FLORAL COMPOSITION DIFFERENCE BETWEEN THE COMMUNITIES OCCURRING ON THE WESTERN AND EASTERN COASTS ON THE TIP OF HENGCHUN PENINSULA

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Introduction

Hengchun Peninsula is situated in the southern part of Taiwan. The Bashi Channel lies between the south tip of Hengchun Peninsula and the Philippine Islands; the Taiwan Strait roars between its western coast and the edge of the Chinese mainland; and to its eastern shore waves calmly the Pacific Ocean. The region of Hengchun Peninsula is bounded by the Feng-kan River (楓港溪) in the north, and ends with the cape of Olanpi (鵝鑾鼻) in the south.

The topography of the Peninsula is the southward extension of the Central Mountains in East Taiwan. Running down to the west of the south-eastern part from the Central Mountains, a rather narrow rectangular belt is formed, the width of which is only 2–3 kilometers. It is the very tip of Hengchun Peninsula. There is a fault on its eastern shore, about 50–100 meters in height. Below the fault there is a beach about 100–200 meters in width. On the west side the beach is broader than that on the east. Along the western side, the coast is composed of coral atolls or beaches.

The climate of the Peninsula is tropical, with high temperature and frequent rainfall. Plants are plentiful and various. Tropical forests are seen on both shores, east and west. It is therefore called a "Tropical rain forest" by Y. Kudo, a Japanese botanist.

Before the restoration of Taiwan from Japan to China, in the year of 1945, the plants grown in this peninsula were investigated by a number of Japanese botanists from time to time, particularly by Sasaki, Suzuki and Fukuyama.

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Sasaki made a full report in 1933 concerning the western coastal woody plants from Tapanlu (大板埒) to Olanpi. Both Suzuki and Fukuyama once devoted a lot of time to studying the eco-type of the eastern coastal forest in 1936.

After Taiwan was restored to China in 1945, some Chinese botanists, including Hui-lin Li and Hsiun Keng, also gave attention to the plant distribution in this region in 1950. They concluded that the plant flora here should be separated from the plants growing elsewhere in Taiwan. It may be treated as an independent flora region.

Since finishing his studies in botanical subjects in 1954 at the School of Science, Taiwan Provincial Normal University, the writer has been teaching at Taiwan Provincial Kaohsiung Middle School. Having been warmly supported by the school authorities, he had the opportunity to direct a group of students going to the seashores of Hengchun peninsula as plant specimen collectors during the spring vacation in April, 1957. This group discovered that the species and eco-type are different between the two coasts, and even the composition of communities is not the same.

From then on, the writer went to the Peninsula on three other occasions; namely, February 1958, July 1959, and January 1960. With great care and interest the writer observed, investigated and collected the plant species. On the basis of this research on four occasions, this report is made up in order to discuss the various causes of the difference between the western and eastern coastal plants on the tip of Hengchun Peninsula, as well as to realize the essential factors that would influence the eco-types of the plants in that region.

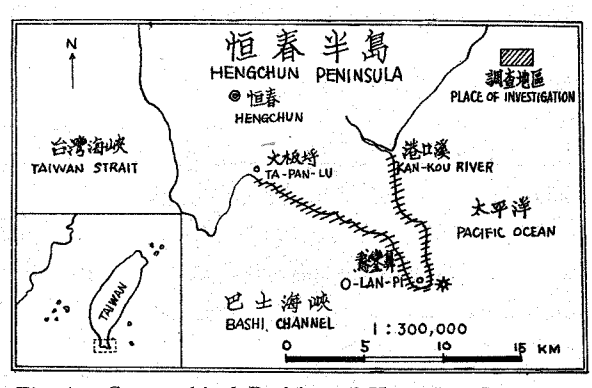


Fig. 1: Geographical Position of Hengchun Peninsula

Investigation of Coastal Plants

The result of the investigation of the difference in plant classification between the shores east and west of Hengchun peninsula is shown in the appendix. These coastal plants are distributed from Tapanlu to Olanpi in the west and from Kan-kou River (港口溪) to Olanpi in the east. There are 159 species in total, among which 153 species were found on the western coast, and 86 species on the east. Eighty species out of 86 were found on both coasts. Six herbaecous species found on the eastern coast are not seen on the western coast.

The plants growing on the west coast are mostly woody, of which the

coastal forest is composed. The plants on the east coast are type of both herbaceous and shrubby associations, by which the coastal plant community is composed. There are only small number of trees growing behind the dunes. The six kinds of plants that are only seen on the east shore are of the herbaceous type growing on the beach.

Plant Communities and their Vertical Distribution

The south tip of Hengchun Peninsula is a plateau or tableland, the east coast of which is a fault above the sea-level from 50–100 meters. Below the fault there is the beach from 100–200 meters in width. The condition on the western coast is rather different. The tableland gradually extends westward in a slope without having any fault, while the average breadth of the beach is about 500–1000 meters.

Above the tidal range high and low coral atolls appear here and there. Behind the range is the sandy beach. A little further back we found a considerable area of soil which was made up of coral atolls and rocks which had been weathered for ages, upon which herbs, shrubs and trees were growing and were distributed in various communities.

On the Western Coast:

In comparison with the eastern coast, the sea-line of the west is more or less irregular, and the beach is rather broad. The varieties of plants are particularly found in the regions of Olanpi, the southernmost tip of the Peninsula, and between Banana Bay (香蕉灣) and Chuan-fan-shih (Sail-like Stone 船帆石). Owing to the different topography and environment required in the course of the growth of plants, various plant communities are to be made up.

Their growing situation as well as their vertical distribution is illustrated as below:

A. Plant Communities:

a. The horizontal herb and shrub communities on the coral atoll:

This community is essentially made up of the *Pemphis acidula* Forst. in occupation of coral atoll about 20–30 meters in size. Amidst the *Pemphis acidula* Forst., some horizontal shrub species of *Ficus Swinhoei* King and *Fimbristylis annua* (All.) O.R. et S. could be discovered sometimes.

b. The horizontal herb community on the beach:

Between the coral atoll and the coastal forest there is a portion of beach, of which Sha-tao or Sand Island (砂島), Ken-ting (墾丁) and Nan-wan or South Bay (南灣) are the widest, where the community is made up of *Ipomoea pes-caprae* (Linn.) Roth. together with a small number of species of *Vitex rotundifolia* Linn., *Cassytha filiformis* Linn., and *Euphorbia Atoto* Forst., etc.

c. The shrub community of the coastal forest:

This community is composed of the erect shrub association of *Tournefortia argentea* Linn. and *Pandanus odoratissimus* L. var. *sinensis* Kaneh., and the horizontal herb association of *Scaevola frutesens* Kraus.. Amidst these associations, the species of *Pandanus* is comparatively widely distributed and growing abundance.

d. The tree community:

Behind the shrub community there is the community of trees, including *Barringtonia asiatica* Kurz, *Hernandia ovigera* Linn., *Calophyllum Inophyllum* Linn., *Terminalia Catappa* Linn., *Bischofia javanica* Bl., together with some *Aglaia formosana* Hay., *Murraya paniculata* Jack. The species of plants in the forest are plentiful and growing up in luxuriance.

The tree and shrub communities mentioned above make up the virgin coastal forest on the western part of this peninsula, with full tropical view.

B. Vertical Distribution:

Plant distribution gradually removes from the tidal range to inland. Except that the topography is caused to slope upward little by little, the growing position of plant communities has its proper rank. Beginning from the horizontal herb and shrub communities up to the erect shrub and tree communities, a terrace coastal forest is formed. The typical plant communities of the western coast alongside the Banana Bay are shown in Figure 2.

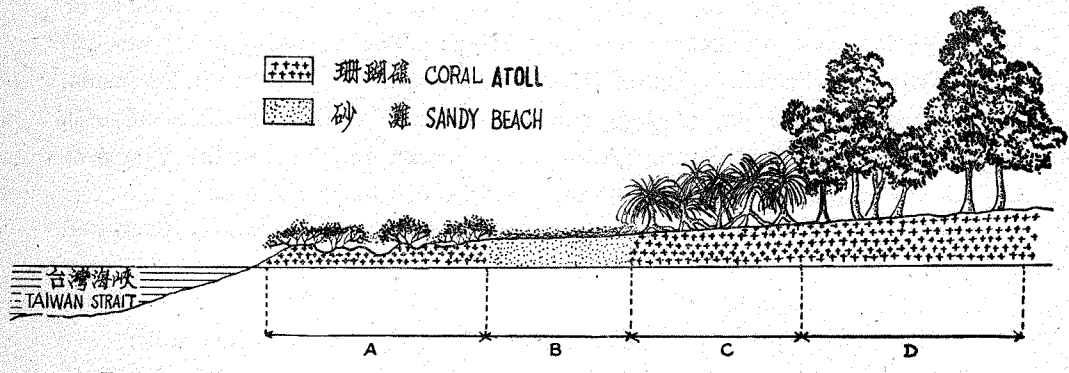


Fig. 2: Distribution of plant community on the Banana Bay of the western coast.
A=The horizontal Herb and Shrub Communities on the coral atolls
B=The horizontal Herb Community on the beach
C=The Shrub Community of the coastal forest
D=The Tree Community of the coastal forest

According to Figure 2, the distribution of coastal plants, starting from the tidal range in average, varies topographically. Table 1 shows the vertical distribution of the principal species of western coastal plants.

On the Eastern Coast:

The beach of the eastern coast is very narrow, the width of which is no more than 200 meters. Behind the beach the fault stands loftily. The NE

Table 1: Vertical distribution of Western Coastal plants

Vertical Height (M)	Plant Community	Species	Quantity
0 -1	—	— — — — — —	—
1 -1.5	Horizontal Herb & Shrub Community	*Pemphis acidula* Forst.	+++
1 -1.5		*Fimbristylis annus* (All.) O.R. et S.	+
1.5-2		*Ficus Swinhoei* King	++
1.5-2		*Scaevola frutescens* Kraus.	++
2 -4	Herizontal Herb Community	*Ipomoea pes-caprae* (Linn.) Roth.	+++
2 -4		*Canavalia lineata* DC.	+
2 -4.2		*Vitex rotundifolia* Linn.	++
3.5-4		*Euphorbia Atoto* Forst.	+
3.5-4.5		*Crimun asiaticum* L. var. *sinicum* Bak.	+
4 -5		*Cassytha filiformis* Linn.	++
3 -5	Shrub Community	*Scaevola frutescens* Kraus.	++
3 15.5		*Tournefortia argentea* Linn.	++
3.5-5.5		*Clerodendron inerme* Linn.	+
3 -6		*Ficus Swinhoei* King	++
3 -6.5		*Hibiscus tilaceus* Linn.	++
3 -6.5		*Guettarda speciosa* Linn.	++
3.5- 7		*Pandanus odoratissimus* L. var. *sinensis* Kaneh.	+++
4 -15	Tree Community	*Ficus septica* Burm. f.	++
4 -15		*Premna odorata* Blanco	++
4 -15		*Calophyllum Inophyllum* Linn.	++
5 -20		*Aglaia formosana* Hay.	+++
5 -25		*Sideroxylon ferrugineum* H. et A.	+++
5 -25		*Terminalia Catappa* Linn.	++
6 -25		*Diospyros vtilis* Hemsl.	++
6 -25		*Macaranga Tanarius* Muell.-Arg.	++
7 -25		*Barringtonia asiatica* Kurz.	++
7 -25		*Hernandia ovigera* Linn.	++

+++=Most abundant ++=Abundant +=Less abundant

monsoon usually blows over the uneven dunes. Hence, the plant communities and vertical distribution caused by topographical features on the eastern coast differ from those of the west.

