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Palynological study of shell Anglo Harlequin D-86 well, offshore British Columbia

W.S. Hopkins, Jr.

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PALYNOLOGICAL STUDY OF SHELL ANGLO HARLEQUIN D-86 WELL (NTS 102-O), OFFSHORE BRITISH COLUMBIA

W.S. Hopkins, Jr.

INTRODUCTION AND GEOLOGY

This well, drilled by Shell Canada, was located about 72 kms (45 miles) east of Cape St. James, Queen Charlotte Islands (51°55'3.585"N; 129°58'12.353"W), British Columbia. Spudding took place on 22 September 1968 and the well was plugged and abandoned on 15 October 1968 at a total depth of 3241 meters (10,320 feet). Drilling was from a floating platform in 140 meters (458 feet) of water.

Clastic sedimentary rocks were encountered from surface to 3146 meters (10,320 feet); volcanic rocks from there to total depth. A comparatively complete description of the penetrated sediments is given in Shell Canada Limited (1968) but in general sandstones dominate with lesser amounts of siltstone, and still less shale. Overlying the basal volcanics are some 152 meters (500 feet) of shale. Two conventional cores were taken, but as they consisted of sand, were not suitable for palynological analysis. A total of 184 sidewall cores were recovered, but these were tested to destruction by the operator.

SAMPLES

As neither suitable conventional or sidewall cores were available to me, this (entire) study is based entirely on cuttings. Because of the unconsolidated nature of the sediments, the rapid rate of bit penetration, and subsequent caving, the palynological results from the samples tends to be somewhat muddied. Future wells studied in this program will be processed utilizing dry sieving techniques which tends to remove cave material and dried drilling mud; therefore, results should be somewhat more meaningful. A total of 93 samples were examined from 384 meters (1260 feet) to total depth, spaced at approximately 30 meter (100 feet) intervals. Although the bottom 91 meters (300 feet) of hole was in

volcanic rocks, the shale recovery was good, probably representing shale caving from immediately above the volcanics.

PALYNOLOGY

Generally speaking the quality of palynomorph preservation was good in the upper part of the well, but quality gradually decreased down hole, mainly resulting from increased carbonization. In addition, many forms, especially the saccate grains were crushed or folded. Therefore, identification in many cases was questionable. Nevertheless, where possible, identifiable taxa were recorded [~~when possible~~]. However, compilation for range charts involved much lumping, the only method which appeared to give meaningful results.

With few exceptions the taxa were the same from top to bottom of the hole, consequently relative proportions had to be employed. Considering the nature of the samples and the considerable reworking or recirculating that must have occurred, results from individual samples are questionable. However, examination of the stratigraphic distribution charts, show that several broad trends are apparent, and these would appear to have both age and environmental signifcance. For example, there is a gradual decrease in proportions (Fig. 3) of ferns, lycopods and bryophytes; a decrease in the Pinaceae was matched by an increase in the Taxodiaceae, (Fig. 4), then a reversal in the bottom half of the hole. The angiosperms (Fig. 7) showed a steady increase, a pronounced decrease, then again an increase. Although the depositional environment may be partially responsible for this variation, I think it more probable that most of these changes are climatic. Consequently they may have value in age dating, a discussion of which follows.

AGE

There seems to be no doubt this is a Neogene sequence, a conclusion based mainly on the modern appearance of the taxa and the presence of such families as Compositae, Chenopodiaceae and Gramineae. Palynological subdivision of the Tertiary is always difficult, and perhaps is more so in this area where well dated marine sequences are absent, which could be used for correlation. In an attempt to establish a probable age for this sequence of rocks, I have compared floras from Alaska (Wolfe, and others, 1966; Wolf, 1966); from the Queen Charlotte Islands (Martin and Rouse, 1966); from interior British Columbia (Piel, 1971) and from the northwestern United States (Leopold, 1969). Unpublished data of my own has also been considered. However, our knowledge of Miocene-Pliocene floras from the margin of the North Pacific Basin is woefully inadequate and many suppositions are necessary.

A through discussion of this will be deferred until examination of several more wells is completed, and foraminiferal data from marine zones can be considered. It is necessary to see if the floral patterns indicated here are consistent in other wells and not just a local aberation. Furthermore, some of the data are somewhat contradictory. However, at this preliminary stage I would suggest that the upper 457 meters (1500 feet) or so of the examined section is essentially equivalent in age and environment to that of the Sknonun Formation of British Columbia, as described by Martin and Rouse (1966). Although their conclusions are admittedly tenuous, they feel the age of this unit is most probably Late Miocene or Early Pliocene. Wolfe and others (1966) subdivided the southcentral Alaska Tertiary into three broad floral groups, the Seldovian, the Homerian and the Clamgulchian. Although the ages assigned here are highly uncertain the Seldovian would appear

to be early to middle Miocene with the possibility of some Oligocene at the base. The Homerian is thought to be mostly or entirely late Miocene, while the Clamgulchian is at least partly Pliocene.

