THE RECENT VEGETATION OF NAN JEN SHAN[1]

TSENG-CHIENG HUANG[2] and CHIH-LIN HUANG[3]

(*Received for publication, March, 1983*)

Abstract: The recent vegetation of Nan Jen Shan has been studied by pollen analysis of surface deposits. Through comparison of present vegetation with pollen spectra, the recent vegetation of Nan Jen Shan was composed chiefly of Fagaceae, Lauraceae, Myrtaceae, Illiciaceae, Daphniphyllaceae, Magnoliaceae, and Theaceae, almost identical to the present ones. The pollen spectra did not reflect the present dominant species well. Generally speaking, they were under-represented, except most taxa of Fagaceae and Magnoliaceae showed over-represented. The vegetation formula can be expressed with the correction factor method (R-value) as:

$$V=Ca+\frac{Cy}{2.13}+\frac{Sy}{0.41}+\frac{Ill}{0.04}+\frac{Da}{0.11}+\frac{Pa}{0.23}+\frac{Li}{15.44}$$
$$+\frac{Sch}{0.81}+\frac{Ma}{2.27}+XPe(0.18\,Ca)+XSc(0.15\,Ca).$$

Aglaomorpha and *Davallia*, the epiphytic ferns, were almost disappeared in the present vegetation, but abundantly appeared in the spore spectra, thus a close canopy of recent vegetation could be inferred. *Dicranopteris* and *Diplazium*, especially *D. donianum*, the heliophytic and sciophytic ferns, their percentage in the spore spectra could be used as an indicator of open vs. close, or dry vs. humid vegetation of this area.

INTRODUCTION

The Nan Jen Shan is located at northeastern part of Ken-tin National Park with long. 120°50′E. lat. 22°9′N. The area comprises many rolling hills with altitudes ranging from 350 to 400 m high above the sea level. Central part was a swamp, however, it becomes a large and several small ponds (Fig. 1). The pond was disturbed by the water buffalo frequently, thus the sampling plots were selected within forests around the pond.

The climatic dondition is known as tropic, with an annual average temperature of c. 23°C. The annual temperature varies in small range; the coldest month being January with an average temperature of 20.7°C, and the warmest month being July with an average temperature of 27.8°C. The annual rainfall is c. 2220 mm and not evenly distributed throughout the year, but concentrated in May to November. The period from November to April is the dry season. From July to September it is the typoon season, and from October to March it blows strong northeastern monsoon. After all, the climate belongs to the Köppen's Am type, *i.e.* tropical monsoon climate (Chen, 1957).

To interpretate the pollen spectra on the basis of ecological aspects is the best way to elucidate the past vegetation and its succession. So far, the study of pollen analysis of the surface deposit to compare with present vegetation has not been carried out in Taiwan

(1) This work was supported by a grant from Biological Research Center of Academia Sinica, National Science Council (71-0201-B001A-40). Thanks to Prof. H. Ohashi, University of Tohoku, Japan for his valuable suggestions.

(2) 黄增泉, Professor, Department of Botany, National Taiwan University.

(3) 黄志林, Graduate student of Botany, National Taiwan University.

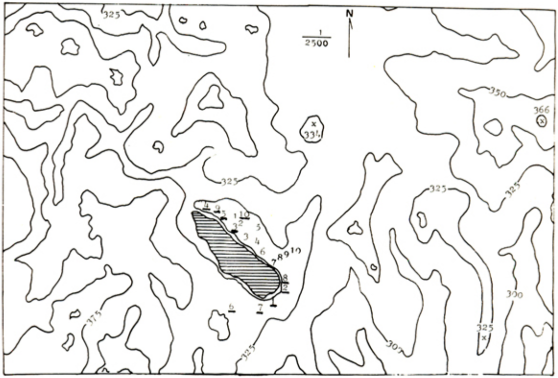


Fig. 1. The distribution map of sampling spots. x: elevation of hill summit; ——: contour line; **1** to **10**: surface soil and b. h. basal area sample plots; 1-10: fern composition survey plots; [pond symbol] : pond.

(Huang, 1982). The application of correction factor to ecological interpretation of past vegetatioon was considered. The present vegetation of Nan Jen Shan had been investigated by Mr. Y. F. Chen (1983), which was available to make a comparative study of recent vegetation. Therefore, the pollen analysis of surface deposits were done by us. We hoped to find out some evidences in reconstruction of recent vegetation, and also the result could be used to aid the interpretation the fossil pollen diagrams of older sediments.

