THE DISTRIBUTION OF WOODY PLANTS OF CHINA

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INTRODUCTION

The flora of China is doubtless one of the richest in the world and the woody plants play an important part in its composition. Although in the plains and at the lower altitudes agriculture has destroyed most of the natural forests, there are still existing in the higher mountains extensive wooded areas. Forests, in China, as well as in any other country, form a part of the wealth of the country, not only by supplying timber and other products, but also as an important climatic and edaphic factor in the regulation of humidity and precipitation and in the prevention of erosion and floods. In China, owing to the neglect of these facts, the natural forests have been destroyed by ruthless cuttings and burnings. The people are now suffering from famines year after year; and there are very few people who ever realize the real cause of these famines. Nobody really knows how much of these forested areas are left, where and of what kinds of trees they are formed, and how many of these forests with economic value still exist, and where necessary afforestation and re-forestation have taken their places. The writer has been trying his best for many years to find the answer to these questions by studying the woody plants of China, first at the Harvard Arnold Arboretum, U. S. A., where there is the largest and most complete collection of specimens of Chinese plants. And where a great number of living Chinese plants have been planted. There is also a wealth of information in the form of fields notes at the Arnold Arboretum.

Then he spent sometime during 1932–1933 at the Royal Botanical Kew Garden in London and in the other large botanical institutions of Europe. In 1934 a volume of Forest Botany of China was published which presented the results of these studies, which indicated the characters, the economic values and uses; and the altitudinal and latitudinal distributions of about 1500 species and varieties of the most important Chinese forest trees and shrubs distributed over the different parts of the entire country. During the year 1961–1962 the writer had opportunity to go back to the Arnold Arboretum for further study. During the period of 28 years which had elapsed since he first studied there, many new families, genera, species and varieties have been discovered and lots of new field notes have been added, and many changes have been made in the nomenclature. This paper is, thus, intended to present the results of the former and of the recent studies so that those who wish, may use

them for reference in reforestation or use them in the statistical analysis of the results to determine the characteristics of distribution of the Chinese woody plants.

The study consists of 65 families, 230 genera, and 4,073 species and varieties of the most important trees and shrubs of China, which are tabulated in table 1.

Using the above statistical results of the prevalent numbers of species and varieties distributed in different provinces and the special characteristics of trees and shrubs of each region, the forest flora of China may be tentatively divided into 8 forest floral regions and forest formation types. The more accurate determination of these regions must wait further studies on the climatic, edaphic, and biotic environmental factors of the different regions corresponding with them. The 8 tentative forest floral regions are as follows:

1. The North-eastern provinces, comprising the Montane Boreal Conifers on the higher altitudes and the Hardwood Mixed Forests of the lower elevation.
2. The Mongolian Desert Provinces, including: West Liaoning, Jehol, Suiyuan, Chahar, Mongolian Gobi, Ninghsia, and Hsinkiang. The Grassland Desert vegetation type with hardwoods and coniferous forests on high mountains.
3. The North China Loess-Steppe Provinces, including Hopei, Honan, Shantung, Shansi, Shensi, and Kansu. The Deciduous Broad-leaved Forest Type.
4. The Middle Chinese-Japanese Laurel Forest Provinces. The Mixed Mesophytic Forest type and this should be sub-divided into two sections:
   a. The lower Yangtze River section, including Kiangsu, Chekiang, Anhwei, and Kiangsi.
   b. The upper Yangtze River section, including West Hupeh, Hunan, Kweichow, and Szechuan.
5. The South-Eastern Maritime Provinces, including Taiwan, Fukien, Kwangtung and Hainan. The Evergreen Broad-leaved Sclerophyll Forests at lower altitudes and Conifers on the higher elevations.
6. The Southern Monsoon Region, including Kwangtung, Kwangsi, and Yunnan. The Mixed Evergreen Broad-leaved Rain Forest type.
7. The South-western Provinces, including parts of Kweichow, Yunnan, and Szechuan. The Sclerophyllous Evergreen and Deciduous Mixed Hardwood Forests and with Conifers on the higher elevations.
8. The South-western Highland Plateau, including Sikang and Tibet. The Evergreen Broad-leaved Forest composed mostly of Rhododendron shrubs and a mixture of conifers and broad-leaved forest types.

