.5	m
30	0.6+0.9=1.5	2.0	1.5	m
31	0.4+1.1=1.5	2.0	2.8	sm
32	0.4+1.1=1.5	2.0	2.8	sm
33	0.7+0.7=1.4	1.9	1.0	m
34	0.5+0.9=1.4	1.9	1.8	sm
35	0.5+0.7=1.2	1.6	1.4	m
36	0.5+0.7=1.2	1.6	1.4	m
37	0.5+0.7=1.2	1.6	1.4	m
38	0.5+0.7=1.2	1.6	1.4	m

Table 72. Measurements of somatic chromosomes of *Dendrobium sutepense* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.1=2.1	3.6	1.1	m
2	1.0+1.1=2.1	3.6	1.1	m
3	0.9+1.2=2.1	3.6	1.3	m
4	0.9+1.2=2.1	3.6	1.3	m
5	0.8+1.2=2.0	3.4	1.5	m
6	0.8+1.2=2.0	3.4	1.5	m
7	0.9+1.0=1.9	3.2	1.1	m
8	0.9+1.0=1.9	3.2	1.1	m
9	0.9+1.0=1.9	3.2	1.1	m
10	0.7+1.0=1.7	2.9	1.4	m
11	0.7+0.9=1.6	2.7	1.3	m
12	0.7+0.9=1.6	2.7	1.3	m
13	0.6+1.0=1.6	2.7	1.7	m
14	0.6+1.0=1.6	2.7	1.7	m
15	0.4+1.2=1.6	2.7	3.0	sm
16	0.4+1.2=1.6	2.7	3.0	sm
17	0.7+0.8=1.5	2.5	1.1	m
18	0.7+0.8=1.5	2.5	1.1	m
19	0.6+0.9=1.5	2.5	1.5	m
20	0.6+0.9=1.5	2.5	1.5	m
21	0.6+0.8=1.4	2.4	1.3	m
22	0.6+0.8=1.4	2.4	1.3	m
23	0.6+0.8=1.4	2.4	1.3	m
24	0.6+0.8=1.4	2.4	1.3	m
25	0.6+0.8=1.4	2.4	1.3	m
26	0.6+0.8=1.4	2.4	1.3	m
27	0.5+0.9=1.4	2.4	1.8	sm
28	0.5+0.9=1.4	2.4	1.8	sm
29	0.4+1.0=1.4	2.4	2.5	sm
30	0.4+1.0=1.4	2.4	2.5	sm
31	0.4+0.9=1.3	2.2	2.3	sm
32	0.4+0.9=1.3	2.2	2.3	sm
33	0.6+0.6=1.2	2.0	1.0	m
34	0.6+0.6=1.2	2.0	1.0	m
35	0.5+0.7=1.2	2.0	1.4	m
36	0.5+0.7=1.2	2.0	1.4	m
37	0.5+0.6=1.1	1.9	1.2	m
38	0.5+0.6=1.1	1.9	1.2	m

Table 73. Measurements of somatic chromosomes of *Dendrobium clavator* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	1.0+1.2=2.2	3.5	1.2	m
2	1.0+1.2=2.2	3.5	1.2	m
3	1.0+1.2=2.2	3.5	1.2	m
4	1.0+1.1=2.1	3.3	1.1	m
5	0.7+1.4=2.1	3.3	2.0	sm
6	0.7+1.4=2.1	3.3	2.0	sm
7	0.7+1.3=2.0	3.2	1.9	sm
8	0.5+1.5=2.0	3.2	3.0	sm
9	0.9+1.0=1.9	3.0	1.1	m
10	0.9+1.0=1.9	3.0	1.1	m
11	0.8+1.1=1.9	3.0	1.4	m
12	0.8+1.1=1.9	3.0	1.4	m
13	0.7+1.1=1.8	2.9	1.6	m
14	0.8+1.0=1.8	2.9	1.3	m
15	0.8+0.9=1.7	2.7	1.1	m
16	0.8+0.9=1.7	2.7	1.1	m
17	0.4+1.3=1.7	2.7	3.3	st
18	0.5+1.1=1.6	2.5	2.2	sm
19	0.5+1.1=1.6	2.5	2.2	sm
20	0.4+1.2=1.6	2.5	3.0	sm
21	0.6+0.9=1.5	2.4	1.5	m
22	0.6+0.9=1.5	2.4	1.5	m
23	0.5+1.0=1.5	2.4	2.0	sm
24	0.5+1.0=1.5	2.4	2.0	sm
25	0.5+1.0=1.5	2.4	2.0	sm
26	0.6+0.8=1.4	2.2	1.3	m
27	0.6+0.8=1.4	2.2	1.3	m
28	0.6+0.8=1.4	2.2	1.3	m
29	0.6+0.8=1.4	2.2	1.3	m
30	0.5+0.9=1.4	2.2	1.8	sm
31	0.5+0.9=1.4	2.2	1.8	sm
32	0.5+0.9=1.4	2.2	1.8	sm
33	0.6+0.7=1.3	2.1	1.2	m
34	0.5+0.8=1.3	2.1	1.6	m
35	0.5+0.8=1.3	2.1	1.6	m
36	0.5+0.8=1.3	2.1	1.6	m
37	0.5+0.7=1.2	1.9	1.4	m
38	0.5+0.7=1.2	1.9	1.4	m