MATERIALS AND METHODS

Ten surface samples were collected around the pond, where the forest was nearly undisturbed. The ground humic soils were collected about 50 gm, and put them in labeled plastic bags. They were brought back to the palynological laboratory, National Taiwan University. The extraction of palynomorphs were made by using the method of Chung and Huang (1972).

The observation of pollen slides was done by Nikon model L-Ke microscope, and more than 400 palynomorphs were examined in each sample. The identification of palynomorphs in this study was referred to two palynological books (Huang, 1972, 1981).

The data of breast height basal area (B. h. basal area) done by Chen (1983) was utilized by us (Table 1, Fig. 1). After calculating the relative percentage of the palynomorph, we found that fern spores has 43.25%. Therefore, it is necessary to investigate the composition of the living fern plants with those composition obtained by pollen analysis. In September 1982 and May 1983, we went to Nan Jen Shan again to verify the

Table 1. The breast height basal area (cm²) and relative percentage of dominant taxa (Y. F. Chen, 1983)

Taxa	Plot number	1	2	3	4	5	6	7	8	9	10	Total	%
Actinidiaceae	(*Saurauia*)									32		32	0.04
Aquifoliaceae	(*Ilex*)	71	205	240	8	231	221	220	644	64	273	2131	2.37
Araliaceae	(*Schefflera*)	1991						850	1706	206	116	4869	5.41
Celastraceae	(*Microtropis*)	62				47	16	92				217	0.24
Chloranthaceae	(*Sarcandra*)									56		56	0.06
Daphniphyllaceae	(*Daphniphyllum*)	44	54	545	454	649	668	179	8	405	258	3264	3.63
Ebenaceae	(*Diospyros*)		51			5	11	109	167			343	0.38
Elaeocarpaceae	(*Elaeocarpus*)	347	495	201		286	147	378				1854	2.06
	(*Sloanea*)								37			37	0.04
Euphorbiaceae	(*Antidesma*)				18				67	32	5	122	0.14
	(*Bredelia*)								3		1	4	0.04
	(*Sapium*)	42		80				875			115	1112	1.24
Fagaceae	(*Castanopsis*)	6038	8285	1427	606	311	323	10732	2785	1223	538	32268	35.87
	(*Cyclobalanopsis*)	183		197			7932	11	1314	135	698	10473	11.64
	(*Lithocarpus*)			261	262	312	54			96		985	1.1
	(*Pasania*)		1010	81	282	407		623		336	389	3128	3.48
Guttiferae	(*Garcinia*)		147	26		54			11		32	270	0.30
Illiciaceae	(*Illicium*)	755	884	54	86	279	729	388	388	81	521	4115	4.57
Juglandaceae	(*Engelharadtia*)				20	155		121	35	12	10	353	0.39
Lauraceae	(*Beilschmiedia*)	13	12			63	19		46	32	1	186	0.21
	(*Cinnamomum*)							54		32		86	0.09
	(*Cryptocarya*)								129			129	0.14
	(*Litsea*)	17				1		50	393		8	469	0.52

Table 1. The breast height basal area (cm²) and relative percentage of dominant taxa (Y. F. Chen, 1983). (Continued)

Taxa	Plot number	1	2	3	4	5	6	7	8	9	10	Total	%
Lauraceae	(*Persea*)	305	859	52	42	94		1530	2461	46	386	5775	6.42
Leguminosae	(*Ormosia*)		11	26			18			32		87	0.10
Magnoliaceae	(*Magnolia*)	446				71		732	2	8		1259	1.40
Moraceae	(*Ficus*)					71		46		2		119	0.13
Myrsinaceae	(*Ardisia*)		918					498	104			1520	1.69
Myrtaceae	(*Syzygium*)	158	226	79	148	249	175	290	2633	3	298	4259	4.73
Oleaceae	(*Osmunthus*)					11	283			34		328	0.36
Podocarpaceae	(*Podocarpus*)						13					13	0.01
Rosaceae	(*Rhaphiolepis*)			1269	186	54	143			32		1684	1.87
Rubiaceae	(*Tricalysia*)	18						8	64			94	0.10
	(*Psychotria*)	37							2			39	0.04
Rutaceae	(*Evodia*)								26		23	49	0.05
Sabiaceae	(*Meliosma*)					23						23	0.03
Staphyleaceae	(*Turpinia*)	46										46	0.05
Styracaceae	(*Alniphyllum*)			11				175				186	0.21
Symplocaceae	(*Symplocos*)						16	92	44	200	20	372	0.41
Theaceae	(*Cleyera*)	603	152	321	42		138	226	1060	158	77	2777	3.09
	(*Eurya*)	11		530	38						24	603	0.67
	(*Gordonia*)			1491	32	191	203					1917	2.13
	(*Schima*)	387		71	638	360	71	558		71		2156	2.40
Urticaceae	(*Laportea*)	38										38	0.04
Total		11612	13309	6962	2862	3924	11180	18837	14129	3328	3793	89936	99.85

result and to investigate the living fern composition. The methods of Braun-Blanquet (1964) and Huang *et al* (1980) were adopted. Ten plots were analized at the same area around the pond (Fig. 1).

