TABLE II : DEVIATION AND CALCULATION OF THE SPECTRAL RATIO OF A PINUS SYLVESTRIS POLLEN GRAIN

	Measurements at various wave-lengths in nm										
Interference filters:	435	474	490	503	520	551	570	591	601	621	685
determinations of α in grades	15.5	37.6	23.6	12.3	10.0	9.6	10.8	14.0	17.6	25.2	6.5
	16.0	37.6	23.9	12.5	10.2	9.3	11.1	14.6	17.5	25.4	6.6
	17.0	38.2	24.2	12.7	10.6	9.7	11.5	14.7	17.8	25.8	6.7
	16.3	38.2	24.6	13.0	10.8	10.0	11.9	14.9	17.8	25.9	6.9
average α	16.2	37.9	24.1	12.6	10.4	9.7	11.3	14.6	17.7	25.6	6.7
average deviation ±	0.7	0.3	0.5	0.3	0.4	0.4	0.5	0.6	0.7	0.3	0.2
Standard deviation in %	5 %	1 %	2 %	3 %	4 %	3-4%	5-6%	4 %	1 %	1.5%	3 %
$F = \sin^2 \alpha$	0.078	0.377	0.167	0.048	0.032	0.028	0.038	0.064	0.092	0.187	0.014
spectral ratio	$Q_5 = \frac{0.377 + 0.167 + 0.048}{0.092 + 0.187 + 0.014} = 2.02$										
intensity of the mercury-vapour lamp	0.003	0.014	0.006	0.002	0.002	0.002	0.004	0.009	0.009	0.004	0.005

Comparison with the fluorescence spectrum of uranglass (fig. 19a) shows that the object light at 435, 474, 621 and 685 nm may also be expressed in the intensities of the mercury lamp, transmitted by the uranglass.

TABLE V : POLLEN ASSOCIATIONS IN CONTAMINATED DEPOSITS

(SEE PLATE V)

	Associations from:		
Samples:	Quaternary	Pliocene	Miocene - Oligocene
Adendorf peat 12 cm	X	——	——
Adendorf clay nr. 3	X	?	——
Nijmegen 34.5 m	X	X	X
Loenermark nr. 7	X	X	X
Sneek 31 m	X	——	?
Sneek 125 m	X	X	X
Spannenburg 61 m	X	X	X
Spannenburg 150 m	X	X	X
Spannenburg 187.5 m	X	——	?
Spannenburg 229 m	X	X	——
Winschoten 3.9 m	X	X	X
Winschoten 99 m	X	X	X
Bookholzberg nr. 18	X	X	X
Lauenberg nr. 12	X	X	X
Glindow/Heeszel	X	X	X
Zweiersdal nr. 14	X	?	——
Duno 5.7 m	X	?	——
Terhagen nr. 42	X	——	X
Spreetal, Lausitz (source area)	——	——	X

X = present

? = uncertain

—— = absent

TABLE VI: SAMPLES OF DEPOSITS OF KNOWN AGE FOR FLUORESCENCE ANALYSES (SEE PLATE III AND FIG. 24)