Table 74. Measurements of somatic chromosomes of *Dendrobium crumenatum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.0=1.8	3.8	1.3	m
2	0.8+1.0=1.8	3.8	1.3	m
3	0.8+0.9=1.7	3.6	1.1	m
4	0.8+0.9=1.7	3.6	1.1	m
5	0.7+0.9=1.6	3.3	1.3	m
6	0.6+0.9=1.5	3.1	1.5	m
7	0.6+0.9=1.5	3.1	1.5	m
8	0.7+0.8=1.5	3.1	1.1	m
9	0.7+0.8=1.5	3.1	1.1	m
10	0.7+0.7=1.4	2.9	1.0	m
11	0.7+0.7=1.4	2.9	1.0	m
12	0.5+0.8=1.3	2.5	1.6	m
13	0.3+0.4+0.7=1.4*	2.9	1.0	m
14	0.3+0.4+0.7=1.4*	2.9	1.0	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.6+0.6=1.2	2.5	1.0	m
18	0.6+0.6=1.2	2.5	1.0	m
19	0.6+0.6=1.2	2.5	1.0	m
20	0.6+0.6=1.2	2.5	1.0	m
21	0.5+0.7=1.2	2.5	1.0	m
22	0.5+0.7=1.2	2.5	1.0	m
23	0.5+0.7=1.2	2.5	1.0	m
24	0.5+0.7=1.2	2.5	1.0	m
25	0.5+0.6=1.1	2.3	1.2	m
26	0.5+0.6=1.1	2.3	1.2	m
27	0.3+0.8=1.1	2.3	2.7	sm
28	0.3+0.8=1.1	2.3	2.7	sm
29	0.4+0.6=1.0	2.1	1.5	m
30	0.4+0.6=1.0	2.1	1.5	m
31	0.3+0.7=1.0	2.1	2.3	sm
32	0.3+0.7=1.0	2.1	2.3	sm
33	0.3+0.7=1.0	2.1	2.3	sm
34	0.3+0.7=1.0	2.1	2.3	sm
35	0.3+0.7=1.0	2.1	2.3	sm
36	0.3+0.7=1.0	2.1	2.3	sm
37	0.3+0.5=0.8	1.7	1.7	m
38	0.3+0.5=0.8	1.7	1.7	m