RESULTS

More than 8,000 palynomorphs were recorded: 56.7% pollen grains and 43.2% fern spores. The proportion of aboreal pollen grains is 52.94% to all palynomorphs identified, and non-aboreal pollen is 3.4%. Thirteen families of Pteridophyta, one family of Gymnosperm and 42 families of Angiosperm were identified (Tables 2-3, Plates 1-3).

In Table 3. pollen grains of *Castanopsis* and *Engelhardtia* occured enormous amounts in plot eight, so this plot was excluded in calculating the pollen percentage of dominant taxa. Among the eleven dominant genera (Table 4) either with b. h. basal area percentage larger than 3.4% or with pollen percentage more than 2%, *Castanopsis*, *Cyclobalanopsis*, *Lithocarpus*, *and Magnolia* were over-represented, while *Pasania*, *Schima*, *Syzygium*, *Daphniphyllum*, *Illicium*, *Schefflera* and *Persea* were under-represented in the pollen spectra (Figs. 2-4).

During our latter trip, we found that most *Blechnum* and some tall trees had been cut and only stubs left. The result of fern composition survey was summerized in Table 5. In all plots we could not find the epiphytic fern *Davallia* and *Aglaomorpha* was found only on one tree. The coverage of *Diplazium* decreased from foot toward top of hill, in contrast to *Dicranopteris* which showed the decreasing coverage from top to foot of the hill. In addition, the abundance of *Dicranopteris* was in proportion to the amount of sunlight.

Table 2. Total numbers and percentages of recent palynomorphs

Vegetation	Families	Genera	Numbers	Percentages
Arboreal	22	29	4478	53.33
Non-arboreal				
dicots	17	17		
monocots	5	5+	280	3.34
Ferns	14	16	3632	43.28
Total	58	67	8390	99.99

DISCUSSION

No dominat exotic pollen types were identified. Such result may be due to the close forest that inhibits the entrance of foreign pollen types. From the data above, the recent vegetation of Nan Jen Shan is mainly composed of Fagaceae, which is nearly similar to present vegetation of the same area. In present vegetation, the two dominant taxa, *Castanopsis* and *Schima* are comparatively well represented by pollen spectra, taxa such as *Illicium* and *Daphniphyllum* appeared under-represented in the pollen spectra, and taxa of *Cyclobalanopsis*, *Lithocarpus* and *Magnolia* showed over-represented. Besides, the occurance of some pollen types, eq. *Castanopsis*, *Engelhardtia*, *Morus*, *Schima*, etc. are not evenly distributed in each sample. These differences may be due to following factors: 1. different pollen productivity of different species; 2. different dispersion mechanism of different species; 3. different preservation circumstances; 4. deposition of whole inflorescence or