A: Quaternary

Unless mentioned otherwise, the localities are situated in the Netherlands

Local. nr. in fig.10	Sample nr. in Pl.III or fig. 24	Locality and type of sediment	Age
14	ZM/SPH/2	Peat bog of Zwartemeer near Emmen- dead Sphagnum layers, unhumified	Subrecent
15	O/16	Besthmerven near Ommen- remains of Phragmites vegetation of the lake bottom	Subrecent
4	EK 30/P	Ekamp near Winschoten- Young Sphagnum Peat, depth 30 cm	Subatlantic VB
	EK 65/P	ibid. - Young Sphagnum Peat, depth 65 cm	ibid.
16	KH/JVV/P	Kloosterhaar - Young Sphagnum Peat, st.33795	Subatlantic VB
3	MT 2.80	Meedenertol-- humic clay, depth 2.80 m	Subatlantic VA
6	KG 1.80/P	Kloostergaren near Winschoten - Phragmites peat, depth 1.80 m	Subboreal IVB
	KG 2.58/P	ibid. - Carex & Phragmites peat, depth 2.58 m	Subboreal IVB
5	NB 18/P	Nieuw Beerta - Carex peat, depth 1.80 m	Subboreal IVA
28	ZV 3.85/P	Zijderveld, Betuwe - clayey Alnus wood peat, depth 3.85 m	base Subboreal IVA
2	NW 6.32/P	Nieuwolda - wood peat, depth 6.32 m	top Atlantic III or base Subboreal
1	DZL	Delfzijl, construction pit new lock - humic clay	Atlantic III
41	LFV 2/P	Leiffender Ven - Phragmites peat	Boreal II
	LFV 1/P	ibid. - wood peat	Preboreal I
19	LTZ/A	Lutterzand near Denekamp - sandy peat from bank of the river Dinkel	Lateglacial
	DE/B/P	Denekamp - clayey peat	Lateglacial
20	LH/P	Laarhuis near Denekamp - sandy peat	base Pleniglac. B
24	AMF/A	Amersfoort, tunnel pit - humic clay	top Pleniglac. A
22	HE/P	Hengelo, construction pit adm. office K.N.Z. - sandy peat, kryoturbate	Pleniglacial A
44	RS 1/P	Rees near Wesel, W.Germany - Phragmites peat below sand with mammoth bones, depth 13 m	Brørup interstad. L. Weichselian
24	AMF/E/p	Amersfoort, construction pit railway tunnel - clayey peat	Eemian E6
13	ZZW/G	Zwolle Zwartewater - clayey gyttja	Eemian E5
49	GENT	Gent, N. Belgium,-bottom dock pit - humic clay	Eemian
80	HÜT/D	Hützel, Lüneburger Heide, W.Germany - diatomite	Eemian
12	VO/HP	Vollenhove - Hypnaceae peat	Eemian E2
	VO/BP	ibid. - Brasenia peat	Eemian E1 (base)
29	HOG	Hoogdonk, well - humic clay	Saalian
9	BA 12.4	Bantega, boring II - peat, depth 12.4 m	ibid.,1st interst.
11	SPB 9/S	Spannenburg, boring 5 - humic sand, depth 9 m	base Saalian
	SPB 35	ibid. - grey sandy loam, depth 35 m	U. Holsteinian
23	NEEDE	Neede, ancient clay pit - grey clay	M. Holsteinain
8	MA 18	Makkum, well - humic clay, depth 24.25 m	M. Holsteinian
9	BA 16.5	Bantega, boring II - peat, depth 16.5 m	M. Holsteinian
	BA 19.1	ibid.,- peat, depth 19.1 m	base Holsteinian
11	SPB 83	Spannenburg, boring 3 - clayey peat, depth 83 m	Elsterian
67	KTL	Klarenthal, W. Germany - grey humic clay	Elsterian
70	BLS/KT	Bilshausen, W. Germany - "Kohleton", humic clay	top Cromerian
56	BCL	Bacton Cliff, E. Anglia, Gr. Britain - peat	Cromerian
33	WES I/3	Westerhoven - grey clay from clay pit	Cromerian
	WES/I/9	ibid. - brown clay	Cromerian
32	EH 88	Eindhoven, boring - brown humic clay, depth 88 m	Waalian A
34	TE/KU	Tegelen, clay pit Kurstjens - grey clay	Waalian
32	EH 97	Eindhoven, boring - grey clay, depth 97 m	Waalian A
	EH 133	ibid.,- green sandy clay, depth 133 m	Eburonian
34	TE/RTT	Tegelen, clay pit Russel Tiglia - grey clay	Tiglian C
	TEG	Tegelen, clay pit Canoy Herfkens - grey clay	Tiglian
50	THT	Turnhout, N. Belgium, clay pit - humic clay	Tiglian
near34	TE 2	Oebel, clay pit Laumans - grey humic clay	Tiglian B
11	SPB 244	Spannenburg, boring 5 - brown loam, depth 244 m	Tiglian
35	BEL	Belfeld, clay pit Jansen Dings - brown clay	Tiglian

TABLE VI (Continued) B: Tertiary, Mesozoic and Paleozoic

Local. nr. in fig. 10	Sample nr. in Pl.III	Locality and sediment type	Age
37	Oebel	Oebel near Kaldenkirchen, clay pit Loumans, W.Germany - humic grey clay	Reuverian C
50	THT 31	Turnhout, boring nr.154, N.Belgium - brown humic clay, depth 31 m	Reuverian
38	BWD 2	Brachterwald near Brüggen, W.Germany, clay pit - dark grey clay from top of the upper layer	Reuverian B
	BWD 8	ibid. - grey clay from base of pit	Reuverian A
40	BOR	Born ([illegible]), pit new Lock - dark [illegible] brown humic clay	c.f Brunssumian
42	BBG 2	Brunssum, pit Bouwberg - grey clay, ca 1.5 m below surface	Brunssumian B
	BBG 4.5	ibid. - grey clay with plant remains depth ca. 5.5 m below surface	Brunssumian A
73	HARS 10	Harsefeld, clay pit, W.Germany - brown sandy clay with shell remains and shark teeth	U.Miocene
78	TWR 2	Twistringen, clay pit O.Sunder, W.Germany - brown humic clay	U.Miocene "Sylter Stufe"
77	HAG 2	Hagen near Vechta, clay pit Frydag, W.Germany - humic sandy clay	U.Miocene "Dingdener St."
48	BRU	Brühl near Cologne, W.Germany - dark brown clay, fine banded	U.Miocene
47	VIL	Ville, pit Wachtberg, W.Germany - dark grey humic clay	M.Miocene
50	TB 36	Terhaegen, Belgium - dark grey sand	M.Miocene
62	PUE	Puentes, Galicia, Spain - brown humic clay	L.Miocene or U.Oligocene
79	WLS 2	Walsrode, clay pit Grasbeck, W.Germany - dark brown clay with shells	U.Oligocene
17	OMS/SC	Ootmarssum, clay pit - grey clay or "Septarien Ton"	M.Oligocene
50	TB/RC	Terhaegen, Belgium - dark grey clay from base layer or "Rupelian clay"	M.Oligocene
77	HAG 6	Hagen near Vechta, clay pit Frydag, W.Germany - brown sandy clay	M.Oligocene
—	MISS 14	Moody's Branch Fm, Mississippi, U.S.A. - dark grey sandy clay	U.Eocene
74	HVH	Havighorst near Hamburg, W.Germany green sandy clay	M.Eocene
—	ALA II	Bashi Fm, Alabama, U.S.A. - brown sandy clay with shell remains	L.Eocene U.Wilcox Form.
54	WHT 6A	White Cliff Bay, Wight, Gr. Britain - humic clay from Bracklesham Beds	L.Eocene
65	AWG	Antweiler Graben, W.Germany - brown humic clay	U.Paleocene
54	WHT 3	Compton Bay, Wight, Gr. Britain - soft clay-shale, dark grey	L.Cretaceous Wealden Marls
21	ESD 2	Enschede, boring nr. 2 - grey marl	L.Cretaceous
54	WHT 2	Compton Bay, Wight, Gr. Britain - grey clay-shale, base Wealden Marls	L.Cretaceous
85	KKW	Krakow, Poland - soft grey shale	Malm
64	LEW	Le Wast near Bologne, France - grey humic clay	L.Bathonian
52	WHT 5A	Golden Cap near Seatown, Dorset, Gr. Britain - grey clay-shale	Liassic Belemnite Marls
51	WHT 11	Lime Regis, Dorset, Gr. Britain - dark blue shale	Liassic Blue Lias
—	LIB	Libya, N. Africa, boring - grey shale depth 5000 ft	Triassic
66	ODH	road near Odernheim, W.Germany - "Schieferton" from L.Rotliegendes	Permian
57	SFD	Sheffield, Ashfield Brick pit, Gr. Britain - grey marl	Permian