DISCUSSION

Table 1. indicated that there was a total number of 61 families, 199 genera, and 1248 species, and varieties studied up to the year 1933; and up to the year 1961 there were 65 families, 230 genera, and 3644 species. During a period of 28 years there

Table 1. Showing the numbers of new families, genera, species, and varities. increased during the recent 28 years (1933–1961)

Family No.	Family name	No. of genera			No. of species			No. of varieties			Grand total of species and varieties			Remarks
		Old	New	Total	Old	New	Total	Old	New	Total	Old	New	Grand total	
1	Cycadaceae	1	0	1	4	2	6	1	0	1	5	2	7	one old var. canceled.
2	Ginkgoaceae	1	0	1	1	0	1	0	5	5	1	5	6	5 new forms added.
3	Taxaceae	2	0	2	3	4	7	4	1	5	7	5	12	
4	Podocarpaceae	1	0	1	2	11	13	1	0	1	3	11	14	1 old spp. canceled.
5	Cephalotaxaceae	2	0	2	4	5	9	3	4	7	7	9	16	2 old var. canceled.
6	Pinaceae	8	0	8	54	21	75	4	19	23	58	40	98	
7	Metasequoiaceae	0	1	1	0	1	1	0	0	0	0	1	1	1 new family discovered
8	Taxodiaceae	4	0	4	4	1	5	1	0	1	5	1	6	
9	Cupressaceae	8	0	8	31	6	37	6	1	7	37	7	44	1 old genus name changed.
10	Ephedraceae	1	0	1	7	0	7	4	0	4	11	0	11	
11	Tumboaceae	1	0	1	1	0	1	0	0	0	1	0	1	
12	Gnetaceae	1	0	1	2	1	3	0	2	2	2	3	5	
13	Graminae	5	8	13	33	77	110	0	0	0	33	77	110	
14	Palmae	9	0	9	13	20	33	0	1	1	33	1	34	
15	Liliaceae	1	0	1	1	0	1	0	0	0	1	0	1	
16	Salicaceae	2	0	2	114	30	144	20	2	22	144	22	166	3 old vareety cancelled
17	Myricaceae	1	0	1	2	3	5	0	1	1	5	1	6	
18	Juglandaceae	5	0	5	20	5	25	0	1	1	25	1	26	
19	Betulaceae	6	0	6	56	48	104	16	4	20	104	20	124	
20	Fagaceae	5	1	6	126	157	283	19	12	31	283	31	314	1 new genus added
21	Ulmaceae	8	0	8	41	26	67	13	0	13	67	13	80	
22	Rhoipteleace	1	0	1	1	0	1	0	0	0	1	0	1	

Family No.	Family name.	No. of genera			No. of species			No. of varieties			Grand total of species and varieties			Remarks
		Old	New	Total	Old	New	Total	Old	New	Total	Old	New	Grand total	
23	Moraceae	9	0	9	23	83	106	2	11	13	106	13	119	
24	Urticaceae	1	0	1	3	2	5	0	0	0	5	0	5	
25	Trochodendrac	1	1	2	2	0	2	0	0	0	2	0	2	
26	Cercidiphyllac	1	0	1	1	0	1	0	0	0	1	0	1	
27	Lardizabalaceae	1	4	5	1	14	15	0	1	1	15	1	16	4 new genera
28	Magnoliaceae	6	1	7	46	46	92	2	2	4	92	4	96	discovered.
29	Calycanthaceae	1	0	1	1	3	4	1	0	1	4	1	5	
30	Lauraceae	9	1	10	112	170	282	4	26	30	282	30	312	1 variety cancelled.
31	Hamamelidaceae	12	0	12	27	35	62	6	0	6	62	6	68	
32	Eucomiaceae	1	0	1	1	0	1	0	0	0	1	0	1	
33	Platanceae	0	1	1	0	1	1	0	0	0	1	0	1	
34	Rosaceae	7	1	8	24	222	246	2	40	42	246	42	288	
35	Leguminosae	10	0	10	67	52	119	7	1	8	119	8	127	
36	Rutaceae	3	0	3	46	25	71	5	1	6	71	6	77	
37	Simarubaceae	2	0	2	5	1	6	2	2	4	6	4	10	
38	Meliaceae	2	0	2	5	1	6	1	2	3	6	3	9	
39	Euphorbiaceae	3	0	3	12	0	12	0	1	1	12	1	13	
40	Anacardiaceae	4	0	4	16	6	22	5	2	7	22	7	29	1 variety cancelled.
41	Aquifoliaceae	1	0	1	1	107	108	1	19	20	108	20	128	
42	Celastraceae	1	0	1	1	20	21	0	2	2	21	2	23	
43	Staphyleaeae	2	1	3	3	9	12	1	0	1	12	1	13	
44	Aceraceae	2	0	2	64	38	102	26	22	48	102	48	150	3 variety cancelled.
45	Hypocastanaceae	2	0	2	4	1	5	0	0	0	5	0	5	
46	Sapindaceae	5	0	5	8	4	12	0	0	0	12	0	12	