A. Plant Communities:

a. The horizontal herb and shrub communities on the coral atoll:

These communities are similar to those of the western coast, except that their distribution is a little narrow in size, while their individual number is less.

The principal species of horizontal shrub community here is composed of *Pemphis acidula* Forst. with a small number *Sesuvium portulacastrum* Linn..

b. The horizontal herb community on the beach and dunes:

The plant community on the beach and dunes is made up of the horizontal herb, which is not seen on the western coast. Being eroded by wind and rain, abnormal beach and dunes are found on the eastern coast. By virtue of sand blown by the monsoon flying over the fault higher than 50 meters, smaller deserts are formed in the inland even at a distance of about a kilometer from the coast. Therefore, the plant communities occupy a larger size. They are *Ipomoea pre-caprae* (L.) Roth., *Wedelia prostrata* Hemsl., *Dactyloctenium aegyptium* (L.) Richt., *Spinifex littereus* (Burm. f.) Merr., *Vitex rotundifolia* L., *Cassytha filiformis* L., *Canavalia lineata* DC., etc. in addition to the erect herb *Crinum asiaticum* L. *var. sinicum* Bak..

c. The erect shrub community on the dunes:

Behind the horizontal herb community is the erect shrub. The widely-spread *Pandanus association* is composed of *Pandanus odoratissimus* L. var. *sinensis* Kaneh. (see Plate I, Fig. 2). Going a little backward we may see both the associations of *Alpinia speciosa* Schum. and *Phoenix Hanceana* Naudin var. *formosana* Becc.. The three species related above are numerous in distribution and quite helpful in prevention of wind and in solidification of the dunes.

Behind these associations and dunes where the wind is weaker, we may see the shrub associations as *Tournefortia argentea* L., *Scaevola frutescens* Kraus. etc.. There are also such shrubby associations as *Calophyllum Inophyllum* L. and *Aglaia formosana* Hay.

d. The tree community behind the dunes:

The dunes caused by the monsoon could be built up to over ten meters in height. The wind is weaker behind the dunes and this enables the tree communities to grow there. They are *Aglaia formosana* Hay., *Macaranga Tanarius* (Linn.) Muell. Arg., *Sideroxylon ferrugineum* Hook. et Arn. etc..

The *Barringtonia asiatica* Kurz. and *Hernandia ovigera* L. which grow on the western coast are not seen here, despite the fact that their seeds and fruits were discovered on the beach. They might have been taken here by coastal tides.

The tree communities in the lowland and the shrub communities on the dunes make up the virgin forest on the eastern coast.

e. The horizontal shrub community on the fault:

About 100–200 meters distant from the tidal range, there is a fault, 50 meters in height, as mentioned before. As it is directly attacked by the monsoon, tall and erect plants are not seen on the fault at all, but on it spread the associations of *Ficus Swinhoei* King, *Gelonium aequorum* Hance and *Ampelopsis heterophylla* S. et Z. in a larger size. Other associations like *Scaevola frutescens* (Mill.)

Krause and *Cassytha filiformis* L., also spread all over the summit of the fault.

B. Vertical Distribution:

Plant distribution of the eastern coast has its starting point from the association of *Pemphis acidula* Forst. from the tidal range through a section of beach towards the uneven dunes, behind which there is a fault 50 meters in height.

The plant distribution on the coast of this section is clearly shown in comparison with that on the opposite western coast.

Figure 3 shows the distributive condition of plant communities on the eastern shore is of equal latitude(s) with that alongside Banana Bay on the opposite side.

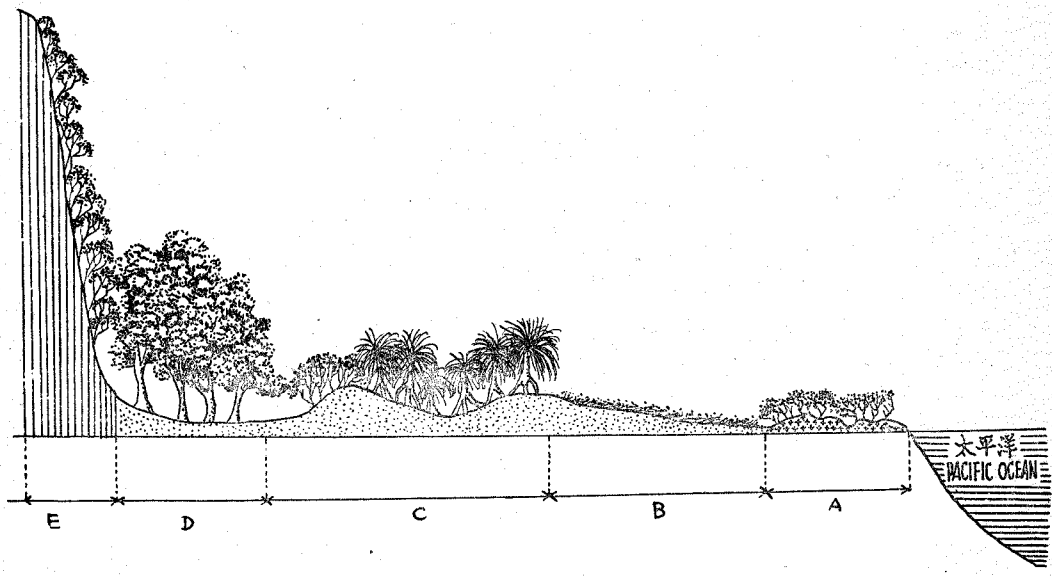


Fig. 3: Distribution of plant community on the coral atoll, sand-dunes and fault of Eastern Coast.

A=The horizontal Herb and Shrub Communities on the coral atolls,
B=The horizontal Herb Community on the beach and dunes
C=The Shrub Communtiy on the sand-dunes
E=The horizontal Shrub Community on the fault

Table 2 indicates the vertical distributive condition of some principal species of plants on the eastern coast.

Table 2: Vertical distribution of the eastern coastal plants

Vertical Height (M)	Plant Community	Species	Quantity
1 -1	—	— — — — — —	—
1 -1.2	Horizontal Herb & Shrub Community	*Pemphis acidula* Forst.	++
1 -1.2		*Sesuvium Portulacastrum* Linn.	+
1 -1.2		*Fimbristylis annus* (All.) O. R. et S.	+

Vertical Height (M)	Plant Community	Species	Quantity
2 - 5	Horizontal Herb Community	*Wedelia prostrata* Hemsl.	+++
2 - 6		*Ipomoea pes-capare* (Linn.) Roth.	+++
3 - 5		*Canavalia lineata* DC.	++
3 - 5		*Statice sp.*	+
3 - 5		*Bothriospermun tenellum* F. et Mey.	++
4 - 8		*Crirnum asiaticum* L. var. *sinicum* Bak.	++
4 - 9		*Vitex rotundifolia* L.	++
4 - 9		*Spinifex littoreus* (Burm. f.) Merr.	+++
5 -10	Shrub Community	*Pandanus odoratissimus* L. var. *sinensis* Kaneh.	+++
5 -10		*Tournefortia argentea* Linn.	++
5 -10		*Scaevola frutescens* Linn.	++
5 -10		*Aglaia fomosana* Hay.	+++
6 -15		*Calophyllum Inophyllum* Linn.	++
6 -20		*Alpinia speciosa* K. Schum.	+++
6 -20		*Phoenix Hanceana* Naudin. var. *formosana* Becc.	+++
4 - 6	Tree Community	*Morinda citrifolia* Linn.	++
4 - 6		*Macaranga Tanarius* Muell-Arg.	++
4 - 7		*Agiaia formosana* Hay.	+++
4 - 7		*Sideroxylon ferrugineum* H. et A.	+++
5 -10		*Murraya paniculata* Jack.	++
5 -10		*Calophyllum Inophyllum* Linn.	+++
10 -25	Horizontal Shurb Community	*Gelonium aequoreum* Hance	++
10 -55		*Ficus Swinhoei* King	+++
10 -55		*Scaevola frutescens* Kraus.	+++
30 -50		*Ampelopsis heterophyll* S. et Z.	++

+++=Most abundant ++=Abundant +=Less abundant

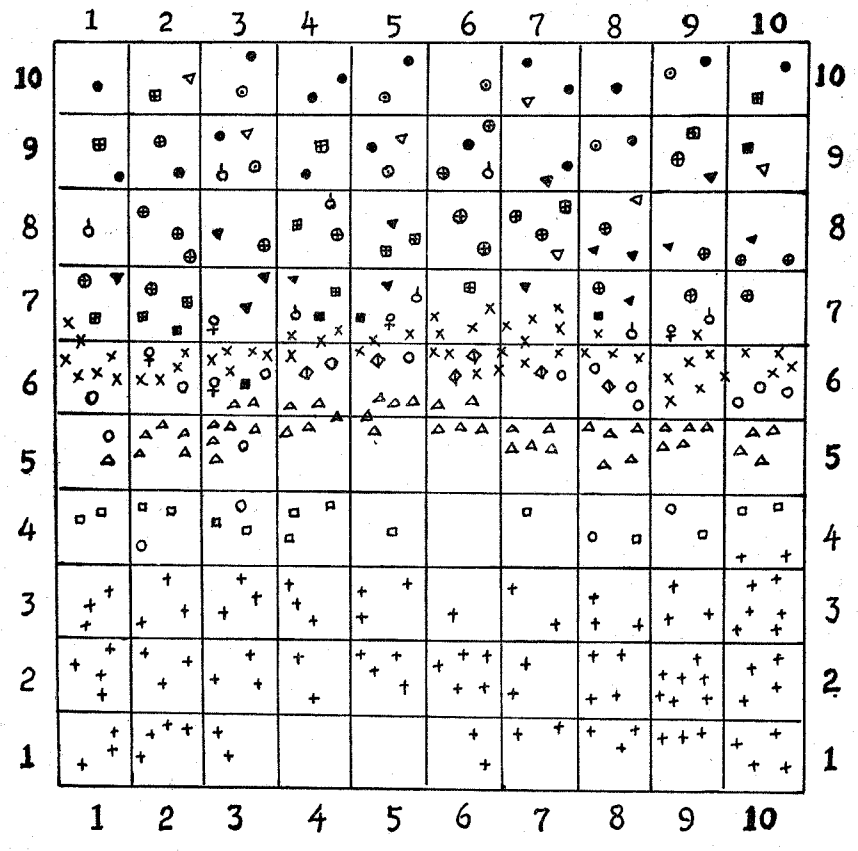
Investigation of Individual Number through the Quadrat Method:

The writer has always tried to apply the Quadrat Method in a place of 100 square meters in order to investigate the plant species and individual number of equal latitude(s) on both the western and eastern coasts. The result is shown in Figures 4 and 5.