TABLE VII : CONTAMINATED DEPOSITS

Locality nr. in fig.10	Locality:	Type of sediment:	Age, according to literature (see text):
76	Adendorf, Lüneburger Heide, clay pit, W.Germany	clayish peat, 12 cm above basis of layer	Holsteinian
	ibid.	dark grey humic clay, sample nr.3, 30 cm above basis of layer	Holsteinian
30	Nijmegen, well for construction pit, building Philos. Fac. Univ.	dark grey clay, 34,5 m below surface	c.f. Holsteinian
25	Loenermark nr. 7	dark grey fine sandy clay, sample nr. 7, above preglacial deposits	c.f. Cromerian
10	Sneek, 31 m	sandy loam	Holsteinian
	Sneek, 125 m	grey fine sandy clay	M. or L.Pleist.
9	Spannenburg, nr. 5	grey fine sandy clay, depth: 61 m	Holsteinian
	Spannenburg, 150 m	grey coarse sandy loam, depth: 150 m	M. or L.Pleist.
	Spannenburg, 187.5 m	brown fine sandy loam, depth: 187.5 m	L.Pleist.
	Spannenburg, 229 m	grey fine sandy clay, depth: 229 m	L.Pleist.
7	Winschoten, 3.9 m	"potklei", dark brown, very humic	M.Pleist.
	Winschoten, 99 m	ibid.	M.Pleist.
72	Bookholzberg, clay pit	dark grey humic clay, fine sandy, sample nr.18, 1.7 m above bottom	c.f. Elsterian
75	Lauenburg upon Elbe, clay pit Basedow, E. of Hamburg, W.Germany	dark grey humic clay, sample nr.12, 5.5 m above bottom of the pit	c.f. Elsterian
83	Clay-pit Glindow at Heeszel, near Berlin, Germany	dark grey humic clay, fine sandy ("Banderton"= banded clay)	c.f. Elsterian
26	Zweiersdal, nr. 14	brown sandy loam, 14 m below surface	c.f. Cromerian
27	Duno, 5.7 m deep	grey sandy loam with fine gravel, 5.7 m below surface	c.f. Elsterian
50	Terhaagen, nr. 42, N.Belgium	light grey clay from clay balls on the base of kryoturbate sands	L.Pleist. or U.Tertiary (younger than U.Miocene)

TABLE VIII : BROWNCOAL AND COAL SAMPLES FOR FLUORESCENCE ANALYSES

Locality nr. in fig.10	Sample nr. in fig.33	Locality:	Type:	Age:
59	I/C	Scotland, Minto Colliery	high volatile bituminous A	Namurian A
45	II/C	Lippe Mulde, W.Germany, from a well	high volatile bituminous A	L.Westphalian
60	III/C	Scotland, Lindsay surface mine	high volatile bituminous A	Namurian A
63	IV/C	Spain, Asturia, near the river Taya	high volatile bituminous B	Carboniferous
86	V/B	Moscow, U.S.S.R., nr. 2041	browncoal	Namurian
55	VI/B	Alum Bay, Hampshire, Gr. Britain	lignite	Eocene, basis Headon Beds
53	VII/B	Alum Bay, Hampshire, Gr. Britain	lignite	Eocene, Headon Beds
82	VIII/B	Helmstedt, W.Germany, "dark layer", nr. 7	lignite	Eocene Viktoria Fl.
	IX/B	ibid., nr. 4	lignite	ibid.
	X/B	ibid., nr. 8, "light layer",	lignite	ibid.
71	XI/B	Geiseltal, E.Germany	lignite	Eocene
46	XII/B	Ville, W.Germany, nr.3 "light layer", main seam	lignite	Miocene (L. Helvetian or U. Burdigalian)
48	XIII/B	Brühl, near Cologne, Rhine area, W.Germany	lignite	ibid.
near 48	XIV/B	Friesdorf near Bonn, W.Germany	lignite	ibid.
69	XV/B	Meiszner, Hessen, W.Germany	lignite	Miocene (Burdigalian)
68	XVI/B	Salzhausen, Wetterau, W.Germany, sample nr. 512	lignite	Pliocene