*: Chromosome with secondary constriction

Table 75. Measurements of somatic chromosomes of *Dendrobium equitans* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+0.9=1.8	4.6	1.0	m
2	0.8+0.9=1.7	4.3	1.1	m
3	0.6+0.8=1.4	3.6	1.3	m
4	0.6+0.8=1.4	3.6	1.3	m
5	0.6+0.7=1.3	3.3	1.2	m
6	0.6+0.6=1.2	3.1	1.0	m
7	0.5+0.7=1.2	3.1	1.4	m
8	0.5+0.7=1.2	3.1	1.4	m
9	0.5+0.6=1.1	2.8	1.2	m
10	0.5+0.6=1.1	2.8	1.2	m
11	0.4+0.7=1.1	2.8	1.8	sm
12	0.4+0.7=1.1	2.8	1.8	sm
13	0.5+0.6=1.1	2.8	1.2	m
14	0.5+0.6=1.1	2.8	1.2	m
15	0.5+0.5=1.0	2.6	1.0	m
16	0.5+0.5=1.0	2.6	1.0	m
17	0.4+0.6=1.0	2.6	1.5	m
18	0.4+0.6=1.0	2.6	1.5	m
19	0.4+0.6=1.0	2.6	1.5	m
20	0.4+0.6=1.0	2.6	1.5	m
21	0.3+0.7=1.0	2.6	2.3	sm
22	0.3+0.7=1.0	2.6	2.3	sm
23	0.4+0.5=0.9	2.3	1.3	m
24	0.4+0.5=0.9	2.3	1.3	m
25	0.4+0.5=0.9	2.3	1.3	m
26	0.4+0.5=0.9	2.3	1.3	m
27	0.3+0.6=0.9	2.3	2.0	sm
28	0.3+0.6=0.9	2.3	2.0	sm
29	0.4+0.4=0.8	2.0	1.0	m
30	0.4+0.4=0.8	2.0	1.0	m
31	0.4+0.4=0.8	2.0	1.0	m
32	0.4+0.4=0.8	2.0	1.0	m
33	0.3+0.5=0.8	2.0	1.7	m
34	0.3+0.5=0.8	2.0	1.7	m
35	0.3+0.5=0.8	2.0	1.7	m
36	0.3+0.5=0.8	2.0	1.7	m
37	0.3+0.5=0.8	2.0	1.7	m
38	0.3+0.5=0.8	2.0	1.7	m

Table 76. Measurements of somatic chromosomes of *Dendrobium acinaciforme* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.0=1.7	3.5	1.4	m
2	0.7+1.0=1.7	3.5	1.4	m
3	0.5+1.1=1.6	3.3	2.2	sm
4	0.5+1.1=1.6	3.3	2.2	sm
5	0.5+1.1=1.6	3.3	2.2	sm
6	0.5+1.1=1.6	3.3	2.2	sm
7	0.6+0.9=1.5	3.1	1.5	m
8	0.6+0.9=1.5	3.1	1.5	m
9	0.6+0.9=1.5	3.1	1.5	m
10	0.6+0.9=1.5	3.1	1.5	m
11	0.6+0.8=1.4	2.9	1.3	m
12	0.6+0.8=1.4	2.9	1.3	m
13	0.5+0.9=1.4	2.9	1.8	sm
14	0.5+0.9=1.4	2.9	1.8	sm
15	0.5+0.9=1.4	2.9	1.8	sm
16	0.5+0.9=1.4	2.9	1.8	sm
17	0.5+0.8=1.3	2.7	1.6	m
18	0.5+0.8=1.3	2.7	1.6	m
19	0.5+0.8=1.3	2.7	1.6	m
20	0.5+0.8=1.3	2.7	1.6	m
21	0.4+0.8=1.2	2.5	2.0	sm
22	0.4+0.8=1.2	2.5	2.0	sm
23	0.4+0.8=1.2	2.5	2.0	sm
24	0.4+0.8=1.2	2.5	2.0	sm
25	0.4+0.7=1.1	2.3	1.8	sm
26	0.4+0.7=1.1	2.3	1.8	sm
27	0.4+0.7=1.1	2.3	1.8	sm
28	0.4+0.7=1.1	2.3	1.8	sm
29	0.4+0.7=1.1	2.3	1.8	sm
30	0.4+0.7=1.1	2.3	1.8	sm
31	0.5+0.5=1.0	2.1	1.0	m
32	0.5+0.5=1.0	2.1	1.0	m
33	0.4+0.5=0.9	1.9	1.3	m
34	0.4+0.5=0.9	1.9	1.3	m
35	0.4+0.5=0.9	1.9	1.3	m
36	0.4+0.5=0.9	1.9	1.3	m
37	0.3+0.5=0.8	1.7	1.7	m
38	0.3+0.5=0.8	1.7	1.7	m