On the Western Coast:

The Quadrat at a place in the north is about 100 meters distant from Banana Bay. Species were taken from the tidal range inland (Figure 4). Close to the tidal range, from 0 to 30 meters, coral atolls are seen, upon which we find the horizontal shrub *Pemphis acidula* Forst. Between the coral atoll and the beach within a distance from 30–40 meters, there is a kind of erect shrub named

Scaevola frutescens Krause. On the beach from 40–50 meters, it is almost covered with the luxuriant horizontal herb *Ipomoea pes-caprae* (L.) Roth.. At a distance of 55–65 meters from the beach, an important species, such as *Pandanus odoratissimus* L. var. *sinensis* Kaneh., grows abundantly at 55–65 meters distant from the beach in an intensive fenced-shape. About 60–100 meters from the beach, we find the trees scientifically named *Terminalia Catappa* L., *Barringtonia asiatica* Kurz. as well as other kinds of trees, namely, *Aglaia formosana* Hay., *Ficus septica* Burm. f. etc., by all of which the coastal virgin forest is formed.



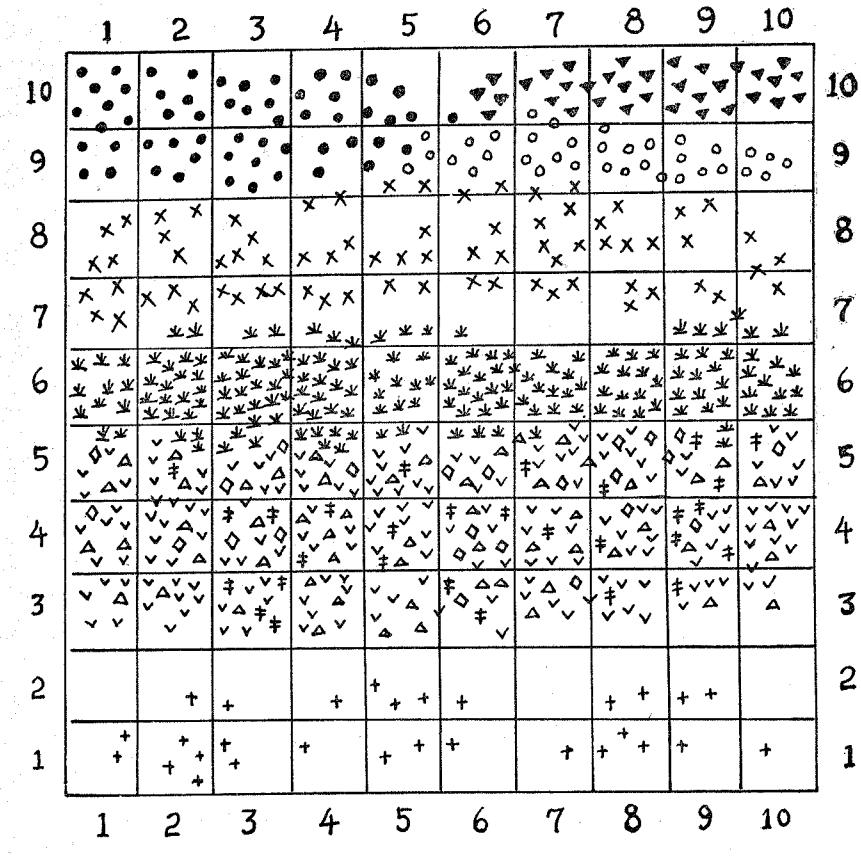
+ =	Pemphis acidula Forst.	⊞ =	Barringtonia asiatica Kurz.
o =	Tournefortia argentea Linn.	◈ =	Clerodendron inerme Linn.
△ =	Ipomoea pes-caprae Roth.	◎ =	Murraya paniculata Jack.
× =	Pandanus odoratissimus L. var. sinensis Kaneh.	▽ =	Macaranga Tanarius Muell-Arg.
		● =	Aglaia formosana Hay.
♀ =	Laportea pterostigma wedd.	♂ =	Ficus septica Burm. f.
▼ =	Calophyllum Inophyllum L.	■ =	Premna odorta Blanco
⊕ =	Terminalia Catappa L.	□ =	Scaevola frutescens Kraus.

Fig. 4: The Quadrat (100m²) of the western coastal plants on Hengchun peninsula on Jan. 1, 1960

On the Eastern Coast:

Similarly, the Quadrat Method was also applied on the eastern coast by taking a place with 100 square meters in size from the tidal range inland. That place has not any proper name since it is a wasteland. It belongs to the same latitude(s) as that of the Banana Bay. Its plant species and individual number are indicated in Figure 5.

Within the distance of 20 meters from the tidal range inland are the coral atolls, narrower than those on the western coast. We find there the horizontal shrub *Pemphis acidula* Forst..



\+ = Pemphis acidula Forst.
△ = Ipomoea pes-caprae Roth.
⋁ = Wedelia prostrata Hemsl.
⊻ = Spinifex littoreus Merr.
× = Pandanus odoratissimus L. var. sinensis Kaneh.
● = Aglaia formosana Hay.
⊹ = Vitex rotundifolia L.
○ = Tournefortia argentea L.
▲ = Calophyllum Inophyllum L.
◇ = Crinum asiaticum L. var. sinicum Bak.

Fig. 5: The Quadrat (100m²) of the eastern coastal plants on Hengchun peninsula on Jan. 2, 1960

Behind the coral atolls there is a section of level beach, and behind the beach are the uneven dunes, upon which some species of horizontal herbs are grown. They are *Ipomoea pes-caprae* (L.) Roth., *Wedelia prostrata* Hemsl., *Vitex rotundifolia* Linn., *Crinum asiaticum* L. var. *sinicum* Bak., all distributed within 20–50 meters between the beach and the dunes.

On the top of the dunes, within a Quadrat 50–65 meters in size, is the *Spinifix littoreus* (Burm. f.) Merr.

A little further back 65–80 meters, is the *Pandanus odoratissmus* L. var. *sinensis* Kaneh., by means of which a tight fenced-shape association is formed.

Behind the Pandanus community of the dunes where the topography descends straight and the wind lessens, a number of shrubs and trees are found, which in turn make up the coastal virgin forest with a size of 80–100 meters. They are *Aglaia formosana* Hay., *Tournefortia argentea* L. and *Calophyllum Inophyllum* Linn..

The percentage of the adjustment and calculation of the plant species and individual number indicated in Figures 3 and 4 is shown in Table 3.

Table 3: Number and percentage of the western and eastern coastal plants in the quadrat ($100m^2$)

Species	Western Coast		Eastern Coast	
	Number	Percent	Number	Percent
Pemphis acidula Forst.	93	27.56	30	4.36
Tournefortia argentea Linn.	18	5.34	36	5.23
Ipomoea pes-caprae (Linn.) Roth.	47	13.44	54	7.56
Scaevola frutescens Kraus.	15	4.45	0	0
Pandanus odoratissimus L. var. *sinensis* Kaneh.	53	15.72	76	11.40
Laportea pterostigma Wedd.	5	1.41	0	0
Calophyllum Inophyllum Linn.	16	4.74	35	5.08
Terminalia Catappa Linn.	21	6.23	0	0
Barringtonia asiatica Kurz.	15	4.45	0	0
Clerodendeon inerme Linn.	6	1.86	0	0
Murraya paniculata Jack.	8	2.37	0	0
Macaranga Tanarius (Linn.)Muell-Arg.	7	2.07	0	0
Aglaia formosana Hay.	18	5.34	59	8.57
Ficus septica Burm. f.	8	2.37	0	0
Premna odorata Blanco	7	2.07	0	0
Wedelia prostrata Hemsl.	0	0	165	23.98
Spinifex littoreus (Burm. f.) Merr.	0	0	176	25.58
Crinum asiaticum L. var. *sinicum* Bak.	0	0	28	4.06
Vitex rotundifolia Linn.	0	0	29	4.21
Total	337	100	688	100

With regard to the above table, it shows that the individual number of the plant species on the eastern coast is double that on the western coast. The reason is that the herbaceous species of plants are dominant on the eastern coast. As to woody plants, their ratio between both the coast east and west seems to be 1:9. In other words, woody plants are particularly dominant on the western coast.

The dominant species on the eastern coast include both kinds of herbaceous and woody plants. As to the former we find *Spinifex littoreus* (Burm. f.) Merr. (25.58%), *Wedelia prostrata* Hemsl. (23.98%), *Ipomoea pes-caprae* (Linn.) Roth (7.56%), and to the latter we find *Pandanus odorastissimus* L. var. *sinensis* Kaneh. (11.4%), *Aglaia formosana* Hay. (8.57%), *Tournefortia argentea* Linn. (5.23%), *Calophyllum Inophyllum* Linn. (5.08%).

Both the dominant species of woody and herbaceous plants on the western coast are *Pemphis acidula* Forst. (27.56%), *Pandanus odoratissimus* L. var. *sinensis* Kaneh. (15.72%), *Terminalia Catappa* Linn. (6.23%), *Aglaia formosana* Hay. (5·34%), *Tournefortia argentea* Linn. (5.34%), all belonging to woody species; there is only the *Ipomoea pre-caprae* (Linn.) Roth. (13.44%) belonging to the herbaceous species.

Individual Eco-type Difference between the Western and the Eastern Coastal Plants

The plants on both shores have been briefly described as above. The species of plants with their compositon of communities are quite different. Even the eco-type of the plants of the same species growing on the east shore and the west are not the same.