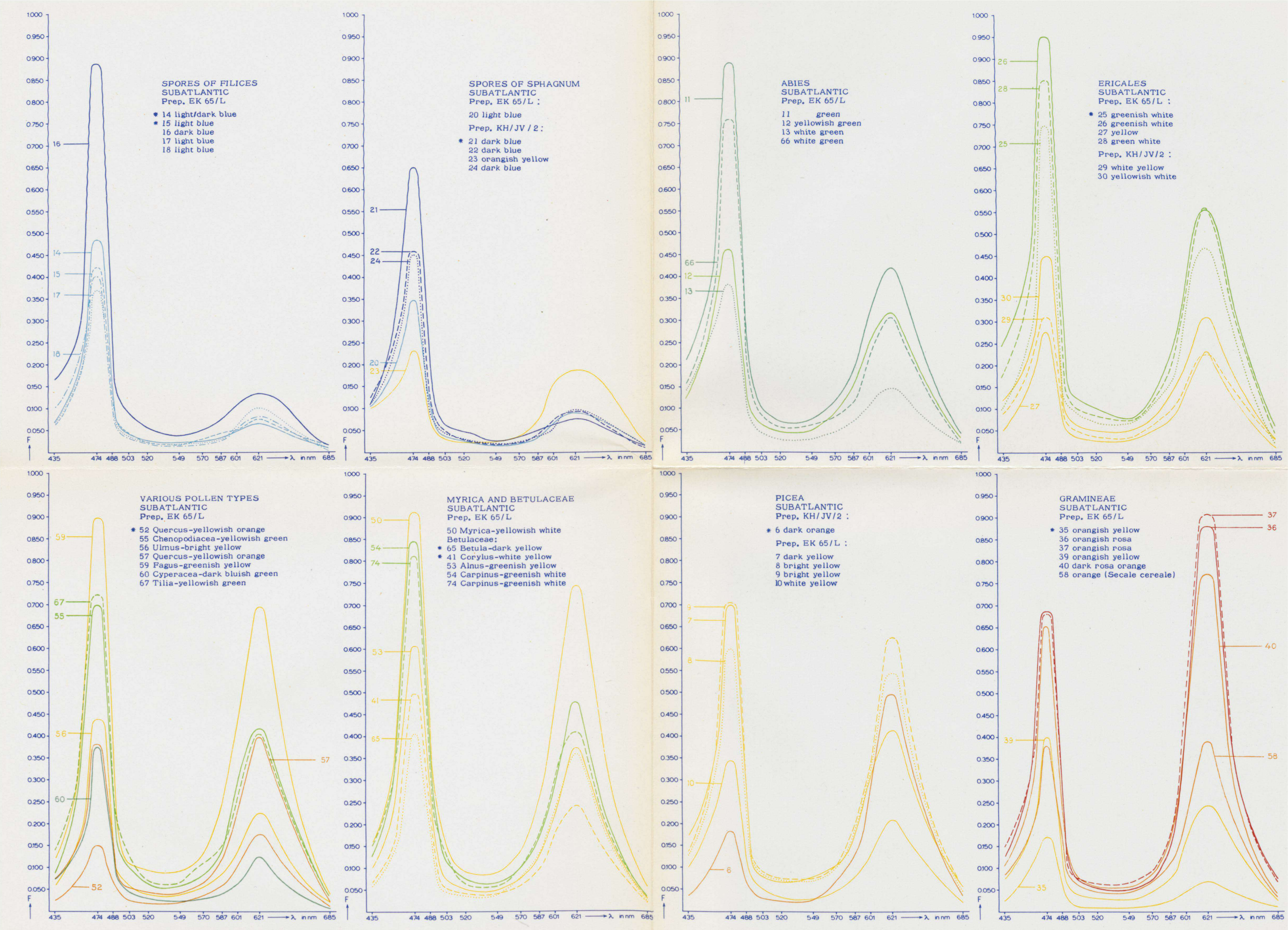

SPORES OF FILICES
SUBATLANTIC
Prep. EK 65/L
* 14 light/dark blue
* 15 light blue
16 dark blue
17 light blue
18 light blue
SPORES OF SPHAGNUM
SUBATLANTIC
Prep. EK 65/L :
20 light blue
Prep. KH/JV/2 :
* 21 dark blue
22 dark blue
23 orangish yellow
24 dark blue
ABIES
SUBATLANTIC
Prep. EK 65/L
11 green
12 yellowish green
13 white green
66 white green
ERICALES
SUBATLANTIC
Prep. EK 65/L :
* 25 greenish white
26 greenish white
27 yellow
28 green white
Prep. KH/JV/2 :
29 white yellow
30 yellowish white
VARIOUS POLLEN TYPES
SUBATLANTIC
Prep. EK 65/L
* 52 Quercus-yellowish orange
55 Chenopodiacea-yellowish green
56 Ulmus-bright yellow
57 Quercus-yellowish orange
59 Fagus-greenish yellow
60 Cyperacea-dark bluish green
67 Tilia-yellowish green
MYRICA AND BETULACEAE
SUBATLANTIC
Prep. EK 65/L
50 Myrica-yellowish white
Betulaceae:
* 65 Betula-dark yellow
* 41 Corylus-white yellow
53 Alnus-greenish yellow
54 Carpinus-greenish white
74 Carpinus-greenish white
PICEA
SUBATLANTIC
Prep. KH/JV/2 :
* 6 dark orange
Prep. EK 65/L :
7 dark yellow
8 bright yellow
9 bright yellow
10 white yellow
GRAMINEAE
SUBATLANTIC
Prep. EK 65/L
* 35 orangish yellow
36 orangish rosa
37 orangish rosa
39 orangish yellow
40 dark rosa orange
58 orange (Secale cereale)
F
λ in nm
435 474 488 503 520 549 570 587 601 621 685