Family No.	Family name	No. of genera			No. of species			No. of varieties			Grand total of species and varieties			Remarks
		Old	New	Total	Old	New	Total	Old	New	Total	Old	New	Grand total	
47	Rhamnaceae	4	0	4	36	30	66	3	1	4	66	4	70	
48	Tiliaceae	1	0	1	18	8	26	3	3	6	26	6	32	
49	Elaeocaryaceae	0	2	2	0	41	41	0	1	1	41	1	42	
50	Sterculiaceae	3	0	3	10	17	27	0	0	0	10	17	27	
51	Theaceae	4	2	6	10	113	123	1	8	9	123	9	132	
52	Flacourtiaceae	5	0	5	8	7	15	3	3	6	15	6	21	
53	Elaeagnaceae	2	0	2	26	9	35	2	1	3	35	3	38	
54	Nyssaceae	3	0	3	4	0	4	0	0	1	4	1	5	
55	Araliaceae	2	1	3	23	48	71	9	12	21	71	21	92	1. variety cancelled.
56	Cornaceae	1	0	1	20	9	29	2	3	5	29	5	34	
57	Ericaceae	1	0	1	0	630	630	0	4	4	0	635	634	
58	Ebenaceae	1	0	1	15	25	40	1	2	3	40	3	43	
59	Symplocaceae	0	1	1	0	112	112	0	5	5	112	5	117	
60	Styracaceae	6	0	6	39	28	67	4	0	4	67	4	71	
61	Oleaceae	2	3	5	16	54	70	6	4	10	70	10	80	3 variety cancelled.
62	Boraginaceae	1	0	1	8	3	11	2	0	2	11	2	13	
63	Scrophlariaceae	1	2	3	8	3	11	1	0	1	11	1	12	
64	Bignoniaceae	1	0	1	6	1	7	0	1	1	7	1	8	
65	Rubiaceae	2	0	2	8	0	8	0	1	1	8	1	9	1 variety added.
	Total	119	31	230	1248	2396	3644	195	234	429	2920	1153	4073	

Table 2. Showing the numbers of spp. and var. in 8 forest regions.
(Only those families that contain above 10 spp. & var. listed)

Family No.	The Number of the 8 Forest Regions. and the Number of spp. & varieties in each							
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
3	0	0	0	9	0	4	0	0
4	0	0	0	3	2	3	5	0
5	0	0	0	3	3	3	5	0
6	8	4	19	4	9	16	32	0
9	0	0	6	4	6	6	14	8
10	0	2	4	0	0	0	2	3
13	0	0	0	12	24	22	52	0
14	0	0	0	0	0	7	27	0
16	9	0	22	6	14	9	83	10
18	2	10	5	6	4	2	7	0
19	6	7	15	10	14	12	152	4
20	2	0	7	46	20	45	186	1
21	7	2	10	14	6	8	30	2
23	1	1	3	9	8	25	71	1
27	0	0	0	2	3	3	8	0
28	0	0	3	10	6	6	65	6
30	0	0	0	21	22	55	203	11
31	0	0	0	8	9	15	34	2
34	9	3	31	20	27	21	157	17
35	1	0	5	8	10	11	87	5
36	1	0	6	9	3	12	46	0
37	0	0	1	1	1	2	4	0
39	0	0	0	0	2	4	7	0
40	0	0	0	2	3	10	13	0
41	0	0	0	8	8	25	85	2
42	0	1	2	1	2	6	11	0
43	0	0	2	1	0	2	8	0
44	6	0	6	20	13	16	81	6
46	0	0	1	2	1	2	6	0
47	3	2	6	6	5	5	41	1
48	1	2	9	7	2	0	9	1
49	0	0	0	0	5	5	32	0
50	0	0	0	0	2	4	21	0
51	0	0	0	5	11	15	101	0
52	0	0	0	1	6	0	14	0
53	1	0	2	2	4	8	19	2
55	4	0	5	3	10	7	63	0
56	0	0	3	5	7	1	17	0
57	1	0	3	9	35	25	405	156
58	0	0	0	4	4	6	28	1
59	0	0	2	5	6	29	73	2
60	0	0	2	7	8	8	43	0
61	2	0	12	11	4	5	42	4
62	0	0	2	2	1	1	7	0
63	0	0	3	1	4	0	4	0
Tot. 45	65	34	197	307	334	471	2300	245

The grand total=45 families, 3953 spp. and varieties.