Five species of plants are chosen for examples:

Species	W. Coast	E. Coast
Pandanus odoratissimus L. var. *senensis* Kaneh.	An erect woody plant, well-grown, having no inclination.	A woody plant with inclination of 15–30 degrees.
Ficus Swinhoei King	An erect woody plant on the seashore.	A woody plant with inclination of 60 degrees on the fault top.
Agave americana L. *Agave sisalana* Per.	Foreign species grown originally in S. America, being fit to be planted here in abundance.	Thanks to the beach or dunes facing toward the wind belt, poorly grown, leaves dried and yellow.
Tournefortia argentea L.	Growing on the coral atolls or beach facing the tidal range, stems and leaves stretching upward over 3 meters.	Growing on beach or dunes toward wind belt, rather SHORT, not over one meter.
Calophyllum Inophyllum L.	Trees	Shrubby

According to the above table, the apparent distinction of the eco-type of the plants between the eastern and western coasts depends on both the inclined phenomenon of the dwarf trees and their short structure with dried and yellow leaves on the eastern shore. The chances are that on the eastern shore directly faces the Pacific Ocean, it is strongly attacked again and again by the north-eastern monsoon, in addition to being influenced by other surrounding factors.

Discussion

Peninsuls Hengchun is situated in the south of Taiwan Island, surrounded by waters on three sides, east, west, and south. The prominent warm Pacific Current move along the east and west coasts of the Peninsula. The yearly average temperature is over 20°C (20 degrees Centigrade). The yearly rainfall is rich. The number of the plants species is plentiful, particularly on the south tip of the coasts, where the tropical rain forest grows to a large size. In respect to temperature, rain quantity and tides, they are almost the same on the narrower rectangular region between two and three kilometers from the west coast to the east on the southern tip of the Peninsula. Theoretically speaking, the plant species and their distribution should be the same. Yet, according to the investigation and observation of the writer, the plants that grow on the eastern and western coasts have clear differences, as we have described above.

There are two movements of the plants on Hengchun Peninsula Coast. One is by ocean current; the other, by wind. Both of them are investigated by some botanists as follows:

According to Sasaki's statement (1933), we were told that the trees on the western coast of the Hengchun Peninsula were almost the same in species in comparison with those on the South Sea Islands. Sasaki insisted that the tropical trees on the western coast gradually made up the coastal virgin forest by means of the ocean current that brought the younger trees or the seeds and the fruits to the coast of the peninsula. But Sze (1947) has said the migration of the plants of flora on Taiwan is aided by typhoon from either the mainland of China or the Philippines. And Li (1953) has also said the movement of the tropical plants, especially along the coast of Hengchun Peninsula, is only from the Philippines both by wind and by ocean current.

The writer himself discovered the seeds of *Pandanus odoratissimus* L. var. *sinensis* Kaneh., *Entada koshunensis* Hay. et Kaneh., *Entada formosana* Kaneh., *Entada phaseoloides* Merr, *Hernandia ovigera* L. and the fruit of *Barringtonia asiatica* Kurz., *Sterculia foetida* Linn. alongside the tidal range on the coastal beach, when the writer went to the eastern coast in collection and investigation of botanical species. They were floating towards the coast from the sea. The mother region of these is not yet known, but it seems quite reasonable to believe that they were floated in from the sea, just as Sasaki pointed out. Provided

that such a supposition was established, the source of the plants on the eastern coast, and their species and distribution as well, would have been the same as those on the west. As a matter of fact, the floating-in plants discovered on the eastern coastal beach were never seen as grown-up trees over there, except the *Pandanus*.

In observing the distribution of the species of wild tropical plants along the coast of Hengchun Peninsula, the writer has found the species of plants on the western and eastern coasts are common to that on the Philippines as Li pointed out. And the writer has also investigated the typhoon in the past days often swept over the Philipines and reached Taiwan, by which the seeds and fruits of the tropical plants could be reasonally brought to the Hengchun Peninsula. This result is the same as Sze. Furthermore, their distribution must be equally along both the western and the eastern coasts. As a matter of fact, they are not distributed equally so, why? There may be other factors that determine whether the plants may exist on the eastern coast or not.

According to the statements of Suzuki and Fukuyama (1936) concerning the woody plants in the Alongway (阿朗衛) region on the eastern coast, the eastern coastal virgin forest had then a majority of younger trees, with no comparatively taller and bigger ones. The dune inclination is botween 6–9 degrees. The region which the writer investigated was to the south of the localities designated by Suzuki and Fukuyama. The dune inclination is over 30 degrees. On the front part of the dunes there are herbaceous plant associtions as *Spinifex littoreus* (Burm. f.) Merr., *Ipomoea pes-caprae* (Linn.) Roth., *Vitex rotundifolia* Linn., *Wedelia prostrata* Hemsl., etc.

The woody plants, in the statements of Suzuki and Fukuyama that were on the front part of the dunes, were found to be the association of *Scaevola-Pandanus*, and behind the dunes were found to be the associations of *Calophyllum* and *Aglaia-Sideroxylon*. The vegetation in the region that the writer investigated is quite similar to the plant species and distribution in the Alongway region that Suzuki and Fukuyama investigated in 1936. On the front part of the dunes the associations of *Scaevola frutescens* Kraus., *Tournefortia argentea* Linn., *Aglaia formosana* Hay., *Sideroxylon ferrugineum* H. et A. were found. They are the dominant species just as they were 26 years ago in the Alongway region. Our attention may be drawn to the fact that within these 20–30 years the conditions of the dunes and distribution of plant communities on the eastern coast have remained more or less the same.

When we try to analyze the plant distribution and eco-type on the eastern coast, their features are shown as follows:

1. Plant species are rather less.
2. Taller and bigger trees are non-existent.

3. The planted trees are inclined and their leaves and branches are partially dried and yellow.

The ressons may possibly be that the eastern coast is always attacked by the north-eastern monsoon, and therefore, the plants on this side of the coast are also influenced by the same factor. According to Chiang Ping-ren's observation in 1954, during the north-eastern monsoon in the Hengchun (恒春) region, the greatest wind speed may exceed 24.2 m/sec. Since its eastern coast is completely exposed toward to the wind, the wind speed there may be rather stronger. The yearly summer typhoon season wind speeds go to 20–70 km/hr. All this, altogether with the salt rainfall caused by storm and waves, and the wind-blown rocks and the drifting sand, has limited the growing and existence of taller and bigger trees, despite the fact that the seeds and fruits of such trees as *Barringtonia asiatica* Kurz. and *Hernandia ovigera* Linn. are continually floating in by means of sea currents. The writer did not find any younger or grown-up trees of the type over there nor did Suzuki and Fukuyama keep records concerning these two species of plants. Henceforth, we have the reason to conclude that the factors of environment would time and again hinder the eastern coastal plants in the formation of a coastal forest of larger size trees.

Moreover, the drifting sand on the eastern shore would generally fly up over the fault 50 meters in height, travelling inland up to one kilometer distant from the shore. The writer went there several times and observed that the desert has the tendency to push on inland year after year. There was not even one inch of grass in the heart of the desert. Alongside its margin the plant associations of *Ipomoea pes-caprae* (Linn.) Roth., *Vitex rotundiforlia* L., *Pandanus odoratissimus* L. var. *sinensis* Kaneh., *Scaevola frutescens* Krause, etc., were found, but other species were not discovered.

On the contrary, the western coastal plants are in a position to develop into luxuriant coastal virgin forest, for the following reasons:

1. The seeds, fruits, and the younger trees of the tropical plants float onto the seacoast.
2. The seacoast is comparatively even, and rarely influenced by topography.
3. The seacoast faces the Strait of Taiwan, so the monsoon in summer season is weak and slight.

The distribution of the western coastal plant species and the composition of their communities show no great difference between what Sasaki reported in 1933 and what the writer has investigated recently.

In short, the differences between plant communities on the eastern coast and west, are caused by such elementary factors as strong monsoon, typhoon, salt rainfall and drifting sand. As to the origin or source of the plant species, this has not yet been brought to light.

Summary

1. Hengchun Peninsula is situated on the uttermost part of South Taiwan (Formosa). A number of tropical plants are growing there on the coasts. For the purpose of comparing the plant communities and ecological differences between the western coast from Ta-pan-lu (大板埒) to O-lan-pi (鷺鑾鼻) and the eastern coast from Kan-kou River (港口溪) to O-lan-pi, the writer has been there four times from 1957 to 1960 in collection and investigation of these coastal plants.
2. A list of 159 species of the coastal plants is given in the appendix, among which 153 species are found on the western coast and 86 species on the eastern coast. Eighty species are found on both coasts and only 6 herbaceous species found on the eastern coast are not seen on the western coast.
3. The writer has compared Quadrates (each 100 meter square) from both coasts which show the development and distribution of the Coastal plants. The dominant species on the Western Coast are mostly woody plants, such as *Pemphis acidula* Forst., *Pandanus odoratissimus* L. var. *sinensis* Kaneh., *Terminalia Catappa* Linn., *Aglaia formosana* Hay. These on the eastern coast, however, are mostly of herbaceous species, such as *Spinifex littoreus* (Burm. f.) Merr., *Wedelia prostrata* Hemsl., *Ipomoea pes-caprae* (L.) Roth., and *Vitex rotundifolia* Linn. among which the *Spinifex* and *Wedelia* are dominant species. The most important woody species are *Pandanus*, *Aglaia*, *Calophyllum* and *Tournefortia*.
4. The woody plants on the eastern coast are dwarf. Owing to the attack of monsoon, most of the trees on the slopes of the dunes or faults facing the sea have an inclination of 15 degrees (*Calophyllum Inophyllum* Linn.) to 60 degrees (*Ficus Swinhoei* King). However, the western coastal plants are by no means inclined.
5. Most of the plants on the eastern coast are distributed on the beach, the dune and the fault. The writer found that there were the woody plants of *Tournefortia argentea* L., *Scaevola frutescens* Krause, *Aglaia formosana* Hay. and *Sideroxylon ferrugineum* H. et A. They are, as investigated by Suzuki and Fukuyama in 1936–20 odd years ago, similar to the plant distribution in the rather north region on the eastern coast of the peninsula. The western coastal plants, however, still remain unchanged. The plant communities over there are orderly arranged stepwise on the slopes: the herbs, the shrubs and the trees.
6. Some seeds and fruits of erect trees such as *Barringtonia asiatica* Kurz. and *Hernandia ovigera* Linn. are keeping on invading the eastern coast through ocean currents, but they hardly grow up because of environmental difference. However, they can grow up abundantly on the western coast.
7. Our attention is drawn to the fact that the topographical features, monsoon,

typhoon, salt-rain and drifting sand are the environmental factors in forming the differences on both coastal plants.