I would suggest that the upper part of the section examined in this well is equivalent to the Homerian while the lower part is Seldovian (Figure 2). The Clamgulchian in Alaska is a very impoverished flora, and it would appear that the comparatively abundant microflora recovered from this well generally represents temperate to warm temperate plants, is older than this. It is possible that Pliocene is present in the upper cemented and unsampled part of the well.

Consequently, I suggest that the sediments in this well are entirely Miocene, although possibly a bit of Oligocene is present at the bottom. My own observations indicate that coastal Oligocene, at least in Oregon, contain schizaeaceous spores which are not present in any of the assemblages here. Therefore, I would suggest if Oligocene is present, it would be only a small amount from the upper part of the Oligocene.

Another method of suggesting age might be the use of Miocene-Pliocene mean temperature curves, established by a number of workers on a number of floras (mainly utilizing various megafossil groups), i.e. Brooks, (1951); Dorf, (1955); Wolfe and Hopkins, (1967); Tanai and Huzioka, (1967). Although the analyses differ in detail, the general picture indicated by most investigators is a warm peak in late early or middle Miocene, followed by a general cooling into the Pleistocene. The early Miocene is considered to be somewhat cooler than the middle Miocene. If we look at the vegetative proportions with this concept in mind we find the lowest proportion of Pinaceae and Maximum Taxodiaceae at about 1707 meters (5600 feet). A marked reduction in the total

percentage of angiosperms also takes place in this zone. This then could prepresent the thermal maximum of the middle Miocene. The general increase of the Pinaceae and decrease of the Taxodiaceae below this zone, could indicate the slightly cooler early Miocene. The gradual cooling from middle to Late Miocene would explain the steady increase in the Pinaceae (mostly pine, spruce and hemlock) and the ferns. During this same interval the Taxodiaceae and the angiosperms show a decrease in abundance.

Therefore, in broadly general terms, interpreted climatic trends compliment the interpretations made by floral comparisons with Alaska, British Columbia and the northwest United States. I must hasten to reemphacize this is all very tenuous at the present time. Floral comparisons can only be suggestive because the floras to which comparisons are made are themselves only tenuously dated. Furthermore, the interpreted climatic changes are suspect, largely because the apparent change in floras as revealed by percentages may be an artifcat of method rather than indicative of significant floral changes.

However, the suggestion is there of a Miocene age, and until further studies on wells and outcrop data are completed, further discussion must be suspended.

ENVIRONMENT

Deposition would appear to have been on a continuously subsiding coastal plain, apparently subsiding rapidly enough to prevent accumulation of organic deposits such as peat. The intermittent and always low frequency of phytoplankton (Fig. 7) suggests deposition at, or occasionally slightly below, sea level. Subsidence was remarkably rapid, permitting the accumulation of 3050 meters (10,000 feet) of clastic sediment during a period no longer, or only slightly longer than the Miocene. Assuming

a 20 million year length for the Miocene this is an accumulation of about .3 meters (1 Foot) every 2000 years.

The plants indicate a warm temperate climate for the middle Miocene ranging to perhaps temperate at the end of the epoch. The presence of Nyssa, Taxodium, Metasequoia, Alnus, Betula and other genera would indicate a comparatively damp climate with abundant rainfall. Temperatures below freezing must have been absent or very rare.

References

Brooks, C.E.P.
1951: Geological and historical aspects of climatic change; in Malone, F. (ed.) Compendium of meteorology, American Meteorological Soc., Boston, p. 1004-1018

Dorf, E.
1955: Plants and the geologic time scale; Geol. Soc. Am. Paper 62, p. 575-592

Leopold, E.B.
1969: Late Cenozoic palynology; in Tschudy, R.H. and Scott, R.A. (eds.) Aspects of Palynology, Wiley Interscience, New York, p. 377-438

Piel, K.M.
1971: Palynology of Oligocene sediments from central British Columbia; Can. J. Bot., v. 49, p. 1885-1920

Martin, H.A. and Rouse, G.E.
1966: Palynology of Late Tertiary sediments from Queen Charlotte Islands, British Columbia; Can. J. Bot., v. 44, p. 171-208

Shell Canada Limited
1968: Well history report, Shell Anglo Harlequin D-86

Tanai, T. and Huzioka, K.
1967 Climatic implications of Tertiary floras in Japan; in Haitai, K. (ed.), Tertiary correlations and climatic changes in the Pacific; Symp. Pacific Sci. Congr., 11th, Tokyo, v. 25, p. 89-94

Wolfe, J.A.
1966: Tertiary plants from the Cook Inlet Region, Alaska; U.S. geol. Surve. Prof. Paper 398-B

Wolfe, J.A., Hopkins, D.M., Leopold, E.B.
1966: Tertiary stratigraphy and paleobotany of the Cook Inlet Region, Alaska; U.S. Geol. Surv. Prof. Paper 398-A

Wolfe, J.A., Hopkins, D.M.
1967: Climatic changes recorded by Tertiary land floras in northwestern North America; in Haitai, K. (ed.) Tertiary correlations and climatic changes in the Pacific; Symp. Pacific Sci. Congr., 11th, Tokyo, v. 25, p. 67-76