PLATE I

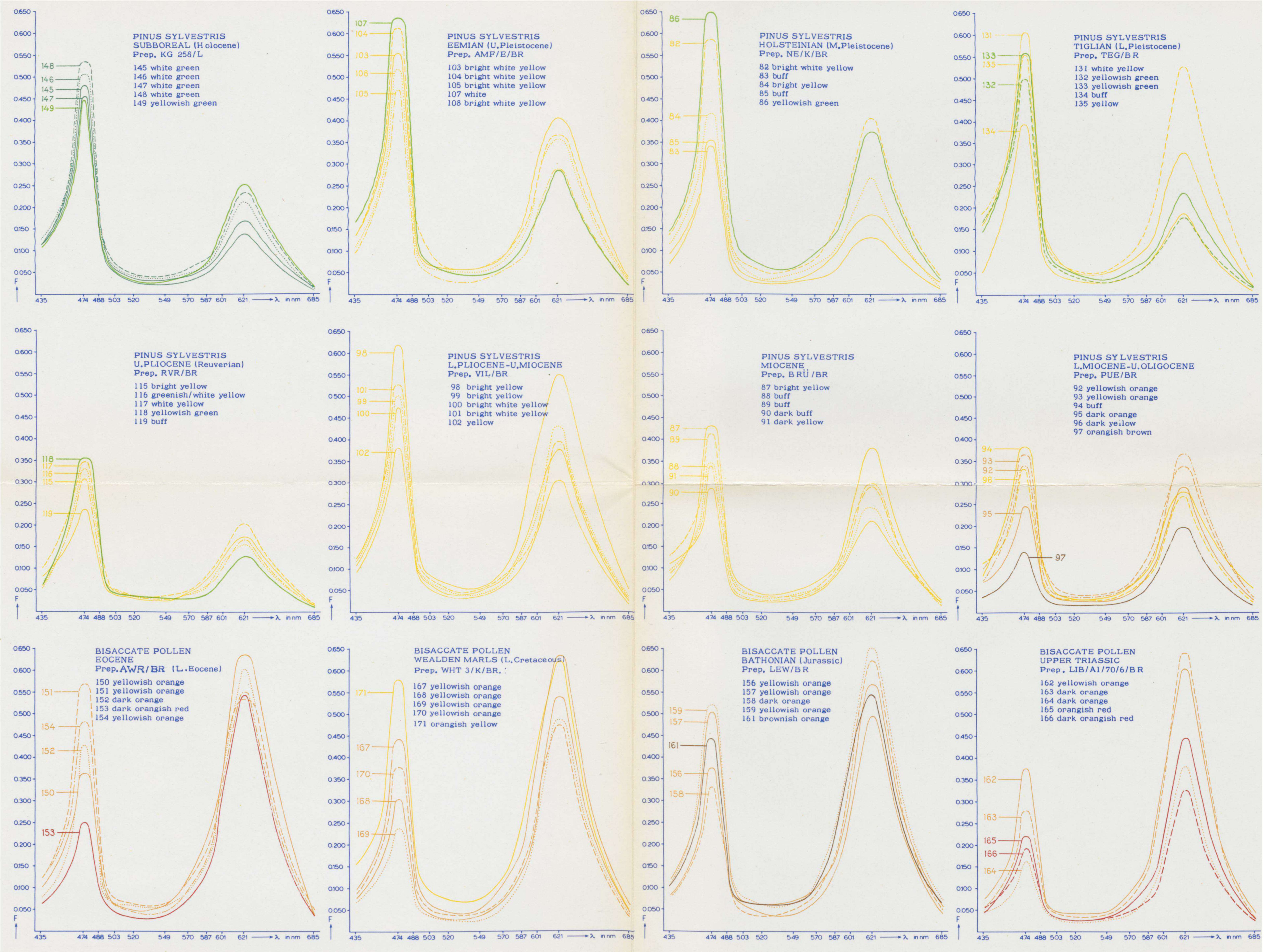
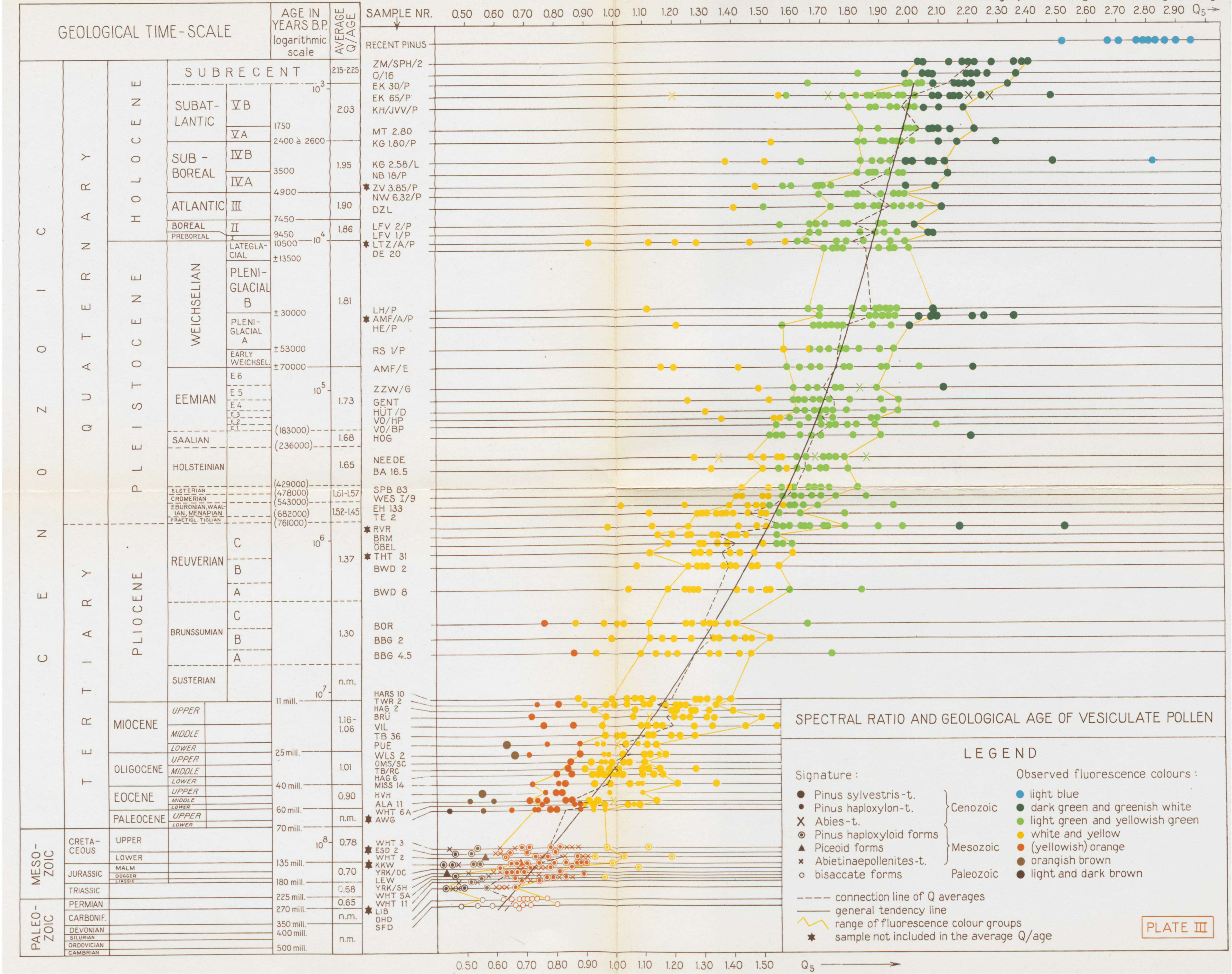