恒春半島南端東海岸與西海岸植物之差異

胡 敬 華

1. 恒春半島位於臺灣島之最南端，生有多種熱帶植物，民46至49年筆者曾四度前往該半島南端，西海岸自大板埒至鵝鑾鼻，東海岸在港口溪以南之地帶，採集調查及研究此地區之海岸植物，並比較東西海岸植物之羣落及生態之差異。
2. 該地帶共有海岸植物 159 種(見附表)，其中西海岸有 153 種，東海岸有86種，東海岸86種中與西海岸相同者有80種，亦即獨見於東海岸者僅有 6 種，均爲草本植物。
3. 從東西海岸之一百平方公尺方塊 (Quadrat) 之調查，分析海岸植物之分佈及發展。西海岸以木本植物占優勢，其種類有水莞花 (*Pemphis acidula* Forst.), 林投 (*Pandanus odoratissimus* L. var. *sinensis* Kaneh.), 欖仁 (*Terminalia Catappa* Linn.), 臺灣樹蘭 (*Aglaia formosana* Hay.), 東海岸占優勢者則爲草本植物，如狗牙根 (*Spinifex littoreus* (Burm. f.) Merr.), 田羅草 (*Wedelia prostrata* Hemsl.), 馬鞍藤 (*Ipomoea pes-caprae* (Linn.) Roth.) 及蔓荊 (*Vitex rotundifolia* Linn.), 其中又以狗牙根 (*Spinifex*)及田羅草 (*Wedelia*)爲優勢之種類，木本植物較重要者有林投，臺灣樹蘭，瓊崖海棠樹 (*Calophyllum Inophyllum* Linn.), 白水草 (*Tournefortia argentea* Linn.) 等。
4. 東海岸之木本植物一般較西海岸爲矮，並見有傾斜現象，傾斜 15° 者有瓊崖海棠樹，傾斜達 60° 者有山猪枷 (*Ficus Swinhoei* King) 而西海岸樹木高大而甚少傾斜。
5. 大部份東海岸植物分佈於海灘砂丘及斷層上，筆者曾觀察到該地之木本植物有白水草及草海桐 (*Scaevola frutscens* Kraus.), 臺灣樹蘭及樹青 (*Sideroxylon ferrugineum* H. et A.) 與 20 餘年前鈴木及福山(1936)調查半島東海岸較北地區之植物分佈情形相類似。而西海岸植物，草本、灌木、喬木等植物羣落呈一階梯狀，植物種類與前人報告比較尚無多大之改變。
6. 某些直立性喬木如棋盤脚樹 (*Barringtonia asiatica* Kurz.) 及臘樹 (*Hernandia ovigera* Linn.) 之種子或果實見有藉海流漂浮至東海岸，但未見此兩種植物於東海岸成長，而在西海岸此兩種樹木生長良好，當與東海岸之環境因素有關。
7. 指出地形，季候風、颱風、鹹雨及飛沙等因子爲造成東西海岸植物差異之因素。(摘要)

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Appendix Table

A list of the eastern and western coastal plants on the tip of Hengchun Peninsula:

E = Eastern Coastal plant
W = Western Coastal plant
+ = Both Eastern and Western Coastal plant

Polypodiaceae

1. (W) *Asplenium Nidus* L.
2. (W) *Cyclophorus adnascens* (Sw.) Desr.
3. (W) *Polypodium scolopendrium* Burm. f.

Schizaeaceae

4. (W) *Lygodium flexuosum* Swarts

11. Lauraceae

5. (W) *Actinodaphne pedicellata* Hay.
6. (+) *Cassytha filiformis* L.

13. Hernandiaceae

7. (W) *Hernandia ovigera* L.

24. Aristolochiaceae

8. (W) *Aristolochia Kankaoensis* Sasaki

36. Capparidaceae

9. (W) *Capparis formosana* Hemsl.

45. Crassulaceae

10. (W) *Bryophyllum calycinum* Salisb.

55. Aizoaceae

11. (+) *Sesuvium portulacastrum* L.

64. Basellaceae

12. (W) *Basella rubra* L.

69. Oxalidaceae

13. (E) *Oxalis corniculata* L.
14. (W) *Oxalis violacea* L.

72. Lythraceae

15. (+) *Lagerstroemia subcostata* Koehne
16. (+) *Pemphis acidula* Forst.

83. Nyctaginaceae

17. (W) *Pisonia umbellifera* (Forst.) Seem.

88. Pittosporaceae

18. (W) *Pittosporum formosanum* Hay.

93. Flacourtiaceae

19. (W) *Scolopia Oldhami* Hance

103. Cucurbitaceae

20. (+) *Melothria leiosperma* Cogn.

106. Caricaceae

21. (W) *Carica Papaya* L.

118. Myrtaceae

22. (W) *Decaspermum fruticosum* Forst.
23. (+) *Psidium Guajava* L.

119. Lecythidaceae

24. (W) *Barringtonia asiatica* (Linn.) Kurz.

121. Combretaceae

25. (W) *Terminalia Catappa* L.

126. Guttiferae

26. (+) *Calophyllum Inophyllum* L.

130. Sterculiaceae

27. (W) *Heritiera littoralis* Dryand.
28. (W) *Kleinhovia Hospita* L.

132. Malvaceae

29. (+) *Abutilon indicum* (Linn.) Sweet
30. (+) *Hibiscus mutabilis* L.
31. (+) *Hibiscus tiliaceus* L.
32. (+) *Malvastrum coromandelinum* (Lnn.) Garcke
33. (+) *Sida acuta* Burm. f.
34. (+) *Thespesia populnea* (Linn.) Soland.
35. (+) *Urena lobata* L.

133. Malpighiaceae

36. (W) *Hiptage bengalensis* Kurz
37. (W) *Tristellateia australasiae* A. Rich.

136. Euphorbiaceae

38. (+) *Antidesma Pentandrum* Merr. var. *barbatum* Merr.
39. (+) *Bischofia javanica* Blume
40. (+) *Breynia accrescens* Hay.
41. (+) *Bridelia Balansae* Tutcher
42. (W) *Croton Cascarilloides* Raeush.
43. (W) *Drypetes littoralis* Merr.
44. (W) *Euphorbia Atoto* Forst.
45. (E) *Euphorbia garambiensis* Hay.
46. (+) *Excoecaria Agallocha* L.
47. (+) *Gelonium aequoreum* Hance

48. (+) *Glochidion Fortunei Hance*
49. (+) *Glochidion philippicum* (Cav.) Benth.
50. (W) *Macaranga Tanarius* (Linn.) Muell.-Arg.
51. (+) *Mallothus repandus* (Rottl) Muell.-Arg.
52. (W) *Mallothus moluccanus* Mull.-Arg.
53. (+) *Phyllanthus reticulatus* Poir.

143. Rosaceae

54. (W) *Eriobotrya deflexa* Nakai var. *koshunensis* Kaneh. et Sasaki

146. Mimosaceae

55. (W) *Acacia confusa* Merr.
56. (W) *Albizzia lebbek* (Linn.) Benth.
57. (+) *Leucaena glauca* (Linn.) Benth.

147. Caesalpiniaceae

58. (W) *Cassia sophora* L.

148. Papilionaceae

59. (W) *Canavalia lineata* DC.
60. (W) *Desmodium dispermum* Hay.
61. (W) *Erythrina variagata* Linn. var. *orientalis* (Linn.) Merr.
62. (+) *Indigofera Zollingeriana* Miq.
63. (+) *Pongamia pinnata* (Linn.) Merr.
64. (W) *Pueraria Thunbergiana* Benth.
65. (W) *Sophora tomentosa* L.

150. Stachyuraceae

66. (W) *Stachyurus himalaicus* Hook. f. et Thoms.

164. Casuarinaceae

67. (+) *Casuarina equisetifolia* L.

167. Moraceae

68. (W) *Cudrania cochinchinensis* (Lour.) var. *gerontogea* (Nakai) Kudo et Masam.
69. (+) *Ficus cuspidato-caudata* Hay.
70. (+) *Ficus retusa* L.
71. (+) *Ficus septica* Burm. f.
72. (+) *Ficus Swinhoei* King
73. (+) *Ficus superba* Miquel.
74. (+) *Ficus vasculosa* Wall.
75. (W) *Malaisia scandens* (Lour.) Planch.

169. Urticaceae

76. (+) *Laportea pterostigma* Wedd.

171. Aquifoliaceae

77. (W) *Ilex asprella* (Hook. et Arn.) Champ.

173. Celastraceae

78.(W) *Celastrus diversifolius* Hemsl.
79. (W) *Gymnosporia diversifolia* Maxim.

186. Santalaceae

80. (W) *Champereia manillana* (Bl.) Merr.

190. Rhamnaceae

81. (W) *Rhamnus formosana* Matsum.

193. Ampelidaceae

82. (+) *Ampelopsis heterophylla* S. et Z.
83. (W) *Leea manillensis* Walp.
84. (+) *Vitis lanata* Roxb.

194. Rutaceae

85. (W) *Clausena lunulata* Hay.
86. (W) *Evodia ptelaefolia* (Champ.) Merr.
87. (+) *Fagara nitida* Roxb.
88. (+) *Murraya paniculata* (Linn.) Jack.
89. (W) *Severinia monophylla* Tonalca.
90. (W) *Toddalia asiatica* (Linn.) Lam.

197. Meliaceae

91. (+) *Aglaia formosana* Hay.
92. (W) *Melia azedarach* L.

198. Sapindaceae

93. (W) *Allophylus timorensis* (DC.) Bl.
94. (W) *Sapindus Mukorossi* Gaertn.

205. Anacardiaceae

95. (W) *Pistacia chinensis* Bunge

212. Araliaceae

96. (W) *Heptapleurum arboricolum* Hay.

221. Ebenaceae

97. (W) *Diospyros utilis* Hemsl.
98. (W) *Maba buxifolia* Pers.

222. Sapotaceae

99. (W) *Palaquium formosanum* Hay.
100. (+) *Sideroxylon ferrugineum* Hook. et Arn.

229. Oleaceae

101. (W) *Jasminum subtriplinerve* Blume

230. Apocynaceae

102. (W) *Cerbera Manghas* L.
103. (+) *Rauwolfia verticillata* (Lour.) Baillon
104. (W) *Tabernaemontana dichotoma* Roxb.

231. Asclepiadaceae

105. (W) *Cynanchum formosanum* Hemsl.