LIST OF FIGURES

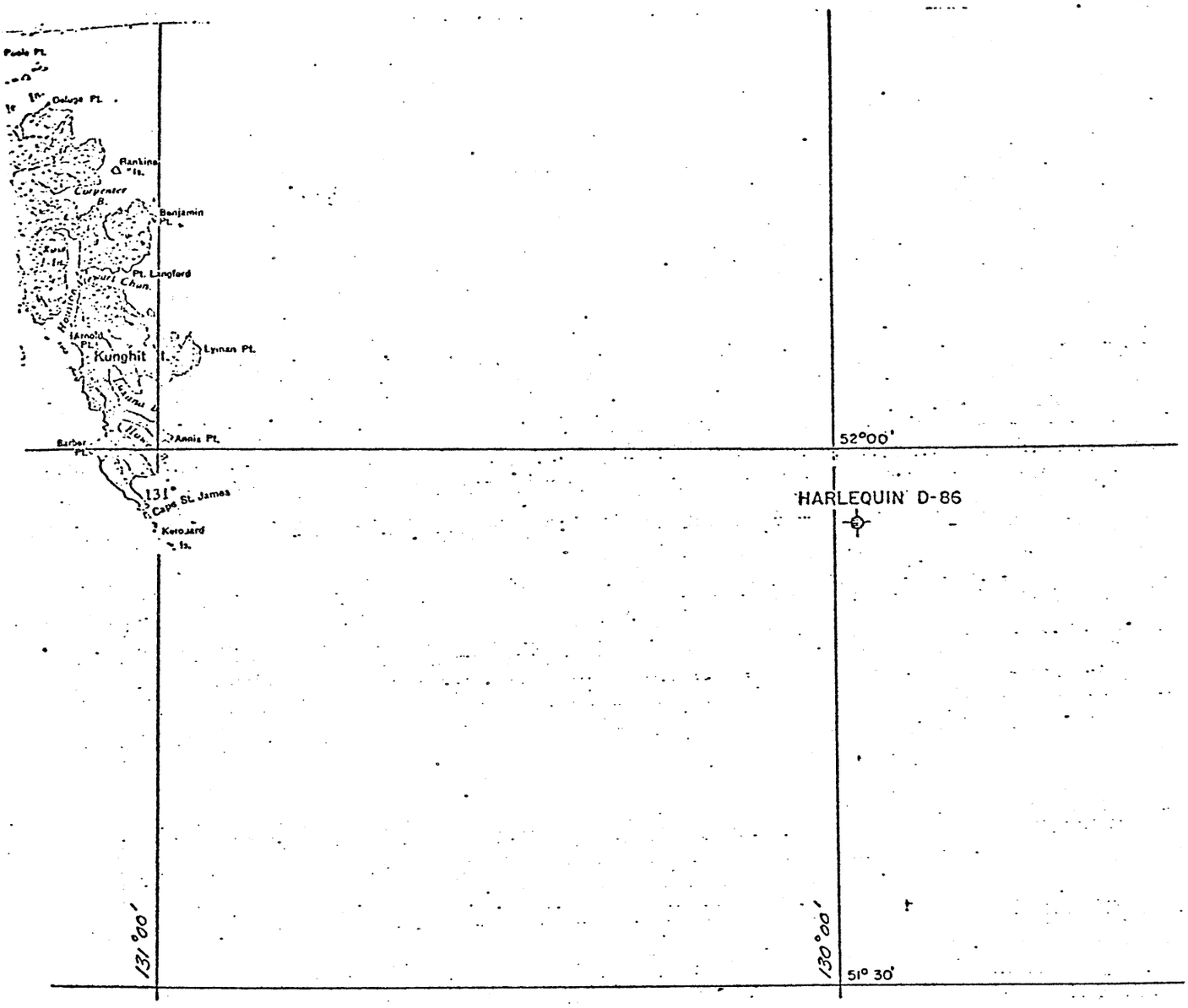


Fig. 1. Index Map Showing Location of Shell Anglo Harlequin D-86 taken from Shell History Report (1969).