Table 3. Numbers and percentages of recent palynomorphs

	Taxa	Plot number	1	2	3	4	5	6	7	8	9	10	Total	%
Aboreal pollen	Actinidaceae	(*Saurauja*)	3										3	0.03
	Aquifoliaceae	(*Ilex*)		1			2	1		1	4	1	10	0.12
	Betulaceae	(*Alnus*)		9			1		4		2	1	17	0.20
	Burseraceae	(*Canarium*)			2								2	0.02
	Daphniphyllaceae	(*Daphniphyllum*)		2	1	2						2	7	0.08
	Elaeocarpaceae	(*Elaeocarpus*)						2					2	0.02
	Fagaceae	(*Castanopsis*)	51	253		5	6		240	2085	19	38	2695	32.03
		(*Cyclobalanopsis*)	22	57	90	29	58	141	11	293	13		714	8.48
		(*Lithocarpus*)	21	171	13	26	34	9	13	261			549	6.52
		(*Pasania*)				4		2	8	59			73	0.88
	Illiciaceae	(*Illicium*)			1			2					3	0.03
	Juglandaceae	(*Engelhardtia*)							6	104		1	111	1.13
	Lythraceae	(*Lagerstroemia*)	2			4	1	2		8		1	18	0.21
	Magnoliaceae	(*Magnolia*)	13	8	3	16	9			4		5	58	0.68
	Moraceae	(*Morus*)			3		9		4	21			37	0.45
	Myricaceae	(*Myrica*)		7		3			3	4	2		19	0.22
	Myrtaceae	(*Syzygium*)	1	13	9	2	2		3	2	3		35	0.41
	Podocarpaceae	(*Podocarpus*)			1			1					2	0.02
	Rosaceae	(*Rosa*)	1	3		1				8			13	0.15
	Rutaceae	(*Fagara*)			1					1			2	0.02
		(*Severinia*)	3										3	0.03
		(*Zanthoxylum*)			1							1	2	0.02
	Saxifragaceae	(*Hydrangea*)								18			18	0.21
	Sterculiaceae	(*Kleinhovia*)		1						14			15	0.17
	Symplocaceae	(*Symplocos*)			1								1	0.01
	Theaceae	(*Gordonia*)			1		4		9		5		19	0.22
		(*Schima*)		28	1				2	12		2	45	0.53
		(*Thea*)										3	3	0.03
	Ulmaceae	(*Zelkova*)		1	1								2	0.02
Subtotal			117	554	129	92	126	160	303	2893	48	56	4478	52.94

Table 3. Numbers and percentages of recent palynomorphs. (Continued)

	Taxa \ Plot number		1	2	3	4	5	6	7	8	9	10	Total	%
Nonaboreal pollen	Amaranthaceae	(*Amaranthus*)						1					1	0.01
	Anacardiaceae	(*Rhus*)			2							6	8	0.08
	Caprifoliaceae	(*Lonicera*)										1	1	0.01
	Celastraceae	(*Maytenus*)									6	7	13	0.15
	Chenopodiaceae	(*Chenopodium*)			2								2	0.02
	Compositae	(*Cirsium*)				1			1			3	5	0.05
	Cyperaceae	(*Cyperus*)								2	1		3	0.03
	Dioscoreaceae	(*Dioscorea*)	5	8			1			5	1		20	0.23
	Euphorbiaceae	(*Phyllanthus*)								1			1	0.01
	Flagellariaceae	(*Flagellaria*)			1								1	0.01
	Labiate	(*Clinopodium*)								1			1	0.01
	Menispermaceae	(*Stephania*)						1					1	0.01
	Monosulcate		33	34	5	20	7	18	17	33	6	24	197	2.34
	Poaceae		3		3	2	2	4				3	17	0.20
	Polygonaceae	(*Polygonum*)				5							5	0.05
	Rhamnaceae	(*Ventilago*)							3		1		4	0.04
	Rubiaceae	(*Hedyotis*)			1								1	0.01
	Scrophulariaceae	(*Veronica*)									1		1	0.01
	Solanaceae	(*Solanum*)			1								1	0.01
	Tiliaceae	(*Triumfetta*)							1			1	2	0.02
	Urticaceae	(*Pilea*)			1					2			3	0.03
	Vitaceae	(*Ampelopsis*)									1		1	0.01
Subtotal			41	42	16	28	10	24	22	44	17	45	289	3.44

Table 3. Numbers and percentages of recent palynomorphs. (Continued)

	Taxa \ Plot number		1	2	3	4	5	6	7	8	9	10	Total	%
Fern spore	Athyriaceae	(*Diplazium*)	134	126	250	320	273	118	149	53	271	252	1946	23.14
	Cyatheaceae	(*Alsophilla*)	25	40	33	212	21	78	10	37	35	37	528	6.28
	Polypodiaceae -Davalliaceae	(*Aglaomorpha -Davallia*)	95	65	42	28	31	24	64	144	67	39	599	7.12
	Dennstaedtiaceae	(*Microlepia*)						2					2	0.02
	Dicksoniaceae	(*Cibotium*)				5							5	0.05
	Equisetaceae	(*Equisetum*)							1				1	0.01
	Gleicheniaceae	(*Dicranopteris*)	14	10	20	120	23	50	7	5	40	12	301	3.58
		(*Diplopterygium*)						2					2	0.02
	Lycopodiaceae	(*Lycopodium*)			1								1	0.01
	Pteridaceae	(*Pteris*)			42	8	20	12	20		4	80	186	2.21
	Schizaeaceae	(*Lygodium*)			3	4			2	4	1	2	16	0.19
	Selaginellaceae	(*Selaginella*)		4		2						1	7	0.08
	Thelypteridaceae	(*Christella*)				1				3			4	0.04
		(*Pronephrium*)								12	17		29	0.34
	Vittariaceae	(*Vittaria*)	1			1				1	2		5	0.05
Subtotal			269	245	391	701	368	286	253	259	437	423	3632	43.24
Total			427	841	536	821	504	470	578	3196	502	524	8399	99.62

Plate 1. Pollen grains; all ×1000.