232. Rubiaceae

106. (+) *Guettarda speciosa* L.
107. (+) *Morinda citrifolia* L.
108. (+) *Morinda umbellata* L.
109. (W) *Mussaenda parviflora* Miq.
110. (+) *Paederia chinensis* Hance
111. (W) *Psychotria rubra* (Linn.) Poir

238. Compositae

112. (+) *Bidens bipinnata* L.
113. (+) *Blumea balsamifera* (Linn.) DC.
114. (+) *Cirsium brevicaule* A. Gr.
115. (+) *Pluchea indica* (Linn.) Less.
116. (+) *Wedolia biloba* DC.
117. (E) *Wedelia prostrata* Hemsl.

241. Plumbaginaceae

118. (+) *Plumbago zeylanica* L.
119. (E) *Statice sp.*

245. Goodeniaceae

120. (+) *Scaevola frutescens* Kraus.

249. Borraginaceae

121. (E) *Bothriospermum tenellum* Fisch. et Mey.
122. (W) *Cordia Kanehirai* Hay.
123. (+) *Ehretia Dicksoni* Hance var. *typica* Nakai
124. (+) *Ehretia microphylla* Lam.
125. (+) *Ehretia resinosa* Hance
126. (+) *Ehretia taiwaniana* Nakai
127. (+) *Tournefortia argentea* Linn. f.
128. (+) *Tournefortia sarmentosa* Lam.

250. Solanaceae

129. (W) *Capsicum frutescens* L.
130. (+) *Solanum xanthocarpum* S. et Z.

251. Convolvulaceae

131. (W) *Ipomoea gracilis* R. Br.
132. (+) *Ipomoea pes-caprae* (Linn.) Roth.

259. Acanthaceae

133. (W) *Crossandra undulaefolia* Salisb.

263. Verbenaceae

134. (+) *Callicarpa formosana* Rolfe
135. (+) *Clerodendron inerme* (Linn.) Gaertn.
136. (+) *Clerodendron trichotomum* Thumb. var. *Fargesii* Rehder

137. (+) *Lantana Camara* L.
138. (+) *Premna odorata* Blenco
139. (W) *Stachtarpheta jamaicensis* (Linn.) Vahl.
140. (+) *Vitex Negundo* L.
141. (+) *Vitex rotundifolia* L.

264. Labiatae

142. (+) *Hyptis suaveolens* Poit.

280. Commelinaceae

143. (W) *Commelina undulata* R. Br.

281. Flagellariaceae

144. (W) *Flagellaria indica* L.

290. Zingiberaceae

145. (+) *Alpinia speciosa* K. Schum.

291. Cannaceae

146. (+) *Canna indica* L. var. orientalis Hook. f.

302. Araceae

147. (W) *Alocasia macrorrhiza* Schott.
148. (W) *Epipremnum mirabile* Schott.

306. Amaryllidaceae

149. (+) *Crinum asiaticum* L. var. *sinicum* Bak.

313. Agavaceae

150. (+) *Agave americana* L.
151. (+) *Agave sisalana* Per.

314. Palmae

152. (W) *Arenga Engleri* Becc.
153. (+) *Phoenix Hanceana* Naudin var. *formosana* Becc.

315. Pandanaceae

154. (+) *Pandanus odoratissimus* L. var. *sinensis* Kaneh.

313. Cyperaceae

155. (+) *Fimbristylis annua* (All.) O. R. et S.

332. Gramineae

156. (+) *Andropogon Ischaemun* L.
157. (+) *Dactyloctenium aegyptium* (Linn.) Richt.
158. (+) *Perotis Latifolia* Ait.
159. (+) *Spinifex littoreus* (Burm. f.) Merr.

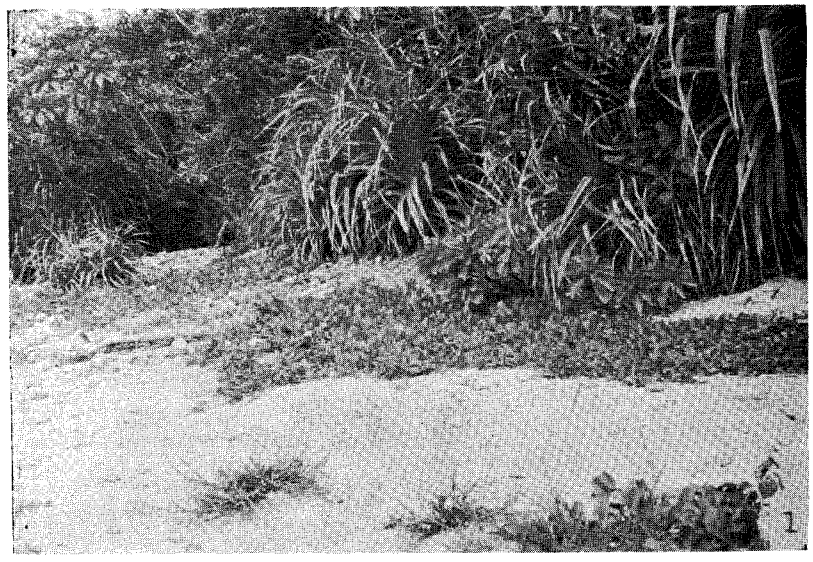
Explanation of plate figures

1: The horizontal herbs (*Ipomoea pes-caprae* (Linn.) Roth etc. and erect shrubs (*Pandanus odoratissimus* L. var. *sinensis* Kaneh.) on the western coast.

2: *Pandanus* Community on the eastern coastal sand-dunes.

3: The inclination of *Ficus Swinhoei* King on the eastern coast about 60 degrees caused by the monsoon.

Plate I

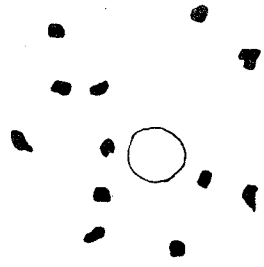


Explanation of Plate

Plate I. Meiotic chromosomes in F_1 plants of intercrosses of RT homozygotes

1. Diakinesis: 12 bivalents (Normal).
2. Metaphase-I: 1 ring of four and 10 bivalents.
3. Diakinesis: 2 rings of four and 8 bivalents
4. Metaphase-I: 2 rings of four and 8 bivalents.
5. Diakinesis: 1 ring of six and 9 bivalents.
6. Metaphase-I: 1 ring of six and 9 bivalents.

Plate I.



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Explanation of the Plate

Figs. 1-3. Plants of the hybrids.
- Fig. 1. *O. paraguaiensis* × *brachyantha*
- Fig. 2. *O. australiensis* × *alta*
- Fig. 3. *O. paraguaiensis* × *australiensis*

Fig. 4. Spikelets of the parents and the hybrids
- A. *O. brachyantha*
- B. *O. paraguaiensis* × *brachyantha*
- C. *O. paraguaiensis*
- D. *O. paraguaiensis* × *australiensis*
- E. *O. australiensis*
- F. *O. australiensis* × *alta*
- G. *O. alta*

Figs. 5-10. Chromosome pairing at MI in the hybrids.
- Fig. 5. *O. paraguaiensis* × *brachyantha*. 36 I.
- Fig. 6. *O. australiensis* × *alta*. 7 II+22 I.
- Fig. 7. *O. australiensis* × *alta*. 10 II+16 I. 9 of the 10 bivalents are heteromorphic.
- Fig. 8. The same as Fig. 7. Camera lucida drawing.
- Fig. 9. *O. paraguaiensis* × *australiensis*. 1 III+10 II+13 I.
- Fig. 10. The same as Fig. 9. Camera lucida drawing.

Plate I

Explanation of Plates

Plate I. Chromosome numbers and chromosome behavior in Taiwan grasses

Fig. 1. *Panicum bisulcatum*, HC-937. Metaphase I with 2 trivalents and 15 bivalents.
Fig. 2. *Panicum brevifolium*, HC-1333. Diakinesis with 18 bivalents.
Fig. 3. *Panicum cordatum*, C-51. Diakinesis with 18 bivalents.
Fig. 4. *Panicum incomtum*, HC-1332. Metaphase I with 18 bivalents.
Fig. 5. *Panicum maximum*, HC-1389. Metaphase I with 16 bivalents.
Fig. 6. *Panicum maximum*, HC-1389. Anaphase I showing 2 pairs of chromosomes separate much later than other pairs.
Fig. 7. *Panicum paludosum*, C-78. Diakinesis with 27 bivalents.
Fig. 8. *Panicum paludosum*, K-3561. Metaphase I with 27 bivalents.
Fig. 9. *Panicum psilopodium* HC-602. Diakinesis with 18 bivalents.
Fig. 10. *Panicum repens*, C-1. Metaphase I with 18 bivalents and 9 univalents.
Fig. 11. *Panicum repens*, C-1. Metaphase I with 17 bivalents and 11 univalents.
Fig. 12. *Panicum repens*, C-1. Metaphase I with 19 bivalents and 7 univalents.
Fig. 13. *Panicum repens*, C-1. Anaphse I showing undivided laggards.