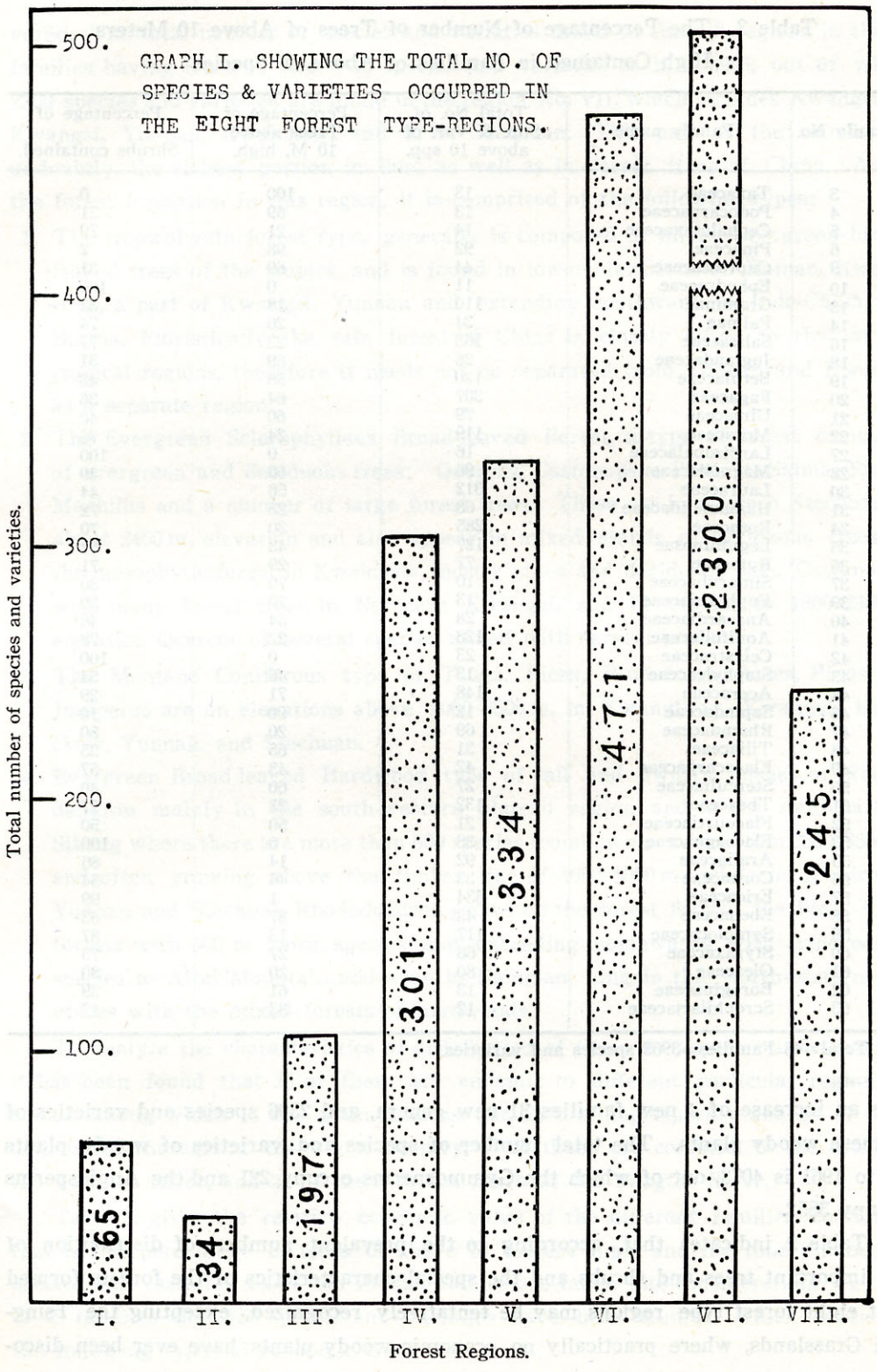
GRAPH I. SHOWING THE TOTAL NO. OF SPECIES & VARIETIES OCCURRED IN THE EIGHT FOREST TYPE-REGIONS.
Total number of species and varieties.
500.
400.
300.
200.
100.
65
34
197
301
334
471
2300
245
I.
II.
III.
IV.
V.
VI.
VII.
VIII.
Forest Regions.