Table 77. Measurements of somatic chromosomes of *Dendrobium distichum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.0=1.7	3.4	1.4	m
2	0.7+1.0=1.7	3.4	1.4	m
3	0.4+1.2=1.6	3.2	3.0	sm
4	0.3+1.2=1.5	3.0	4.0	st
5	0.7+0.8=1.5	3.0	1.1	m
6	0.7+0.8=1.5	3.0	1.1	m
7	0.6+0.9=1.5	3.0	1.5	m
8	0.6+0.9=1.5	3.0	1.5	m
9	0.5+1.0=1.5	3.0	2.0	sm
10	0.5+1.0=1.5	3.0	2.0	sm
11	0.5+1.0=1.5	3.0	2.0	sm
12	0.5+1.0=1.5	3.0	2.0	sm
13	0.5+0.9=1.4	2.8	1.8	sm
14	0.5+0.9=1.4	2.8	1.8	sm
15	0.5+0.8=1.3	2.6	1.6	m
16	0.5+0.8=1.3	2.6	1.6	m
17	0.5+0.8=1.3	2.6	1.6	m
18	0.6+0.7=1.3	2.6	1.2	m
19	0.6+0.7=1.3	2.6	1.2	m
20	0.6+0.7=1.3	2.6	1.2	m
21	0.5+0.7=1.2	2.4	1.4	m
22	0.5+0.7=1.2	2.4	1.4	m
23	0.5+0.7=1.2	2.4	1.4	m
24	0.5+0.7=1.2	2.4	1.4	m
25	0.4+0.8=1.2	2.4	2.0	sm
26	0.4+0.8=1.2	2.4	2.0	sm
27	0.4+0.8=1.2	2.4	2.0	sm
28	0.4+0.8=1.2	2.4	2.0	sm
29	0.4+0.7=1.1	2.2	1.8	sm
30	0.4+0.7=1.1	2.2	1.8	sm
31	0.4+0.7=1.1	2.2	1.8	sm
32	0.4+0.7=1.1	2.2	1.8	sm
33	0.3+0.8=1.1	2.2	2.7	sm
34	0.3+0.8=1.1	2.2	2.7	sm
35	0.4+0.6=1.0	2.0	1.5	m
36	0.4+0.6=1.0	2.0	1.5	m
37	0.4+0.6=1.0	2.0	1.5	m
38	0.4+0.6=1.0	2.0	1.5	m

Table 78. Measuremenrs of somatic chromosomes of *Dendrobium leonis* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+0.8=1.5	3.6	1.1	m
2	0.7+0.8=1.5	3.6	1.1	m
3	0.6+0.8=1.4	3.4	1.3	m
4	0.6+0.8=1.4	3.4	1.3	m
5	0.6+0.7=1.3	3.1	1.2	m
6	0.6+0.7=1.3	3.1	1.2	m
7	0.5+0.8=1.3	3.1	1.6	m
8	0.5+0.8=1.3	3.1	1.6	m
9	0.5+0.7=1.2	2.9	1.4	m
10	0.5+0.7=1.2	2.9	1.4	m
11	0.4+0.8=1.2	2.9	2.0	sm
12	0.4+0.8=1.2	2.9	2.0	sm
13	0.4+0.7=1.1	2.6	1.8	sm
14	0.4+0.7=1.1	2.6	1.8	sm
15	0.4+0.7=1.1	2.6	1.8	sm
16	0.4+0.7=1.1	2.6	1.8	sm
17	0.5+0.5=1.0	2.4	1.0	m
18	0.5+0.5=1.0	2.4	1.0	m
19	0.5+0.5=1.0	2.4	1.0	m
20	0.5+0.5=1.0	2.4	1.0	m
21	0.4+0.6=1.0	2.4	1.5	m
22	0.4+0.6=1.0	2.4	1.5	m
23	0.4+0.6=1.0	2.4	1.5	m
24	0.4+0.6=1.0	2.4	1.5	m
25	0.4+0.6=1.0	2.4	1.5	m
26	0.4+0.6=1.0	2.4	1.5	m
27	0.3+0.7=1.0	2.4	2.3	sm
28	0.3+0.7=1.0	2.4	2.3	sm
29	0.3+0.7=1.0	2.4	2.3	sm
30	0.3+0.7=1.0	2.4	2.3	sm
31	0.3+0.7=1.0	2.4	2.3	sm
32	0.3+0.7=1.0	2.4	2.3	sm
33	0.4+0.6=1.0	2.4	1.5	m
34	0.4+0.6=1.0	2.4	1.5	m
35	0.4+0.6=1.0	2.4	1.5	m
36	0.4+0.6=1.0	2.4	1.5	m
37	0.4+0.6=1.0	2.4	1.5	m
38	0.4+0.6=1.0	2.4	1.5	m