PINUS SYLVESTRIS
SUBBOREAL (Holocene)
Prep. KG 258/L
145 white green
146 white green
147 white green
148 white green
149 yellowish green
PINUS SYLVESTRIS
EEMIAN (U.Pleistocene)
Prep. AMF/E/BR
103 bright white yellow
104 bright white yellow
105 bright white yellow
107 white
108 bright white yellow
PINUS SYLVESTRIS
HOLSTEINIAN (M.Pleistocene)
Prep. NE/K/BR
82 bright white yellow
83 buff
84 bright yellow
85 buff
86 yellowish green
PINUS SYLVESTRIS
TIGLIAN (L.Pleistocene)
Prep. TEG/BR
131 white yellow
132 yellowish green
133 yellowish green
134 buff
135 yellow
PINUS SYLVESTRIS
U.PLIOCENE (Reuverian)
Prep. RVR/BR
115 bright yellow
116 greenish/white yellow
117 white yellow
118 yellowish green
119 buff
PINUS SYLVESTRIS
L.PLIOCENE-U.MIOCENE
Prep. VIL/BR
98 bright yellow
99 bright yellow
100 bright white yellow
101 bright white yellow
102 yellow
PINUS SYLVESTRIS
MIOCENE
Prep. BRÜ/BR
87 bright yellow
88 buff
89 buff
90 dark buff
91 dark yellow
PINUS SYLVESTRIS
L.MIOCENE-U.OLIGOCENE
Prep. PUE/BR
92 yellowish orange
93 yellowish orange
94 buff
95 dark orange
96 dark yellow
97 orangish brown
BISACCATE POLLEN
EOCENE
Prep. AWR/BR (L.Eocene)
150 yellowish orange
151 yellowish orange
152 dark orange
153 dark orangish red
154 yellowish orange
BISACCATE POLLEN
WEALDEN MARLS (L.Cretaceous)
Prep. WHT 3/K/BR.
167 yellowish orange
168 yellowish orange
169 yellowish orange
170 yellowish orange
171 orangish yellow
BISACCATE POLLEN
BATHONIAN (Jurassic)
Prep. LEW/BR
156 yellowish orange
157 yellowish orange
158 dark orange
159 yellowish orange
161 brownish orange
BISACCATE POLLEN
UPPER TRIASSIC
Prep. LIB/A1/70/6/BR
162 yellowish orange
163 dark orange
164 dark orange
165 orangish red
166 dark orangish red
F
λ in nm