1: Anacardiaceae (*Rhus*); 2-4: Aquifoliaceae (*Ilex*); 5-6: Fagaceae (*Castanopsis*); 7-8: Fagaceae (*Cyclobalanopsis*); 9-10: Fagaceae (*Lithocarpus*); 11: Fagaceae (*Pasania*); 12-13: Juglandaceae (*Engelhardtia*); 14-15: Lythraceae (*Lagerstroemia*); 16: Myricaceae (*Myrica*); 17: Magnoliaceae (*Magnolia*).

Plate 2. Pollen grains; all ×1000.

1: Poaceae; 2: Podocarpaceae (*Podocarpus*); 3: Rosaceae (*Rosa*); 4-5: Rutaceae (*Fagara*); 6: Solanaceae (*Solanum*); 7-8: Sterculiaceae (*Kleinhovia*); 9: Symplocaceae (*Symplocos*); 10: Theaceae (*Schima*); 11-12: Tiliaceae (*Triumfetta*); 13: Ulmaceae (*Zelkova*).

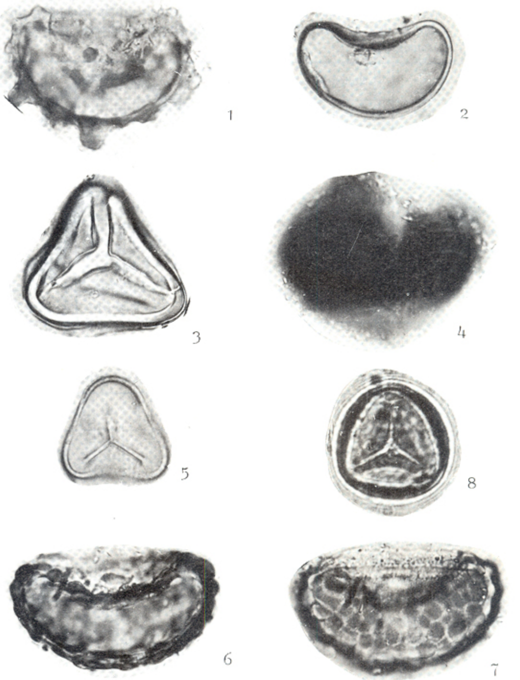


Plate 3. Pteridophytic spores; all ×1000.

1-2: Athyriaceae (*Diplazium*); 3-4: Cyathaceae (*Alsophila*); 5: Gleicheniaceae (*Dicranopteris*); 6-7: Polypodiaceae-Davalliaceae (*Aglaomorpha-Davallia*); 8: Pteridaceae (*Pteris*).

Table 4. The breast height basal area percentage (over 3.4%) pollen percentage (over 2.0%, obtained from total aboreal pollen grains excluding the value of plot 8) and correction factor of dominant aboreal taxa (Ca: *Castanopsis*)

Taxa	Pollen %	Breast height basal area %	Correction factor	Ratio of correction factor
Castanopsis	38.40	35.87	1.07	1
Cyclobalanopsis	26.56	11.64	2.28	2.13
Lithocarpus	18.17	1.0	16.52	15.44
Magnolia	3.4	1.4	2.43	2.27
Syzygium	2.08	4.74	0.44	0.41
Schima	2.08	2.4	0.87	0.81
Pasania	0.88	3.48	0.25	0.23
Daphniphyllum	0.44	3.63	0.12	0.11
Illicium	0.19	4.57	0.04	0.04
Schefflera	0	5.41	0.15 Ca	0.15 Ca
Persea	0	6.42	0.18 Ca	0.18 Ca

Table 5. The percentage of the basal area of fern and fern-allies

Taxa \ Plot number		1	2	3	4	5	6	7	8	9	10	Total	%
Aspidiaceae:	*Pleocnemia*	3	3									6	1.2
	Tectaria		1	3								4	0.8
Aspleniaceae:	*Asplenium*					1						1	0.2
Athyriaceae:													
	Diplazium donianum	50	25	75	25		75	25	3			278	54.6
	Diplazium mettenianum			3		28						31	6.1
	Diplazium dilatatum		3									3	0.6
Blechnaceae:	*Blechnum*	3		3					1	1		8	1.6
Dryopteridaceae:	*Dryopteris*		1		50			3	10	1		65	12.7
Gleicheniaceae:	*Dicranopteris*								1	25	50	76	14.9
Lindsaeaceae:	*Lindsaea*								1			1	0.2
	Sphenomeris								10			10	2.0
	Tapeinidium			3				10	3			16	3.1
Polypodiaceae:	*Aglaomorpha*				1		1					1	0.2
Schizaeaceae:	*Lygodium*		1									1	0.2
Selaginellaceae:	*Selaginella*									1		2	0.4
Thelypteridaceae:	*Pronephrium*		3	3								6	1.2
Total		56	37	90	76	29	76	38	29	28	50	509	100