Figure 2

G.S.C. Loc. Numbers all samples : C-30111

Feet Depth	Pal. No.	Depth - Meters	
1213 - 1260	733-1	385-394	
1355 - 1400	733-2		
[illegible]	733-3		
[illegible]	733-4		
1750 - 1800	733-5		
[illegible]	733-6		
[illegible]	733-7		
[illegible]	733-8		
2050 - 2100	733-9		UPPER MIOCENE
2150 - 2200	733-10		
2250 - 2300	733-11	686-701	
2350 - 2400	733-12		
2450 - 2500	733-13		
[illegible]	733-14		
[illegible]	733-15		
[illegible]	733-16		
[illegible]	733-17		
2950 - 3000	733-18		
3038 - 3100	733-19		
3150 - 3200	733-20		
3250 - 3300	733-21	991-1006	ESTIMATED
3350 - 3400	733-22		
3450 - 3500	733-23		
3550 - 3600	733-24		
3650 - 3700	733-25		
3775 - 3800	733-26		
3850 - 3900	733-27		
[illegible]	733-28		
4050 - 4078	733-29		
4152 - 4175	733-30		
4243 - 4273	733-31	1293-1302	
4346 - 4367	733-32		
4470 - 4525	733-33		
4554 - 4582	733-34		
4641 - 4671	733-35		
4733 - 4764	733-36		
4846 - 4878	733-37		
4963 - 4990	733-38		
5074 - 5117	733-39		
5150 - 5190	733-40		
5245 - 5275	733-41	1599-1608	
5363 - 5376	733-42		
5457 - 5475	733-43		
5562 - 5575	733-44		MIDDLE MIOCENE
5658 - 5688	733-45		
5820 - 5840	733-46		
6000 - 6040	733-47		
6100 - 6120	733-48		
6280 - 6307	733-49		
6348 - 6378	733-50		
6439 - 6463	733-51	1962-1972	
6554 - 6621	733-52		
6684 - 6715	733-53		
6743 - 6779	733-54		
6833 - 6862	733-55		
6950 - 6988	733-56		
7051 - 7082	733-57		
7144 - 7175	733-58		
7237 - 7275	733-59		
7335 - 7367	733-60		
7436 - 7461	733-61	2266-2276	
7534 - 7560	733-62		
7640 - 7660	733-63		
7750 - 7780	733-64		
7871 - 7920	733-65		
7960 - 7980	733-66		
8050 - 8070	733-67		
8160 - 8170	733-68		
8260 - 8270	733-69		
8320 - 8370	733-70		
8460 - 8470	733-71	2579-2582	ESTIMATED
8560 - 8570	733-72		
8660 - 8670	733-73		
8760 - 8780	733-74		
8860 - 8890	733-75		
8950 - 8960	733-76		
9050 - 9060	733-77		
9160 - 9170	733-78		
9260 - 9270	733-79		
9360 - 9370	733-80		
9460 - 9470	733-81		
9560 - 9573	733-82	2883-2917	
9660 - 9670	733-83		LOWER MIOCENE
9760 - 9770	733-84		
9860 - 9870	733-85		
9960 - 9970	733-86		
10,060 - 10,070	733-87		
10,160 - 10,170	733-88		
10,260 - 10,270	733-89		
10,360 - 10,370	733-90		
10,460 - 10,470	733-91	3188-3191	
10,560 - 10,570	733-92		
10,660 - 10,670	733-93		