PLATE II


GEOLOGICAL TIME-SCALE
AGE IN YEARS B.P. logarithmic scale
AVERAGE Q/AGE
SAMPLE NR.
SPECTRAL RATIO AND GEOLOGICAL AGE OF VESICULATE POLLEN
LEGEND
Signature:
Pinus sylvestris-t.
Pinus haploxylon-t.
Cenozoic
Abies-t.
Pinus haploxyloid forms
Piceoid forms
Mesozoic
Abietinaepollenites-t.
bisaccate forms
Paleozoic
Observed fluorescence colours:
light blue
dark green and greenish white
light green and yellowish green
white and yellow
(yellowish) orange
orangish brown
light and dark brown
connection line of Q averages
general tendency line
range of fluorescence colour groups
sample not included in the average Q/age
PLATE III
CENOZOIC
QUATERNARY
TERTIARY
MESOZOIC
PALEOZOIC
HOLOCENE
PLEISTOCENE
PLIOCENE
MIOCENE
OLIGOCENE
EOCENE
PALEOCENE
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
CARBONIF.
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
SUBRECENT
SUBATLANTIC
SUBBOREAL
ATLANTIC
BOREAL
PREBOREAL
WEICHSELIAN
EEMIAN
SAALIAN
HOLSTEINIAN
ELSTERIAN
CROMERIAN
EBURONIAN, WAALIAN, MENAPIAN
PRAETIGL. TIGLIAN
REUVERIAN
BRUNSSUMIAN
SUSTERIAN
Q5