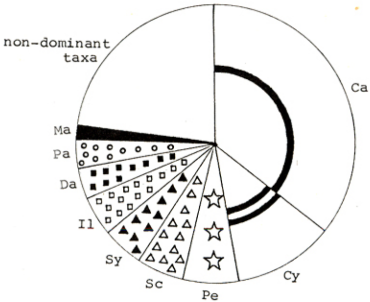


Fig. 2. Graphical representation showing dominant taxa of the present vegetation.

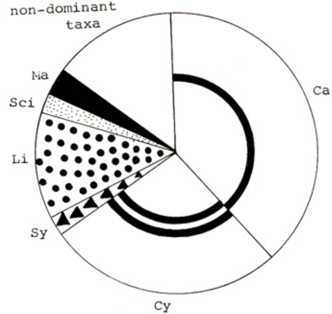
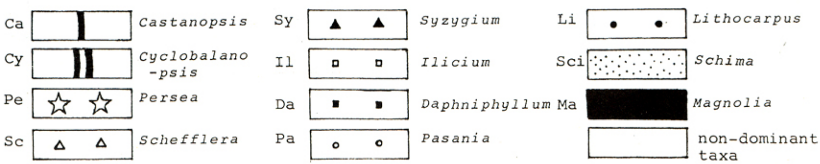


Fig. 3. Graphical representation of pollen species.

Symbols used in figures 2 and 3.



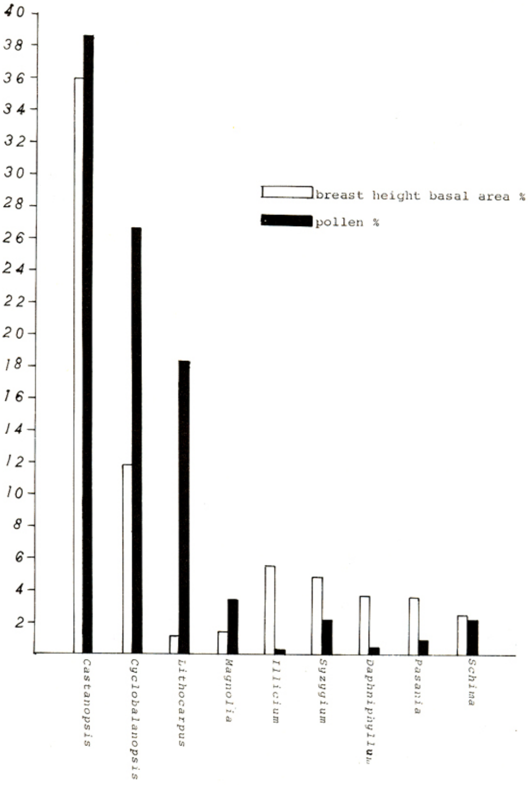


Fig. 4. A comparative map showing the percentage of breast height basal area and pollen grains.

anthers. Owing to above factors, the pollen spectra may bias the representation to living vegetation. This might be able to adjust by calculation of the correction factor (*R*-value) of certain taxa (Davis, 1963).

The *R*-value of Davis's is derived by the equation as:

$$R=\frac{\text{pollen percentage}}{\text{vegetation percentage}}$$

But practically, in the large part of Taiwan, the vegetation has been occupied by Lauro-Fagaceae taxa, the members of Lauraceae are mostly associated with members of Fagaceae (Liu, 1968), but the pollen grains of Lauraceae were completely destroyed during preservation. Therefore, we should add the possible Lauraceae taxa to the vegetation formula in this study. We have taken the certain taxon as a standard to obtain ratios of *R*-values in order to reconstruct the vegetation in more idealistic situation, *Castanopsis* is selected as a standard toxon to calculate the correction factor as following formula:

The ratio for correction factor of taxon A

$$=\frac{\text{pollen percentage of taxon A/pollen percentage of } \textit{Castanopsis}}{\text{b. h. basal area percentage of taxon A/b. h. basal area percentage of } \textit{Castanopsis}}$$