Figure 6

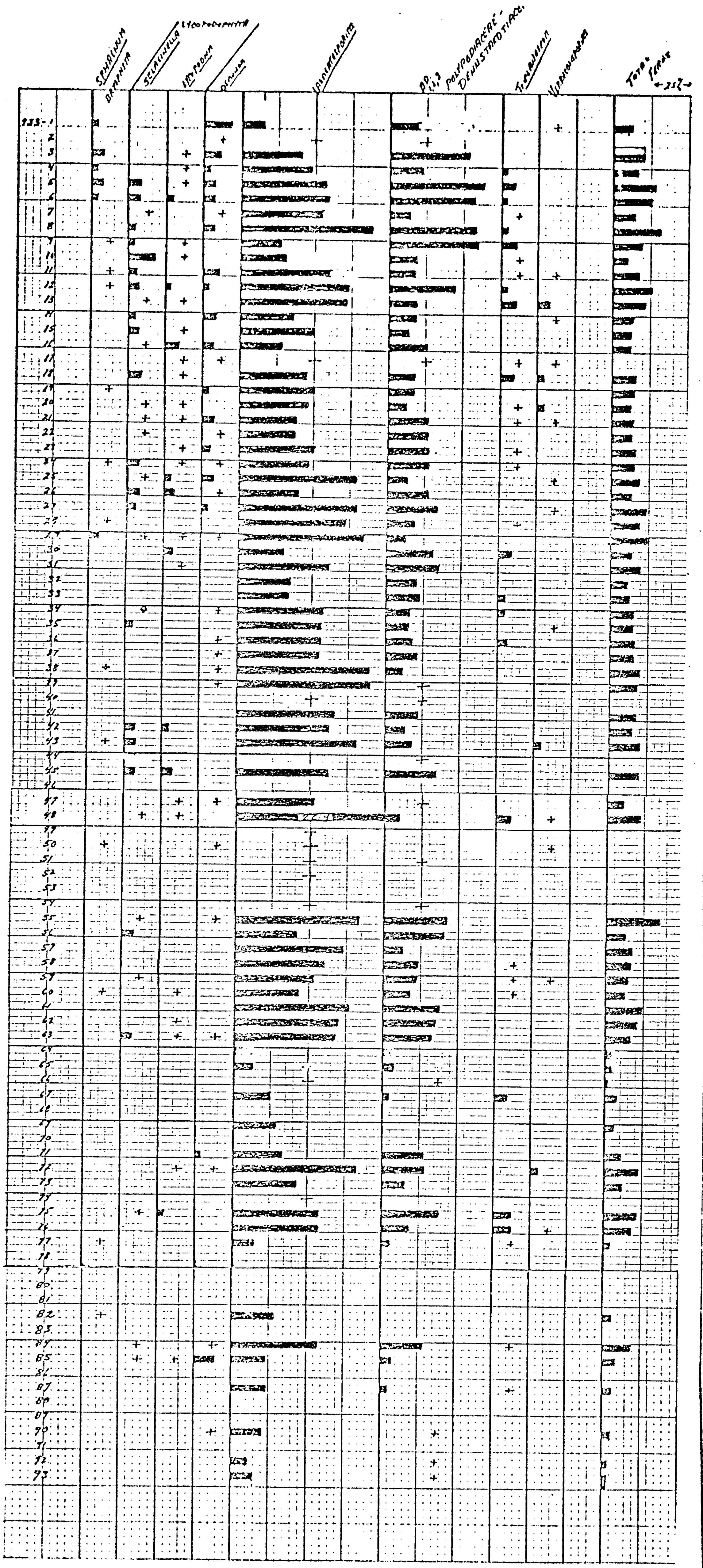


Figure 4