Table 79. Measurements of somatic chromosomes of *Dendrobium mannii* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.2=2.1	4.1	1.3	m
2	0.9+1.0=1.9	3.7	1.1	m
3	0.7+1.2=1.9	3.7	1.7	m
4	0.5+0.5+0.9=1.9*	3.7	2.8	sm
5	0.5+0.5+0.9=1.9*	3.7	2.8	sm
6	0.5+1.1=1.6	3.1	2.2	sm
7	0.8+0.8=1.6	3.1	1.0	m
8	0.8+0.8=1.6	3.1	1.0	m
9	0.8+0.8=1.6	3.1	1.0	m
10	0.8+0.8=1.6	3.1	1.0	m
11	0.6+0.9=1.5	2.9	1.5	m
12	0.6+0.9=1.5	2.9	1.5	m
13	0.5+0.9=1.4	2.8	1.8	sm
14	0.5+0.9=1.4	2.8	1.8	sm
15	0.5+0.9=1.4	2.8	1.8	sm
16	0.5+0.9=1.4	2.8	1.8	sm
17	0.6+0.7=1.3	2.6	1.7	m
18	0.6+0.7=1.3	2.6	1.7	m
19	0.6+0.7=1.3	2.6	1.7	m
20	0.6+0.7=1.3	2.6	1.7	m
21	0.6+0.7=1.3	2.6	1.7	m
22	0.6+0.7=1.3	2.6	1.7	m
23	0.5+0.7=1.2	2.4	1.4	m
24	0.5+0.7=1.2	2.4	1.4	m
25	0.5+0.7=1.2	2.4	1.4	m
26	0.5+0.7=1.2	2.4	1.4	m
27	0.5+0.6=1.1	2.2	1.2	m
28	0.5+0.6=1.1	2.2	1.2	m
29	0.5+0.6=1.1	2.2	1.2	m
30	0.5+0.6=1.1	2.2	1.2	m
31	0.3+0.7=1.0	2.0	2.3	sm
32	0.3+0.7=1.0	2.0	2.3	sm
33	0.3+0.7=1.0	2.0	2.3	sm
34	0.3+0.7=1.0	2.0	2.3	sm
35	0.4+0.5=0.9	1.8	1.3	m
36	0.4+0.5=0.9	1.8	1.3	m
37	0.4+0.5=0.9	1.8	1.3	m
38	0.4+0.5=0.9	1.8	1.3	m

* : Chromosome with secondary constriction

Table 80. Measurements of somatic chromosomes of *Dendrobium subulatum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.4+1.0=1.4	3.5	2.5	sm
2	0.4+1.0=1.4	3.5	2.5	sm
3	0.5+0.8=1.3	3.3	1.6	m
4	0.5+0.8=1.3	3.3	1.6	m
5	0.5+0.8=1.3	3.3	1.6	m
6	0.5+0.8=1.3	3.3	1.6	m
7	0.5+0.8=1.3	3.3	1.6	m
8	0.5+0.8=1.3	3.3	1.6	m
9	0.3+0.9=1.2	3.0	3.0	sm
10	0.3+0.9=1.2	3.0	3.0	sm
11	0.3+0.8=1.1	2.8	2.7	sm
12	0.3+0.8=1.1	2.8	2.7	sm
13	0.4+0.7=1.1	2.8	1.8	sm
14	0.4+0.7=1.1	2.8	1.8	sm
15	0.5+0.6=1.1	2.8	1.2	m
16	0.5+0.6=1.1	2.8	1.2	m
17	0.5+0.6=1.1	2.8	1.2	m
18	0.5+0.6=1.1	2.8	1.2	m
19	0.4+0.6=1.0	2.5	1.5	m
20	0.4+0.6=1.0	2.5	1.5	m
21	0.3+0.6=0.9	2.3	2.0	sm
22	0.3+0.6=0.9	2.3	2.0	sm
23	0.3+0.6=0.9	2.3	2.0	sm
24	0.3+0.6=0.9	2.3	2.0	sm
25	0.4+0.5=0.9	2.3	1.3	m
26	0.4+0.5=0.9	2.3	1.3	m
27	0.4+0.5=0.9	2.3	1.3	m
28	0.4+0.5=0.9	2.3	1.3	m
29	0.3+0.6=0.9	2.3	2.0	sm
30	0.3+0.6=0.9	2.3	2.0	sm
31	0.4+0.5=0.9	2.3	1.3	m
32	0.4+0.5=0.9	2.3	1.3	m
33	0.4+0.5=0.9	2.3	1.3	m
34	0.4+0.5=0.9	2.3	1.3	m
35	0.4+0.5=0.9	2.3	1.3	m
36	0.4+0.5=0.9	2.3	1.3	m
37	0.3+0.5=0.8	2.0	1.7	m
38	0.3+0.5=0.8	2.0	1.7	m