The selection of *Castanopsis* is partly based on the well representation (Fig. 2) and partly on the previous works of pollen analysis on Tertiary deposits of Taiwan (Huang, 1980) in which the constant occurance of *Castanopsis* is concerned. So the choose of standard taxon varies with the different local vegetation and data of pollen analysis. The past vegetation of Nan Jen Shan can be written down by the vegetation formula (Stamp, 1919) using correction factors as follow:

$$V=Ca+\frac{Cy}{2.13}+\frac{Sy}{0.41}+\frac{Ill}{0.04}+\frac{Da}{0.11}+\frac{Pa}{0.23}+\frac{Li}{15.44}+\frac{Sch}{0.81}+\frac{Ma}{2.27}+Xi+\cdots$$

V: vegetaion
Ca: pollen percentage of *Castanopsis*
Cy: pollen percentage of *Cyclobalanopsis*
Sy: pollen percentage of *Syzygium*
Ill: pollen percentage of *Illicium*
Da: pollen percentage of *Daphniphyllum*
Pa: pollen percentage of *Pasania*
Li: pollen percentage of *Lithocarpus*
Sch: pollen percentage of *Schima*
Ma: pollen percentage of *Magnolia*
Xi: kinds of taxa that can be emended according to knowledge of vegetational survey.

The vegetation formula of Nan Jen Shan, mentioned above, would reveal a more accurate past vegetation than that deduced directly from pollen analysis in this area (Table 4, Figs. 2-3). The kinds of taxa, *Xi*, are variable and depend on local vegetation. *Persea* is a dominant taxon in present vegetation, it has b. h. basal area percentage of 5.42, when it is divided by the b. h. basal area percentage of 35.87 of *Castanopsis*, the quotinent is 0.81, the value 0.81 *XPe* might indicate that *Persea* has 0.18 times the relative composition of the standard taxon, *Castanopsis*, in the past vegetation. Different vegetation has different composition; so the vegetation formula of any area needs more data of similar researches to verify its application to the reconstruction of the past vegetation.

Most plant ecological researches are done in temperate regions chiefly European and

Fig. 5. Graphic description of the succession of Nan Jen Shan.

A: *Aglaomorpha*;
D: *Davallia*;
L & F: member of Lauro-Fagaceae.

American plant ecologists, whereas plants of the fern and fern allies are rare in temperate regions, for instances, the state of Iowa, USA is six times larger than Taiwan in area, but the former has about twenty native species of fern plants (Conard, 1958), but the latter has over five hundred native species of fern plants (Li *et al*, 1979). In tropical or subtropical areas, fern plants are also one of the notable components in mordern vegetation or in pollen spectra. Unfortunately, there are few plant ecologists who have ever combined their researchs on vegetation together with pollen analysis, which will be able to infer the recent succession of the regional vegetation or to deduce the past vegetation type. In this study, we suggest that the combination of vegetational knowledge and using the ratios among correction factors to recover the blind spots (Davis, 1963) are helpful in reconstruction of past vegetation in area like Nan Jen Shan.

Having compared data of living fern composition with spore spectra, we found that *Davallia* and *Alsophila* were absent and *Aglaomorpha* was found only on one tree in *Castanopsis stellato-spina* Hay. in present vegetation of the sampling area, but occurred abundantly in the spore spectra. The habitats of *Davallia* and *Aglaomorpha* are epiphytes on large trees of mainly *Castanopsis championii* (Benth.) Oerst *ex* Schott, *Lithocarpus amygdalifolius* (Skan) Hay., and *Alsophila* often mingle with the forest and thrive near to moist places. Large trees were cutted about twenty years ago in Nan Jen Shan, and before that time some large trees might be hosted with epiphytic *Davallia* and *Aglaomorpha*. They are considered to become extinct by the cutting and disappeared from the present area. *Dicranopteris* is a heliophtic fern, and *Diplazium donianum* (Mett.) Tard.-Blot a sciophytic fern. The percentage of both taxa is a good indicator of forest conditions either open vs. close, or dry vs. humid in Nan Jen Shan area (Table 5). The percentage of the two taxa in the spore spectra can also be used as a clue in reconstruction of past vegetation. The succession of Nan Jen Shan from deposit time of the sampled soil to present can be sketched as following figures (Fig. 5).