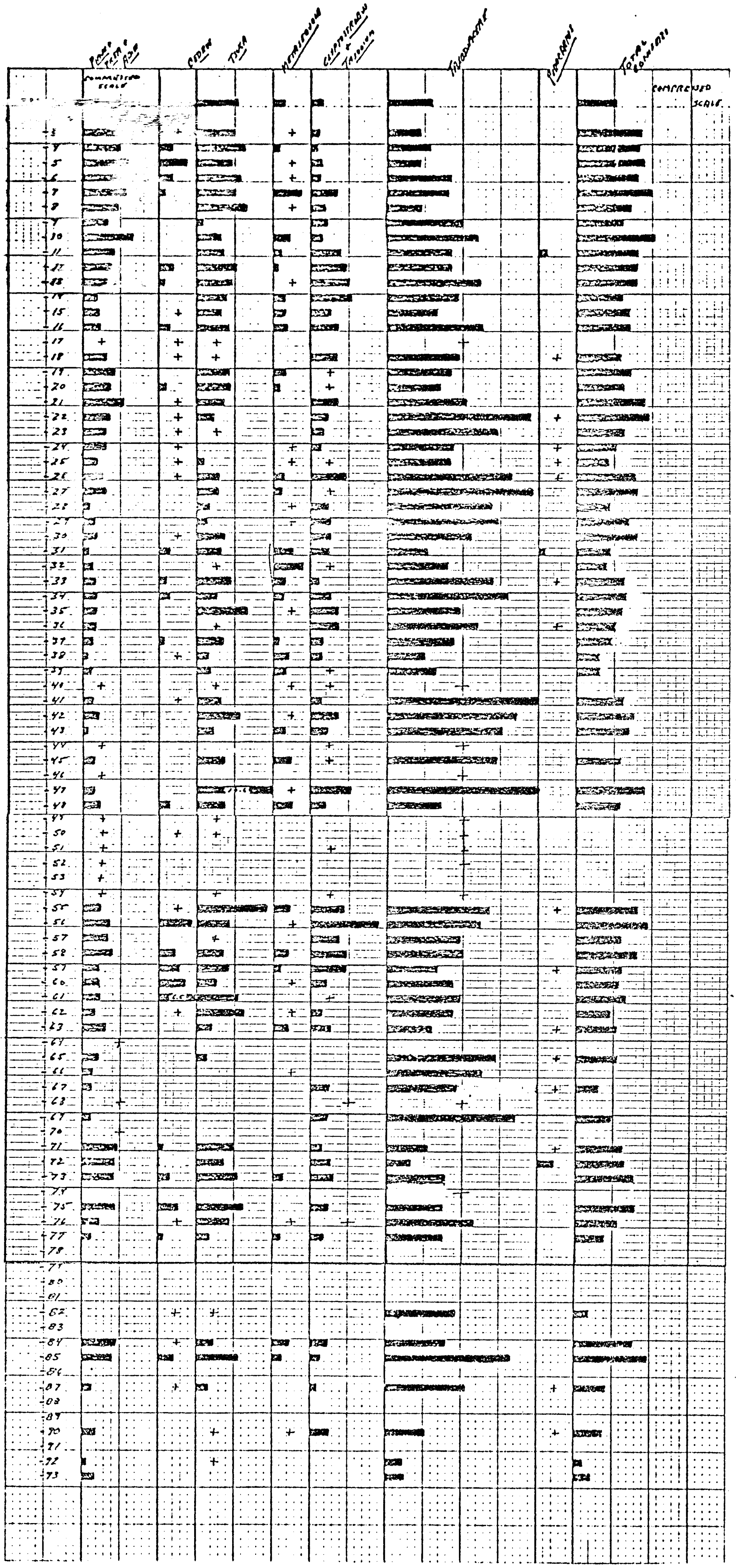


Fig 5