Plate 1

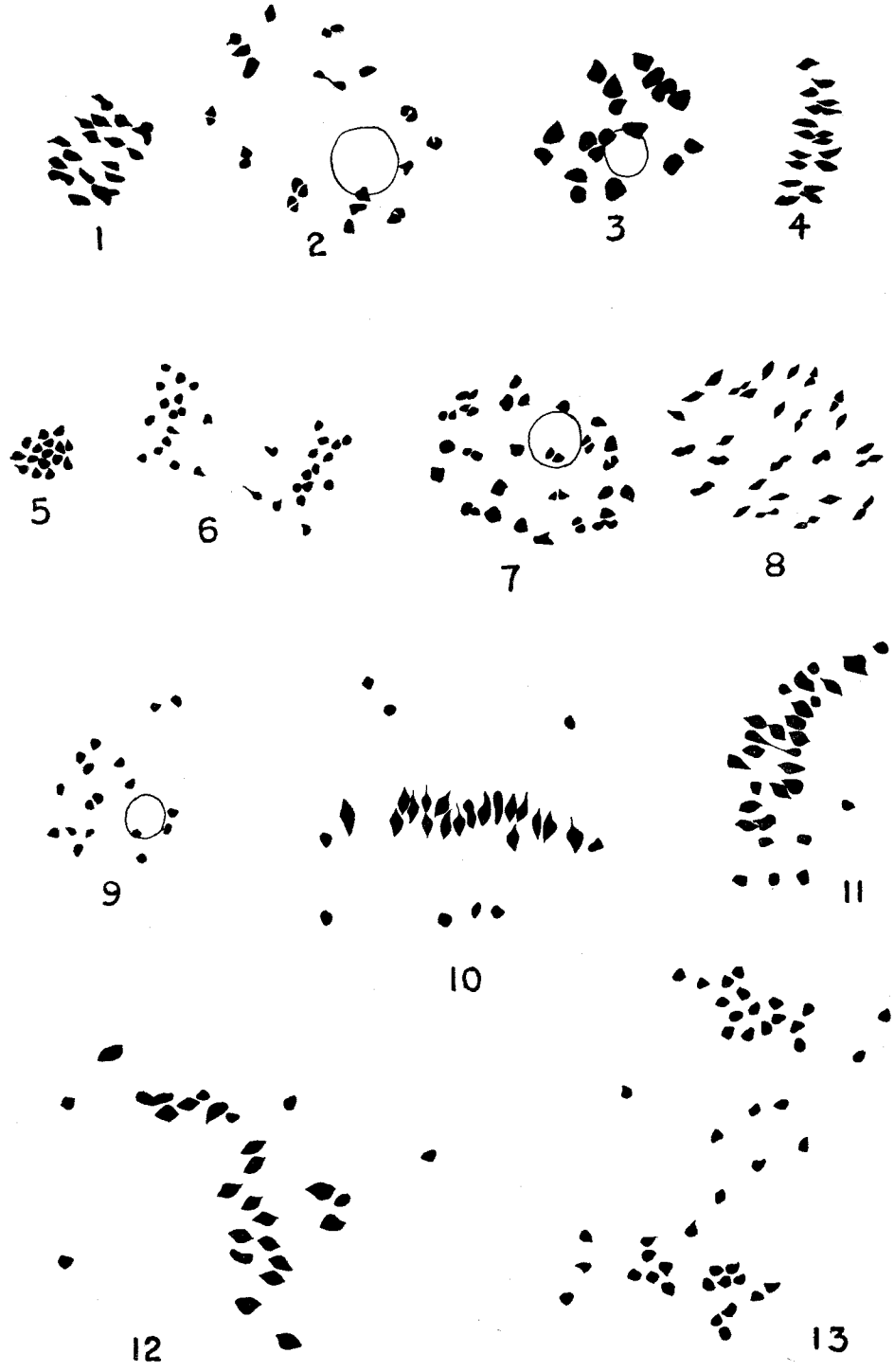


Plate II. Chromosome numbers and chromosome behavior in Taiwan grasses

Fig. 14. *Panicum repens*, C-1. Anaphase II showing excluded chromosomes.
Fig. 15. *Panicum repens*, C-1. Prometaphse II, one cell with 26 chromosomes and the other with 19 chromosomes.
Fig. 16. *Brachiaria distachya*, C-27. Diakinesis with 36 bivalents.
Fig. 17. *Brachiaria reptans*, C-79. Diakinesis with 7 bivalents.
Fig. 18. *Brachiaria villosa*, C-109. Diakinesis with 18 bivalents.
Fig. 19. *Ichnanthus vicinus*, HC-904. Metaphase I with 20 bivalents.
Fig. 20. *Echinochloa colonum*, HC-829. Anaphase I showing 27:27 distribution of chromosomes.
Fig. 21. *Echinochloa crusgalli*, HC-982. Diakinesis with 27 bivalents.
Fig. 22. *Echinochloa crusgalli* var. *caudata*, K-3562. Diakinesis with 27 bivalents.
Fig. 23. *Oplismenus compositus* var. *intermedius*, HC-908. Diakinesis with 36 bivalents.
Fig. 24. *Oplismenus compositus* var. *Owatarii*, C-106. Diakinesis with 36 bivalents.
Fig. 25. *Sacciolepis indica*, C-46. Diakinesis with 9 bivalents.
Fig. 26. *Sacciolepis indica*, C-114. Metaphase I with 9 bivalents.

Plate 2

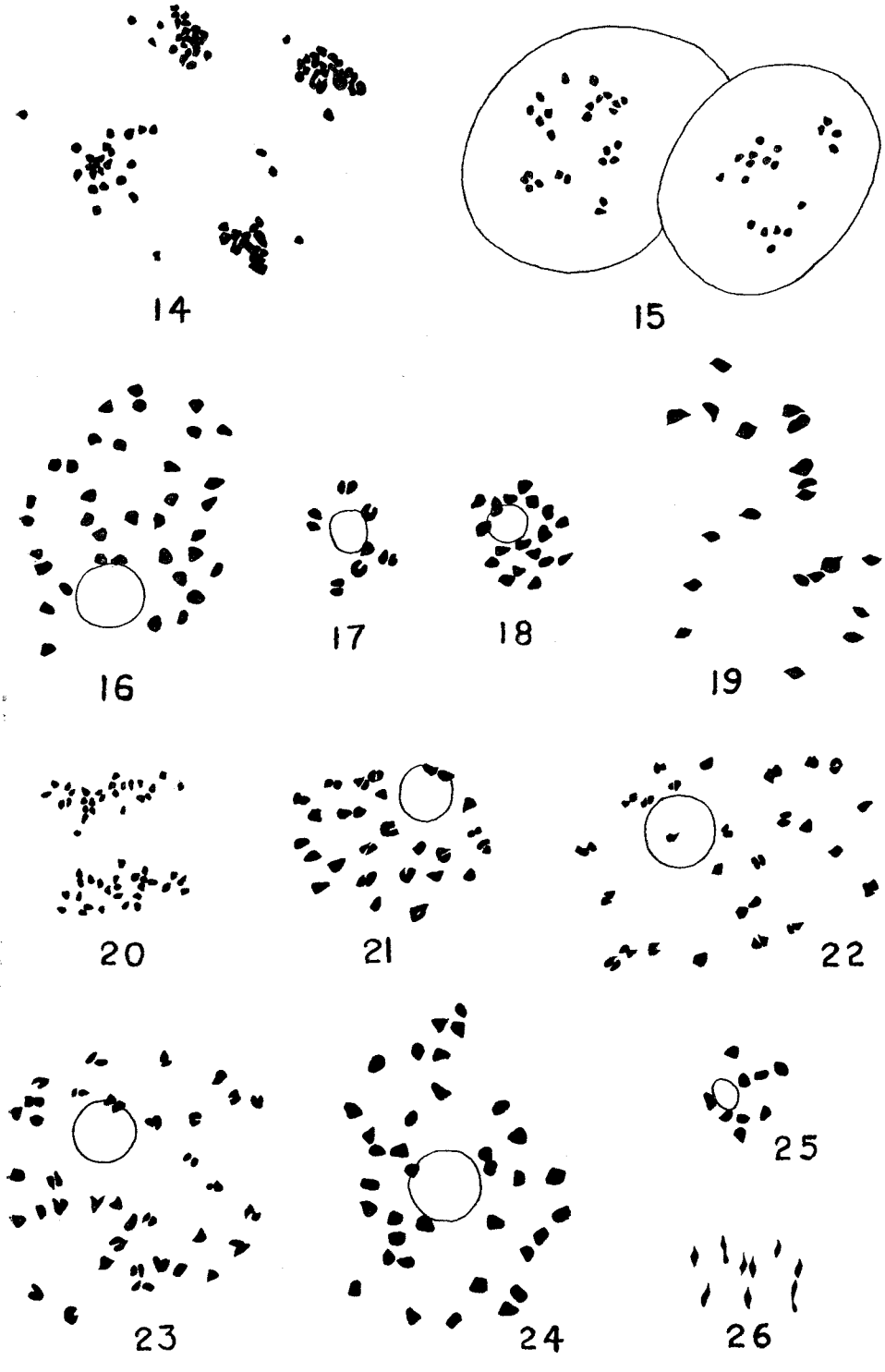


Plate III. Chromosome numbers and chromosome behavior in Taiwan grasses

Fig. 27. *Cyrtococcum pantens*, HC-1339. Diakinesis with 18 bivalents.
Fig. 28. *Digitaria adscendens*, C-132. Diakinesis with 27 bivalents.
Fig. 29. *Digitaria adscendens*, C-124. Diakinesis with 9 bivalents and 9 univalents.
Fig. 30. *Digitaria adscendens*, C-124. Metaphase I with 9 bivalents and 9 univalents.
Fig. 31. *Digitaria adscendens*, C-124. Metaphase I with 1 trivalent, 8 bivalents and 8 univalents.
Fig. 32. *Digitaria adscendens*, C-124. Anaphase I showing 10-8-9 distribution of chromosomes.
Fig. 33. *Digitaria adscendens*, C-124. Metaphase II showing unequal distribution of chromosomes and excluded chromosomes and fragments.
Fig. 34. *Digitaria chinensis*, C-31. Diakinesis with 9 bivalents.
Fig. 35. *Digitaria chinensis* var. *hirsuta*, HC-1250. Metaphase I with 9 bivalents.
Fig. 36. *Digitaira Henryi*, C-30. Diakinesis with 18 bivalents.
Fig. 37. *Digitaria leptalea* var. *reticulmis*, HC-1230. Anaphase I showing 18:18 distribution of chromosomes.
Fig. 38. *Digitaria longiflora*, H-471. Anaphase I showing 9:9 distribution of chromosomes.
Fig. 39. *Digitaria magna*, C-96. Diakinesis with 18 bivalents.
Fig. 40. *Digitaria microbachne*, HC-1130. Late diakinesis with 36 bivalents.
Fig. 41. *Digitaria sericea*, C-53. Diakinesis with 27 bivalents.
Fig. 42. *Digitaria Shimadama*, C-97. Diakinesis with 18 bivalents.
Fig. 43. *Digitaria Shimadama*, C-97. Metaphase I showing 1 bivalent precociously divided.
Fig. 44. *Digitaria Shimadama*, C-97. Anaphase I showing divided and undivided laggards.
Fig. 45. *Digitaria violescens*, C-39. Diakinesis with 18 bivalents, 1 nucleolus and 4 nucleolar-like droplets.
Fig. 46. *Ereochloa procera*, C-74. Diakinesis with 18 bivalents.