More researches in Nan Jen Shan area are needed for statistical approach to *R*-value (Parson, 1981; Webb *et al*, 1981) to confirm the deduction made in this paper, and the supplementary studies of pollen productivity and dispersion are also required to improve our conclusion. We accept the limitations of our ecological concept on ferns and the vegetation formula of this area, which we propose, however, it illustrates certain points we wish to make.

LITERATURE CITED

BRAUN-BLANQUET, J., 1964. Pflzensoziologie Grundzüge der Vegetationskunde. Wien. New York.

CHUNG, T. F. and T. C. HUANG, 1972. Paleoecological study of Taipei Basin (1). Taipei Botanical Garden. Taiwania, **17**(2): 118-143.

CONARD, H. S., 1958. Plants of Iowa. John S. Swift Co. Inc. U. S. A.

DAVIS, M. B., 1963. On the theory of pollen analysis. Am. J. Sci., **261**: 897-912.

———— and J. C. GOODLETT, 1960. Comparison of the present vegetation with pollen spectra in surface sample from Browington Pond, Vermont. Ecology, **41**: 346-357.

GRIFFIN, K. R., 1975. Vegetation studies and modern pollen spectra from the Red Lake Peatland Northern Minnesoda. Ecology, **56**: 531-546.

HUANG, T. C., 1972. Pollen Flora of Taiwan. Botany Department Press. NTU, Taipei, Taiwan, R. O. C.

————, 1980. Miocene palynomorphs of Taiwan. V. Angiospermous grains. Taiwania, **25**: 57-103.

————, 1981. Spore Flora of Taiwan. privately published. Taipei, Taiwan, R. O. C.

————, 1982. Review of palynological studies in Taiwan. Proc. Natl. Sci. Counc. B. R. O. C. **6**: 59-70.

LI, H. L., T. S. LIU, T. C. HUANG, T. KOYAMA and C. E. DEVOL, 1979. Flora of Taiwan, **6**: 2.

PARSONS, R. W., 1981. Statistical approaches to R-values and the pollen-vegetation relationship. Rev. Palaeobot. Palynol., **32**: 127-152.

STAMP, C., 1929. Vegetation Formula. Nature, **123**: 833-834.

TINSLEY, H. M. and R. T. SMITH, 1974. Surface pollen studies across a woodland/heath transition and their application to the interpretation of pollen diagrams. New Phytol., **73**: 547-565.

WEBB, T. III, D. HOWE, R. H. W. BRADSHAW and K. M. HEIDE, 1981. Estimating plant abundances from pollen percentages: the use of regression analysis. Rev. Palaeobot. Palynol., **34**: 269-300.

柳 榗, 1968. 臺灣植物羣落分類之研究. I. 臺灣植物羣系之分類. 臺灣省林業試驗所報告第 166 號 1-25 頁.

陳正祥, 1957. 氣候之分類與分區. 臺灣大學實驗林. 林業叢刊第 7 號 1-174 頁.

陳玉峯, 1983. 南仁山之植被分析. 臺灣大學植物學研究所碩士論文 1-103 頁.

黃增泉, 郭城孟, 鄒元春, 陳玉峯, 黃志林, 1980. 臺北市頭廷里新動物園預定地之植羣調查. 環境保護，第 3 期 1-28 頁.

南仁山近代植被相

黃增泉　黃志林

摘　要

南仁山之近代植被相已由地表孢粉分析做更深入的研究。經花粉圖譜與現生植被相比較以後，南仁山之近代植被相主要由殼斗科、樟科、桃金孃科、八角茴香科、虎皮楠科、木蘭科及茶科等所組成，其成份與現生植被相大約一致。花粉圖譜並未正確地反映出現生優勢種之相對量。一般來說，除了大部分的殼斗科和木蘭科過多出現外，現生優勢種係以過低出現。南仁山植被相可藉校正值方法 (*R*-值) 表示如下公式：

$$V = Ca + \frac{Cy}{2.13} + \frac{Sy}{0.41} + \frac{Ill}{0.04} + \frac{Da}{0.11} + \frac{Pa}{0.23} + \frac{Li}{15.44} + \frac{Sch}{0.81} + \frac{Ma}{2.27} + XPe(0.81\,Ca) + XSc(0.15\,Ca)$$

連珠蕨及骨碎補兩屬附生蕨類殆消失於現生植被相中，却以大量的孢子出現於孢粉圖譜中，如此可推測近代植被相爲鬱閉的森林。芒萁屬及雙蓋蕨屬，尤其是細柄雙蓋蕨，前者爲陽性蕨類植物，後者是陰性蕨類植物，它們在孢子圖譜中之百分比，可做爲本區是否開放與鬱閉，乾燥與潮濕的指標植物。