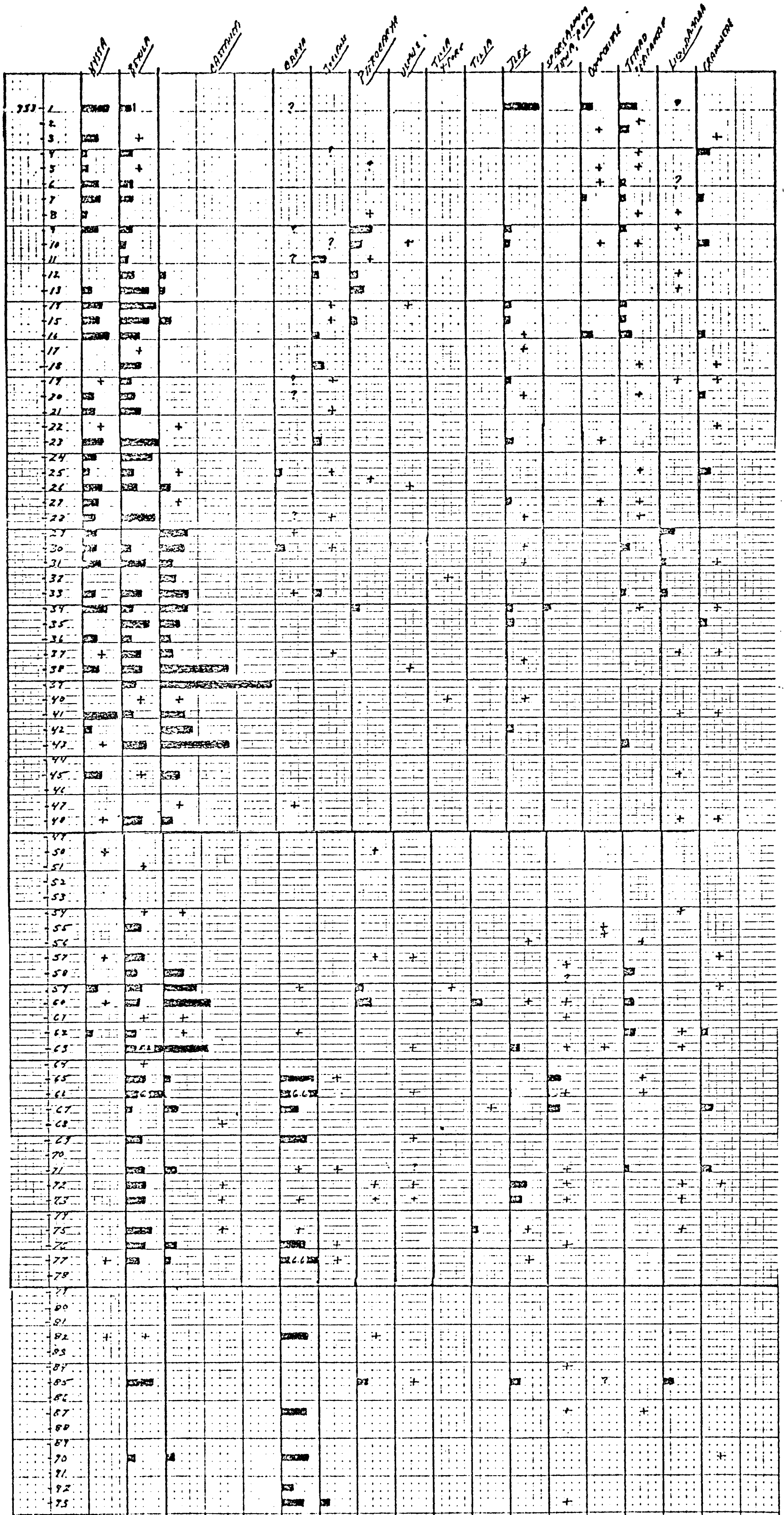
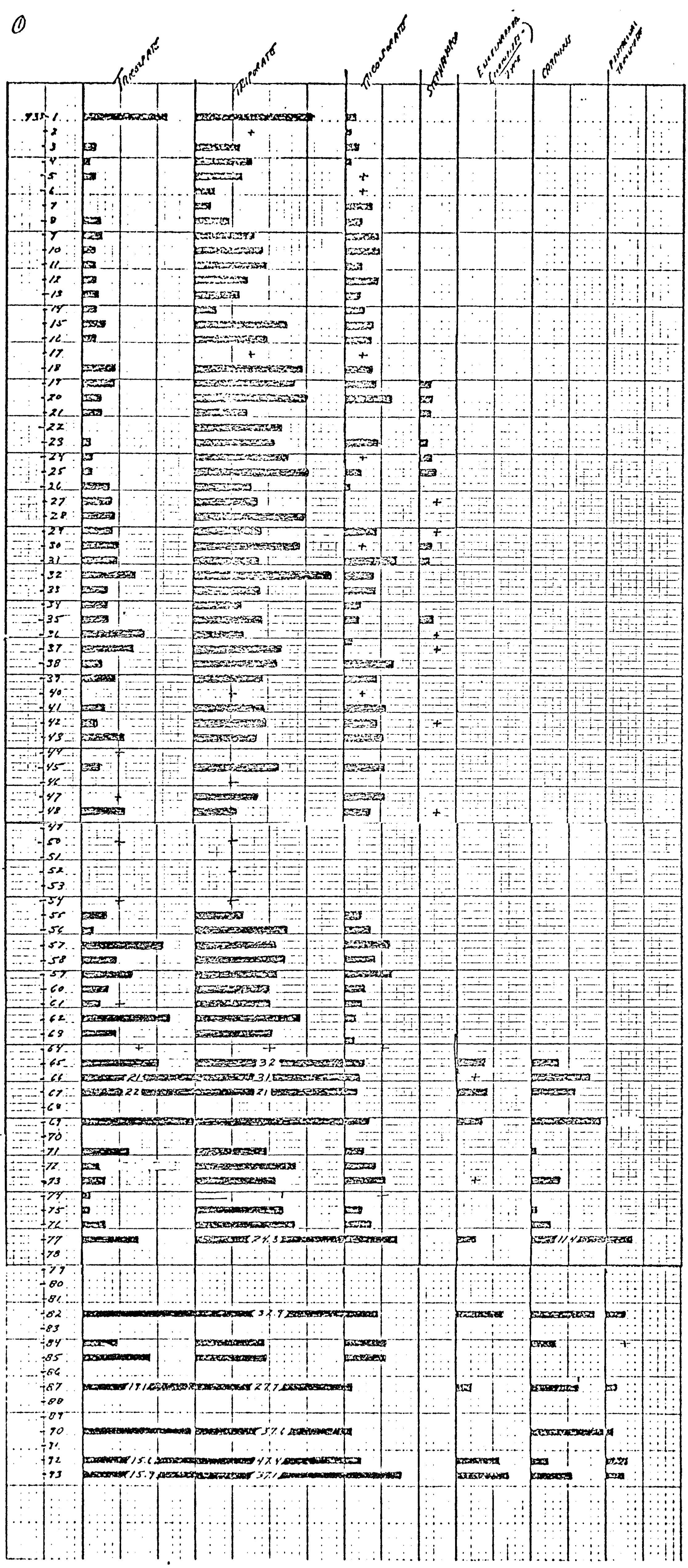