Table 3. The Percentage of Number of Trees of Above 10 Meters High Contained in Families of Above 10 Species

Family No.	Family name	Total No. of Spp. & Var. of above 10 spp.	Percentage of Trees above 10 M. high.	Percentage of Shrubs contained.
3	Taxaceae	13	100	0
4	Podocarpaceae	13	69	31
5	Cephalotaxaceae	14	21	79
6	Pinaceae	92	98	2
9	Cupressaceae	44	69	31
10	Ephedraceae	11	0	100
13	Graminae	110	18	82
14	Palmae	34	26	74
16	Salicaceae	163	23	77
18	Juglandaceae	26	69	31
19	Betulaceae	120	55	45
20	Fagaceae	307	64	36
21	Ulmaceae	79	60	40
22	Moraceae	119	24	76
27	Lardizabalaceae	16	0	100
28	Magnoliaceae	96	60	40
30	Lauraceae	312	56	44
31	Hamamelidaceae	68	28	72
34	Rosaceae	285	30	70
35	Leguminosae	127	43	57
36	Rutaceae	77	29	71
37	Simarubaceae	10	70	30
39	Euphorbiaceae	13	70	30
40	Anacardiaceae	28	54	46
41	Aquifoliaceae	128	22	78
42	Celastraceae	23	0	100
43	Staphyleaceae	13	46	54
44	Aceraceae	148	71	29
46	Sapindaceae	12	90	10
47	Rhamnaceae	69	20	80
48	Tiliaceae	31	65	35
49	Elaeocarpaceae	42	43	57
50	Sterculiaceae	27	60	40
51	Theaceae	132	23	77
52	Flacourtiaceae	21	50	50
53	Elaeoagnaceae	38	0	100
55	Araliaceae	92	14	86
56	Cornaceae	33	46	54
57	Ericaceae	634	1	99
58	Ebenaceae	43	37	63
59	Symplocaceae	117	13	87
60	Styraxaceae	68	27	73
61	Oleaceae	80	20	80
62	Boraginaceae	13	61	39
63	Scrophilariaceae	12	83	17

Total=45 Families=3953 species and varieties.

was an increase of 4 new families 31 new genera, and 2396 species and varieties of Chinese woody plants. The total number of species and varieties of woody plants up to 1961 is 4073, out of which the Gymmosperms occupy 221 and the Angiosperms occupy 3852.

Table 2. indicates that, according to the prevalent numbers of distribution of the important trees and shrubs and the special characteristics of the forests formed that eight forest type regions may be tentatively recognized, excepting the Tsing-Hai Grasslands, where practically no economic woody plants have ever been disco-

vered. The total number of species and varieties found in these 8 regions in the 45 families having trees of above 10 species and varieties each, is 3953, out of which 2300 species and varieties are found in the region No. VII, which includes Kwangtung, Kwangsi, Yunnan, Kweichow, and S. W. Szechuan. This part of the country is, undoubtly, the richest portion in flora as well as in forest trees of China. As to the forest formation in this region, it is comprised of the following types:

1. The tropical rain forest type, generally is composed of mixed evergreen broad-leaved trees of the tropics, and is found in lower elevations on Hainan, Kwangtung, a part of Kwangsi, Yunnan and extending southward to Indo-China and Burma. Floristically the rain forest of China is closely allied to that of the tropical regions, therefore it needs not be separated from Yunnan and Kwangsi as a separate region.
2. The Evergreen Sclerophyllous Broad-leaved Forest, a type of forest composed of evergreen and deciduous trees: Quercus, Castanopsis, Pasania, Shima, Fagus, Machilus and a number of large forest trees. These are in western Szechuan to about 2400 m. elevation and also appear in mixed stands of deciduous trees of the mesophytic forest in Kweichow, mostly pines and deciduous oaks, Castanopsis with many laurel trees in Northern Kwangsi, and in Yunnan to 1800–2300 m. elevation Quercus of several species mixed with several pines.
3. The Montane Coniferous type of Tsuga, Picea, Psudotsuga, Abies, Pinus and Juniperus are on elevations above 2000–2500 m. in Kwangtung, Kwangsi, Kweichow, Yunnan, and Szechuan.
4. Evergreen Broad-leaved Hardwood type of tall and dwarfy bushes of Rhododendron mainly in the south-western plateau region and in the south-eastern Sikong where there are more than 600 species found on elevations from 2500–3500 m. and often growing above the timber line of 4000–5000 m., while in Kweichow, Yunnan and Szechuan Rhododendron grows on the forest floor of the Picea-Abies forests with 600 or more species and extending northwards with hundreds of species to Altai Mountain and even to Hsing-an Ling in the North-eastern provinces with the mixed forests of hardwoods.

To analyze the characteristics of distribution of these 4073 species and varieties, it has been found that 35 of them are endemic to different particular regions of China, among which 15 are gymnosperms and 20 are angiosperms, and 20 of them distributed throughout the whole country, 47 of them are confined to the south of the Yangtze River, and 28 of them to the north of the Yangtze River.

Table 3. gives the relative economic value of the different families contained, that is the percentage of trees of above 10 meters high and the total number of species and varieties above ten in that family are taken into consideration. A total of 45 families and 3953 species and varieties have been studied, which consist of the following types of economic trees:

1. The Montane Boreal conifers in northern latitudes and those of the southern latitudes on higher elevations.
2. The deciduous broad-leaved trees.
3. The evergreen broad-leaved scelophyllous trees.
4. The evergreen mixed mesophytic broad-leaved trees of the subtropical and tropical regions.
5. The rain forest broad-leaved evergreens.
6. The large sized bamboos in the subtropical and tropical regions. The largest trees and those of the greatest values are those conifers belonging to Taxaceae, Coniferae, and Cupressaceae, which are distributed in higher latitudes and the higher altitudes in the south, occupy the economic values of 100, 98, and 69% in order. Among the angiosperms there are more than 16 families of great economic value of above 50% each, predominate among the families are: Sclerophilariaceae, Sapindaceae, Aceraceae, Juglandaceae. Fagaceae, Simarubaceae, Euphorbiaceae, Tiliaceae, Sterculiaceae, Boraginaceae, Ulmaceae, Magnoliaceae, Lauraceae, Betulaceae, Anacardiaceae, and Flacurtiaceae. Speaking from the point of view of economic importance in regard to timber production, the families: Ephedraceae, Celastraceae, Lardizabalaceae, Elaeagnaceae, and Ericaceae being 100% shrubby, are of the least economic value, however some of the these have other economic values, such as Ephedraceae and Araliaceae have medicinal uses and Ericaceae bears the most beautiful flowers, e. g. Rhododendrons which decorate the scenery of parks and gardens. Moreover, Bambusaceae, though they occupy only 18% when it comes to their economic value based on their size, yet the smaller plants are very valuable in hand-crafts, supplying raw materials for paper making, and for hundreds of other kinds of economic uses.

SUMMARY

1. The total number of species and varieties of the Chinese Woody plants studied is 4073, which belong to 65 families, and 230 genera, 4 of which are new families, 31 are new genera, and 2396 are new species and 429 are new varieties discovered and redetermined during the recent 28 years.
2. According to the statistical results of studies of the prevalent numbers of species and varieties distributed in different regions and the special characteristics of trees and shrubs in each region, eight tentative forest type-regions have been recognized.
3. Out of 65 families, 45 families containing above 10 species and varieties each, and with trees of above 10 meters high have been tabulated, and the percentages of trees and shrubs in each family has been calculated.
4. Out of the total of 3953 species and varieties of large trees, 187 are conifers and 3765 are hardwoods.

5. The distributional characteristics show that 35 species and varieties are endemic to different special localities, 47 being limited to the south of the Yangtze River, 28 to the north of the Yangtze River, and 20 distributed throughout the whole country as cosmopolitan forms.
6. The distribution of the forest floral regions of China and that of the more accurate divisions, require further study on the different climatic, edaphic, and biotic factors of the different regions in order to correlate them with the forest conditions. For the time being eight forest type regions have been tentatively recognized.

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