Table 81. Measurements of somatic chromosomes of *Dendrobium bambusiaefolium* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.8+1.1=1.9	4.1	1.4	m
2	0.7+1.0=1.7	3.7	1.4	m
3	0.7+1.0=1.7	3.7	1.4	m
4	0.6+1.1=1.7	3.7	1.8	sm
5	0.6+1.1=1.7	3.7	1.8	sm
6	0.6+1.0=1.6	3.4	1.7	m
7	0.7+0.9=1.6	3.4	1.3	m
8	0.7+0.9=1.6	3.4	1.3	m
9	0.7+0.8=1.5	3.2	1.1	m
10	0.7+0.8=1.5	3.2	1.1	m
11	0.6+0.9=1.5	3.2	1.5	m
12	0.6+0.9=1.5	3.2	1.5	m
13	0.6+0.9=1.5	3.2	1.5	m
14	0.6+0.8=1.4	3.0	1.3	m
15	0.6+0.7=1.3	2.8	1.2	m
16	0.6+0.7=1.3	2.8	1.2	m
17	0.5+0.8=1.3	2.8	1.6	m
18	0.5+0.8=1.3	2.8	1.6	m
19	0.5+0.7=1.2	2.6	1.4	m
20	0.5+0.7=1.2	2.6	1.4	m
21	0.5+0.7=1.2	2.6	1.4	m
22	0.5+0.7=1.2	2.6	1.4	m
23	0.5+0.7=1.2	2.6	1.4	m
24	0.5+0.7=1.2	2.6	1.4	m
25	0.5+0.6=1.1	2.4	1.2	m
26	0.5+0.6=1.1	2.4	1.2	m
27	0.5+0.5=1.0	2.2	1.0	m
28	0.5+0.5=1.0	2.2	1.0	m
29	0.4+0.5=0.9	1.9	1.3	m
30	0.4+0.5=0.9	1.9	1.3	m
31	0.4+0.4=0.8	1.7	1.0	m
32	0.4+0.4=0.8	1.7	1.0	m
33	0.4+0.4=0.8	1.7	1.0	m
34	0.4+0.4=0.8	1.7	1.0	m
35	d+0.6=0.6	1.3	<∞	t
36	d+0.6=0.6	1.3	<∞	t
37	d+0.6=0.6	1.3	<∞	t
38	d+0.6=0.6	1.3	<∞	t

d : dot

Table 82. Measurements of somatic chromosomes of *Dendrobium insigne* at mitotic metaphase, 2n=36+2f