NYSSA
BETULA
CASTANEA
CARYA
ULMUS
TILIA
ILEX
COMPOSITAE
LIQUIDAMBAR
GRAMINEAE

Figure 6



Numbers on vertical scale refer to "Pal No's" as given on Figure 2

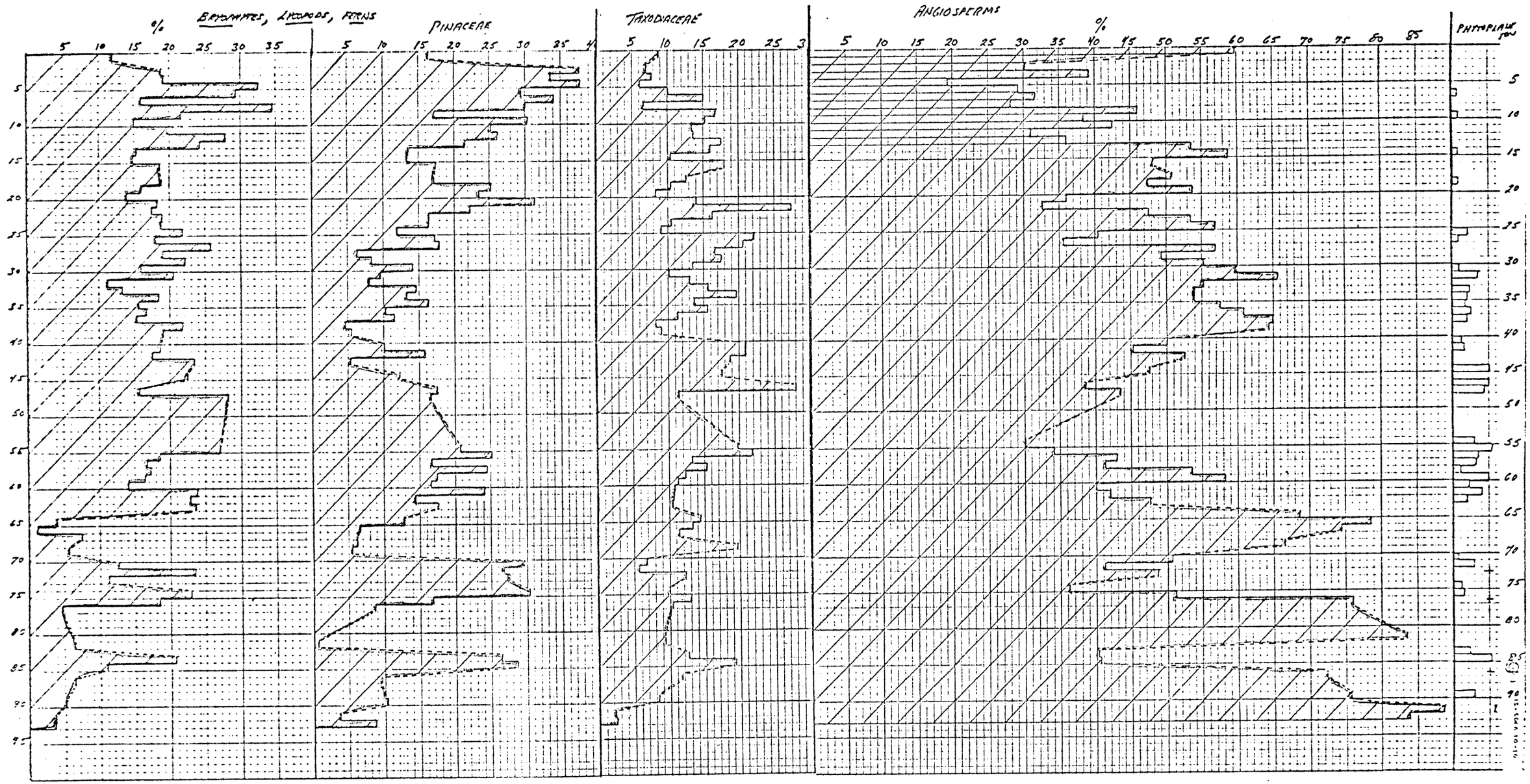


FIGURE 7

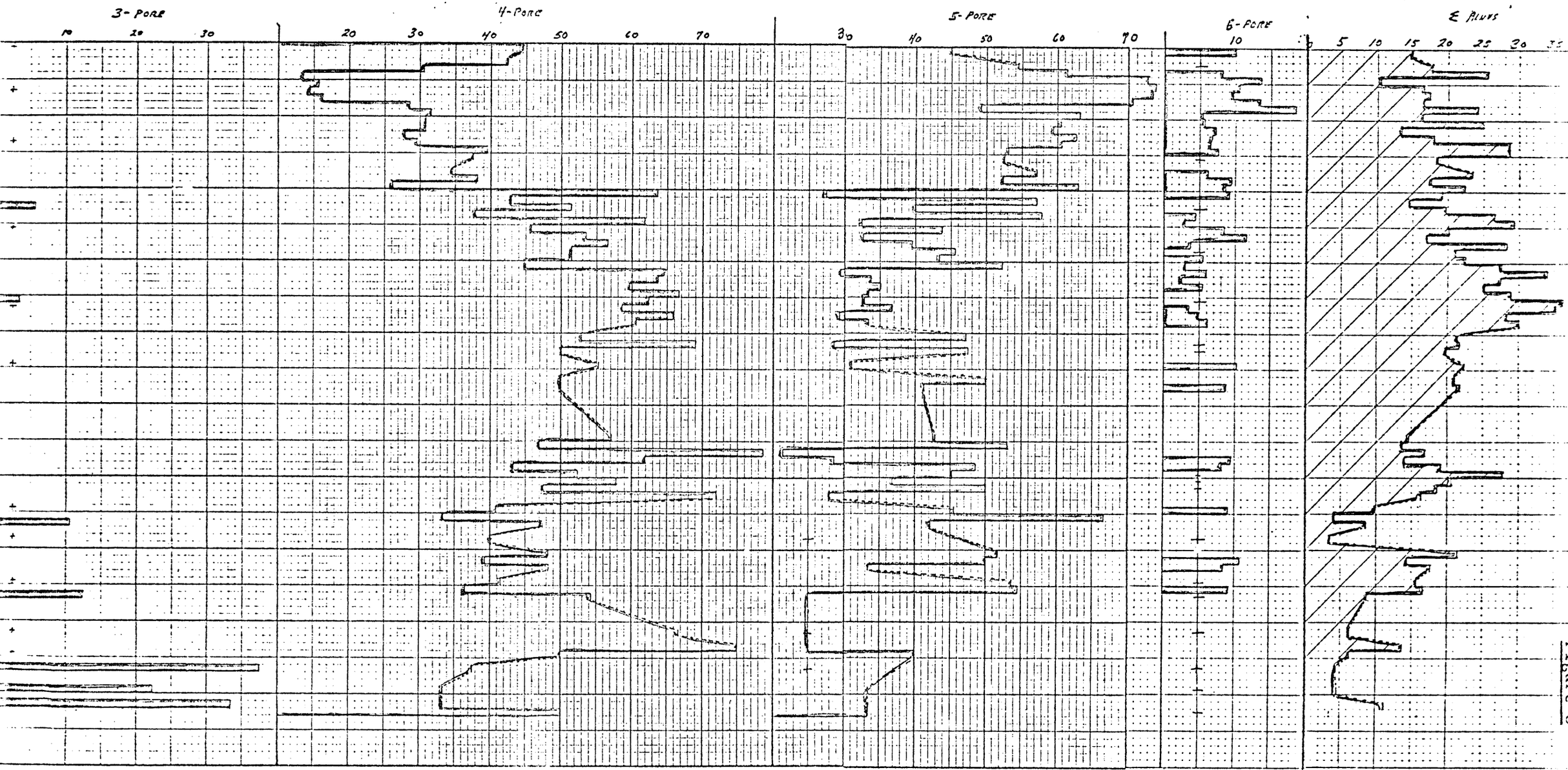

3- PORE
10
20
30
4- PORE
20
30
40
50
60
70
5- PORE
30
40
50
60
70
6- PORE
10
E PLUS
5
10
15
20
25
30

Figure 8