Plate 3

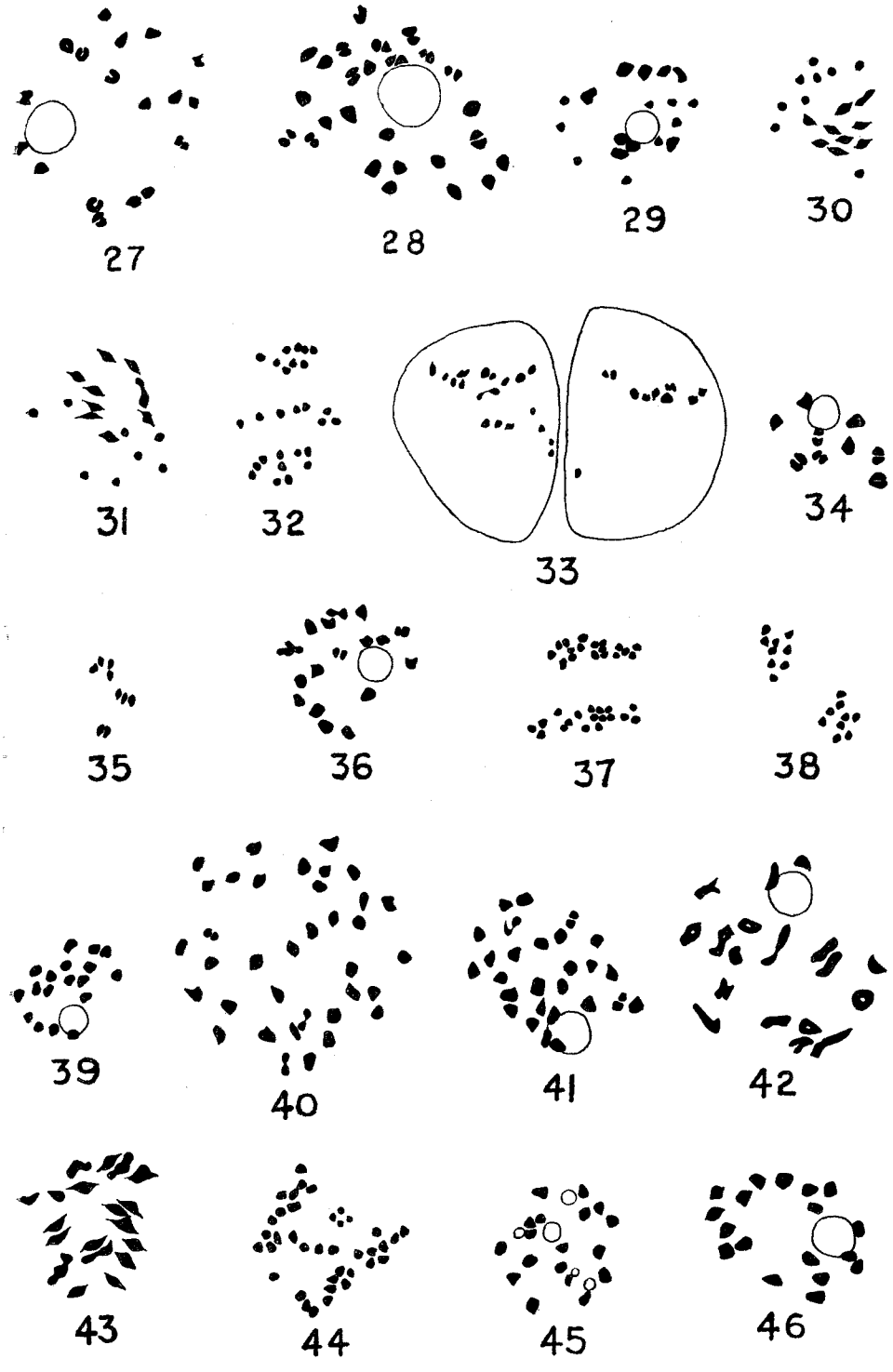
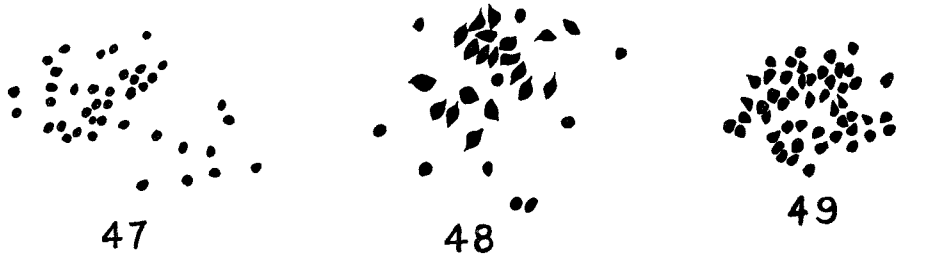
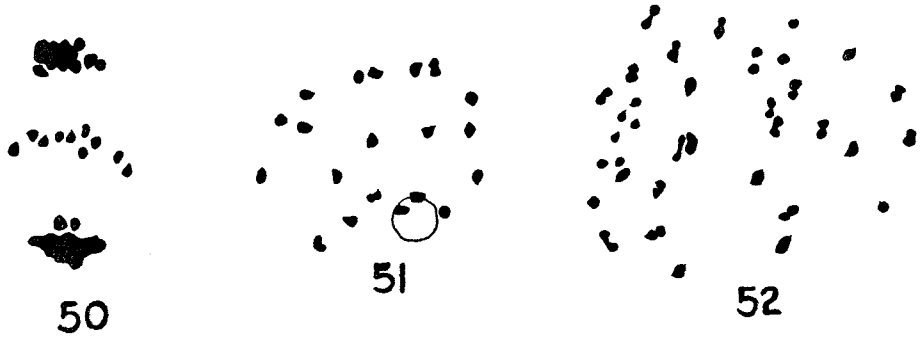


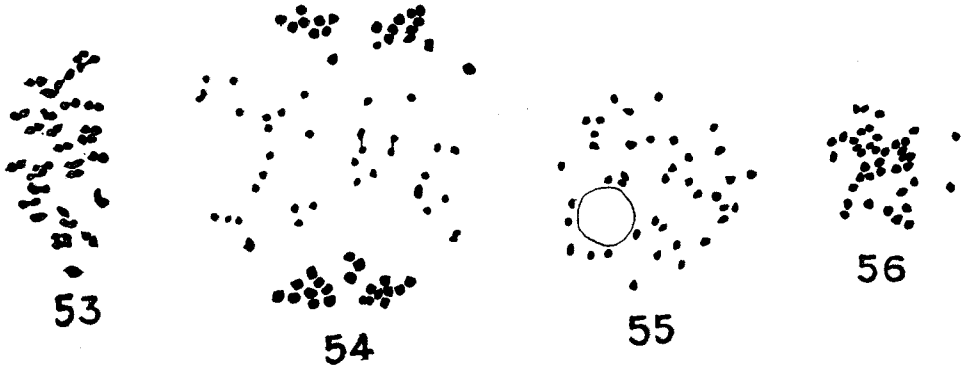
Plate IV. Chromosome numbers and chromosome behavior in Taiwan grasses

Fig. 47. *Paspalum conjugatum*, C-28. Prometaphase I with 40 univalents; chromosomes completely asynaptic at this stage.
Fig. 48. *Paspalum dilatatum*, C-8. Metaphase I with 20 bivalents and 10 univalents.
Fig. 49. *Paspalum dilatatum*, C-8. Anaphase I showing 50 chromosomes.
Fig. 50. *Paspalum dilatatum*, C-8. Telophase I showing 10 undivided laggards.
Fig. 51. *Paspalum distichum*, C-135. Diakinesis with 20 bivalents.
Fig. 52. *Paspalum distichum*, C-134. Metaphase I with 24 bivalents and 12 univalents.
Fig. 53. *Paspalum distichum*, C-134. Metaphase I with 1 quadrivalent and 28 bivalents.
Fig. 54. *Paspalum distichum*, C-134. Anaphase I showing 20-20-20 distribution of chromosomes; 20 laggards either divided or undivided.
Fig. 55. *Paspalum longifolium*, HC-1064. Diakinesis with 40 univalents; chromosomes completely asynaptic at this stage.
Fig. 56. *Paspalum longifolium*, HC-1064. Prometaphase I with 40 univalents; chromosomes completely asynaptic at this stage.
Fig. 57. *Paspalum scrobiculatum*, C-25. Metaphase I with 20 bivalents.
Fig. 58. *Paspalum viginatum*, C-21. Diakinesis with 10 bivalents.
Fig. 59. *Setaria geniculata*, C-129. Diakinesis with 36 bivalents.
Fig. 60. *Setaria palmifolia*, C-13. Metaphase I with 27 bivalents.

Plate 4







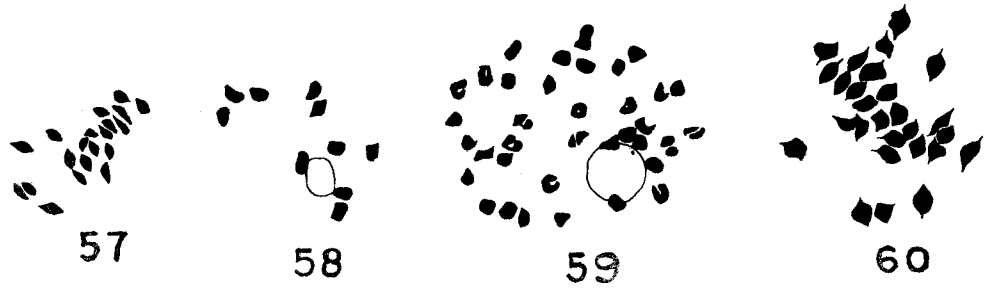


Plate V. Chromosome numbers and chromosome behavior in Taiwan grasses

Fig. 61. *Setaria viridis* var. *pachystachys*, C-20. Anaphase I showing 9:9 distribution of chromosomes.

Fig. 62. *Pseudoraphis squarrosa*, HC-614. Metaphase I with ca. 1 trivalent, 14 bivalents and 9 univalents.

Fig. 63. *Pseudoraphis squarrosa*, HC-614. Metaphase II showing excluded chromosomes and fragments.

Fig. 64. *Pennisetum alopecuroides*, HC-936. Metaphase I with 9 bivalents.

Fig. 65. *Cenchrus calycubatus*, C-82. Metaphase I with 34 bivalents.

Fig. 66. *Isachne albens*, C-44. Diakinesis with 30 bivalents.

Fig. 67. *Isachne globosa*, C-103. Diakinesis with 30 bivalents, 1 nucleolus and 3 nucleolar-like droplets.

Fig. 68. *Isachne globosa*, C-130. Diakinesis with ca. 90 chromosomes, 1 nucleolus and 3 nucleolar-droplets.

Fig. 69. *Isachne globosa*, C-130. Early anaphase I with ca. 90 chromosomes.

Fig. 70. *Isachne globosa*, C-130. Late anaphase I with more than 20 undivided laggards.

Fig. 71. *Isachne globosa*, C-130. Late anaphase I with 13 divided laggards.

Fig. 72. *Isachne nipponensis*, C-14. Metaphase I with 20 bivalents.

Fig. 73. *Thuarea involuta*, HC-1025. Diakinesis with 9 bivalents.

Plate 5