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.9+1.5=2.4	5.0	1.7	m
2	0.9+1.5=2.4	5.0	1.7	m
3	0.8+1.2=2.0	4.1	1.5	m
4	0.7+1.0=1.7	3.5	1.4	m
5	0.7+1.0=1.7	3.5	1.4	m
6	0.7+1.0=1.7	3.5	1.4	m
7	0.6+1.0=1.6	3.3	1.7	m
8	0.6+1.0=1.6	3.3	1.7	m
9	0.6+0.9=1.5	3.1	1.5	m
10	0.6+0.9=1.5	3.1	1.5	m
11	0.4+1.0=1.4	2.9	2.5	sm
12	0.4+1.0=1.4	2.9	2.5	sm
13	0.6+0.8=1.4	2.9	1.3	m
14	0.6+0.8=1.4	2.9	1.3	m
15	0.6+0.7=1.3	2.7	1.2	m
16	0.6+0.7=1.3	2.7	1.2	m
17	0.6+0.7=1.3	2.7	1.2	m
18	0.6+0.7=1.3	2.7	1.2	m
19	0.6+0.6=1.2	2.5	1.0	m
20	0.6+0.6=1.2	2.5	1.0	m
21	0.5+0.7=1.2	2.5	1.4	m
22	0.5+0.7=1.2	2.5	1.4	m
23	0.5+0.6=1.1	2.3	1.2	m
24	0.5+0.6=1.1	2.3	1.2	m
25	0.4+0.6=1.0	2.1	1.5	m
26	0.4+0.6=1.0	2.1	1.5	m
27	0.4+0.6=1.0	2.1	1.5	m
28	0.4+0.6=1.0	2.1	1.5	m
29	0.4+0.6=1.0	2.1	1.5	m
30	0.4+0.6=1.0	2.1	1.5	m
31	0.4+0.5=0.9	1.9	1.3	m
32	0.4+0.5=0.9	1.9	1.3	m
33	0.4+0.5=0.9	1.9	1.3	m
34	0.4+0.5=0.9	1.9	1.3	m
35	0.4+0.4=0.8	1.7	1.0	m
36	0.4+0.4=0.8	1.7	1.0	m
37	0.3+0.3=0.6	1.2	1.0	m
38	0.3+0.3=0.6	1.2	1.0	m

Table 83. Measurements of somatic chromosomes of *Dendrobium agrostophyllum* at mitotic metaphase, 2n=38

Chromosome	Length(μm)	Relative length	Arm ratio	Position of centromere
1	0.7+1.5=2.2	4.1	2.1	sm
2	0.6+1.5=2.1	3.9	2.5	sm
3	0.6+1.5=2.1	3.9	2.5	sm
4	0.6+1.2=1.8	3.4	2.0	sm
5	0.7+1.0=1.7	3.2	1.4	m
6	0.6+1.1=1.7	3.2	1.8	sm
7	0.7+0.9=1.6	3.0	1.3	m
8	0.7+0.9=1.6	3.0	1.3	m
9	0.5+1.0=1.5	2.8	2.0	sm
10	0.6+0.9=1.5	2.8	1.5	m
11	0.7+0.8=1.5	2.8	1.1	m
12	0.7+0.8=1.5	2.8	1.1	m
13	0.6+0.9=1.5	2.8	1.5	m
14	0.6+0.9=1.5	2.8	1.5	m
15	0.6+0.9=1.5	2.8	1.5	m
16	0.6+0.8=1.4	2.6	1.3	m
17	0.6+0.8=1.4	2.6	1.3	m
18	0.6+0.8=1.4	2.6	1.3	m
19	0.6+0.8=1.4	2.6	1.3	m
20	0.6+0.8=1.4	2.6	1.3	m
21	0.5+0.9=1.4	2.6	1.8	sm
22	0.5+0.9=1.4	2.6	1.8	sm
23	0.6+0.7=1.3	2.4	1.2	m
24	0.6+0.7=1.3	2.4	1.2	m
25	0.6+0.7=1.3	2.4	1.2	m
26	0.6+0.7=1.3	2.4	1.2	m
27	0.5+0.7=1.2	2.2	1.4	m
28	0.5+0.7=1.2	2.2	1.4	m
29	0.5+0.7=1.2	2.2	1.4	m
30	0.4+0.8=1.2	2.2	2.0	sm
31	0.4+0.7=1.1	2.0	1.8	sm
32	0.5+0.6=1.1	2.0	1.2	m
33	0.5+0.6=1.1	2.0	1.2	m
34	0.5+0.6=1.1	2.0	1.2	m
35	0.5+0.6=1.1	2.0	1.2	m
36	0.5+0.6=1.1	2.0	1.2	m
37	0.4+0.6=1.0	1.9	1.5	m
38	0.4+0.6=1.0	1.9	1.5	m

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