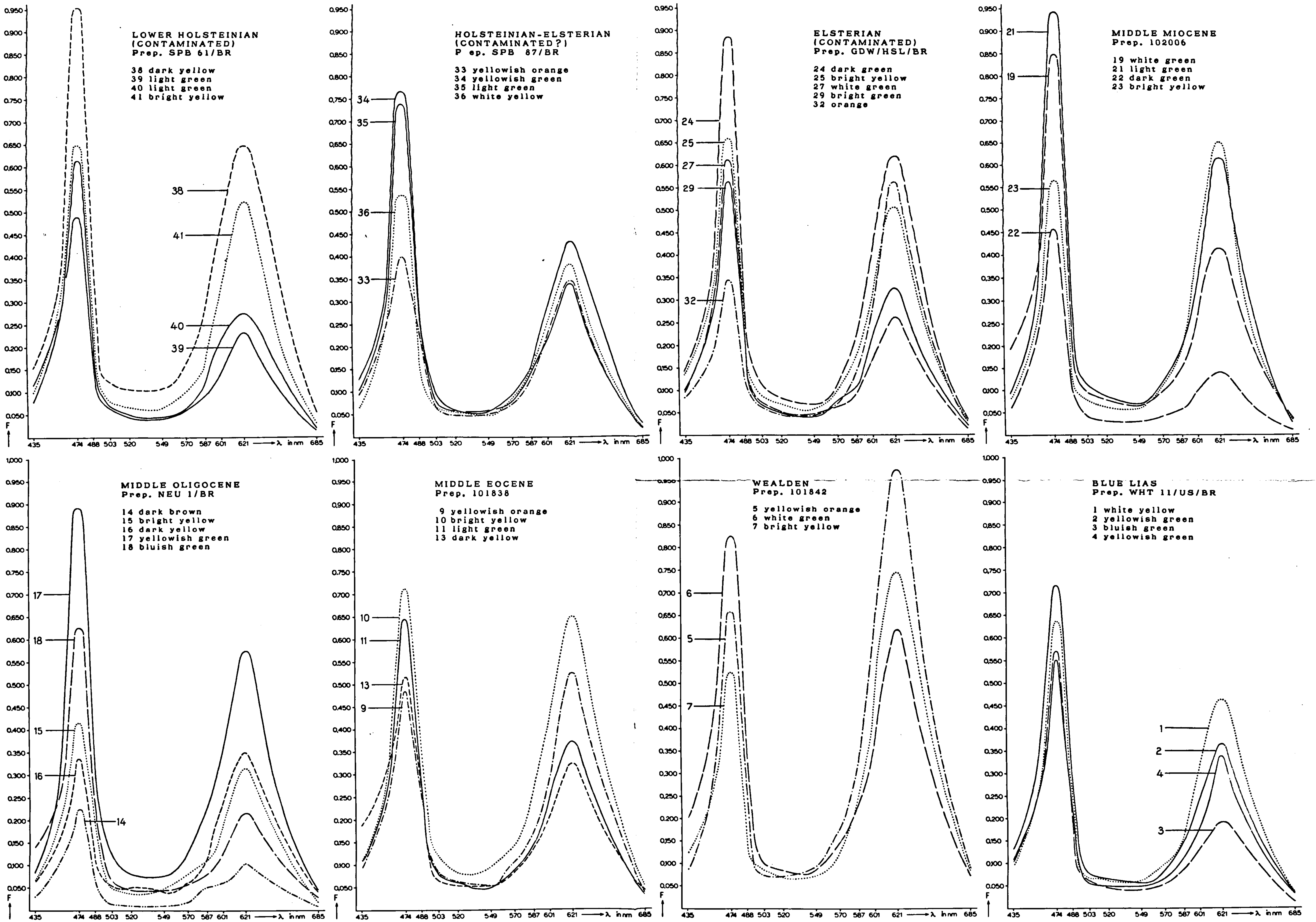

LOWER HOLSTEINIAN
(CONTAMINATED)
Prep. SPB 61/BR
38 dark yellow
39 light green
40 light green
41 bright yellow
HOLSTEINIAN-ELSTERIAN
(CONTAMINATED?)
P ep. SPB 87/BR
33 yellowish orange
34 yellowish green
35 light green
36 white yellow
ELSTERIAN
(CONTAMINATED)
Prep. GDW/HSL/BR
24 dark green
25 bright yellow
27 white green
29 bright green
32 orange
MIDDLE MIOCENE
Prep. 102006
19 white green
21 light green
22 dark green
23 bright yellow
MIDDLE OLIGOCENE
Prep. NEU 1/BR
14 dark brown
15 bright yellow
16 dark yellow
17 yellowish green
18 bluish green
MIDDLE EOCENE
Prep. 101838
9 yellowish orange
10 bright yellow
11 light green
13 dark yellow
WEALDEN
Prep. 101842
5 yellowish orange
6 white green
7 bright yellow
BLUE LIAS
Prep. WHT 11/US/BR
1 white yellow
2 yellowish green
3 bluish green
4 yellowish green
F
λ in nm

PLATE IV

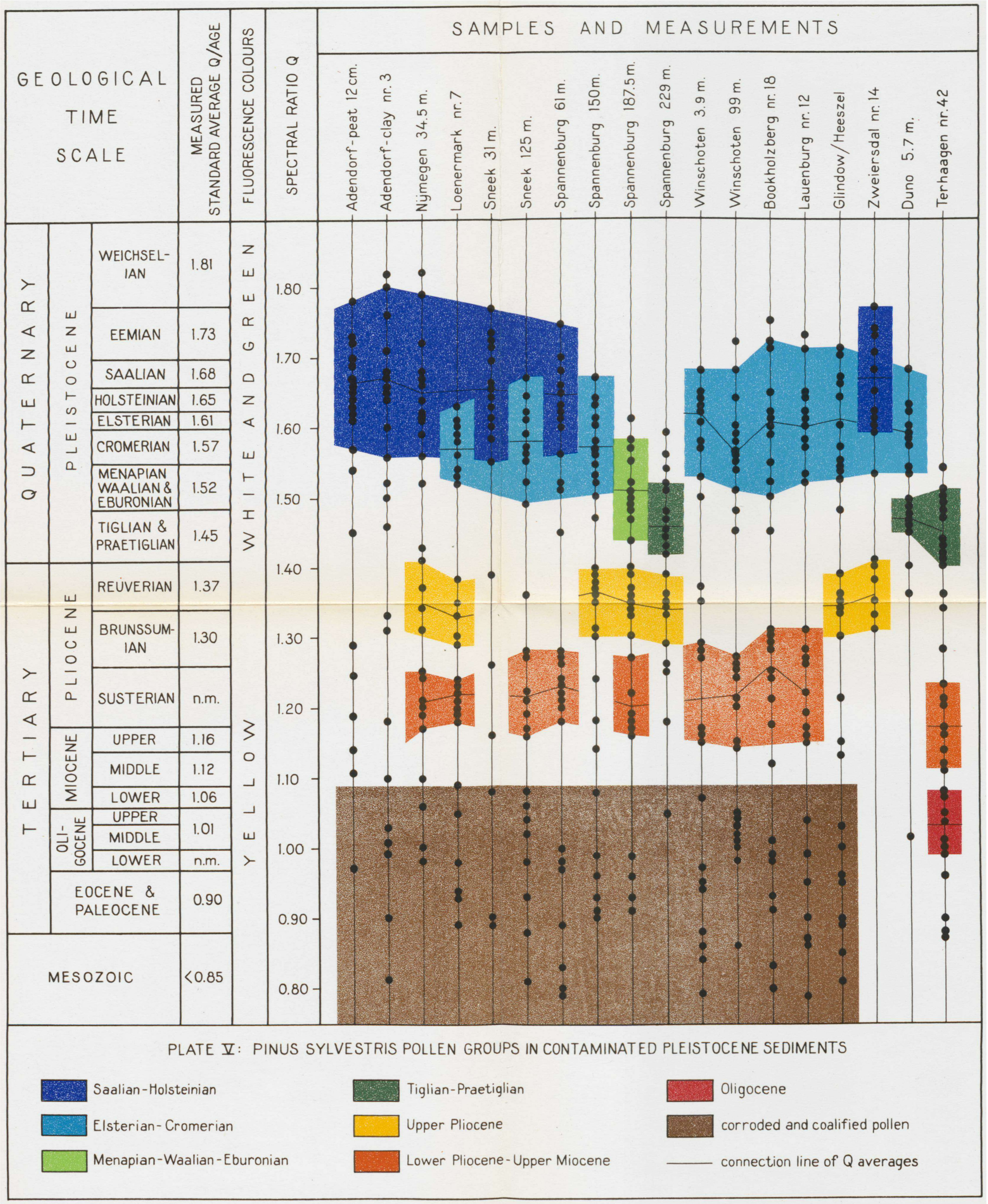


PLATE V: PINUS SYLVESTRIS POLLEN GROUPS IN CONTAMINATED PLEISTOCENE SEDIMENTS