A study of the vegetational history of the Pow-hill valley bog area, county Durham (April - August 1972)

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A STUDY OF THE VEGETATIONAL HISTORY OF THE POW-HILL VALLEY BOG AREA, COUNTY DURHAM (April - August 1972)

by

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Advanced course in Ecology, University of Durham

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INTRODUCTION

POW - HILL valley bog was chosen for this study of vegetational history for two main reasons:

1. Nobody has done any work on vegetational history in the Derwent Valley. People have worked in Weardale to the south. Mrs. Pamela Ward did two diagrams, one from Bollihope and one from Steward Shield Meadows in Weardale and worked out the history of the vegetation during pollen zones V11 b and V111. She found evidence for Iron Age and Romano British forest clearence, late medieval clearence and final clearence of the forest in the 16th century. So it was thought Pow - Hill would be interesting to compare with Mrs. Ward's site in Weardale.

2. The second reason for choosing this site was that Durham County Council intended building a car park on the site at Pow - Hill in 1973. So it was important to investigate the site at once.

During the course of the investigation, the idea of comparing the pollen diagram with that of Mrs. Ward's was given up, as the bog proved to be much older than was originally thought. It proved to be late - glacial and post - glacial age.

(a) TOPOGRAPHY AND MODERN VEGETATION.

The Derwent river, in the valley of which the bog lies, is a tributary of the river Tyne (see map 1). The Derwent-reservoir, as shown in the map, lies some five miles west of CONSETT.

POW - HILL lies to the south of the reservoir (See map 1) and the bog lies in the depression within it (See map 2). The highest point reached by the elevated ground, to the east of the bog is 865 feet O.D. where as to the west of the bog it reaches 805 feetO.D. (See map 2). This little basin leads to the car park (See map 2) and several streams and springs drain their water into the bog. This draining of water into the basin, before bog formation, must have made the basin with its rapidly growing vegetation water - logged and eventually initiated peat formation.

To the east of the bog, the ground is covered with heather, where as to the west there is bracken.

The land in the surrounding area of the Derwent valley similarly consists of gently undulating ground. The land in the north west of County Durham slopes gradually from North-West to East.

THE VEGETATION ON THE BOG AND THE SURROUNDING AREAS OF THE DERWENT VALLEY.

The following species of Bryophytes are thriving on the bog.

1. MOSSES.

1. *Arcrocladium cuspidatum*
2. *Leucobryum glaucum*
3. *Polytrichum commune*
4. *Dicranum scoparium*
5. *Rhytidiadelphus squarrosus*
6. *Philonotis fontana*
7. *Hypnum cupressiforme*
8. *Sphagnum plumulosum*
9. *Sphagnum subsecundum*

LIVER WORTS

1. *Lophocolea bidentata*
2. *Cephaloziella species*
3. *Plagiochila asplenoides*

THE MAJOR SPECIES OF ANGIOSPERMS are:

1. *Juncus effusus*
2. *Potentilla palustris*
3. *Viola palustris*
4. *Menyanthes trifoliata*
5. *Eriophorum angustifolium*
6. *Oxycoccus palustris*
7. *Epilobium species*
8. *Vaccinium myrtillus*
9. *Chrysosplenium oppositifolium*
10. *Erica tetralix*
11. *Empetrum nigrum*

The vegetation of the surrounding Derwent Valley area, apart from the bog, was not studied in detail. H owever, the general features of the vegetation have been described by the Sunderland Water Company.

Before the reservoir was constructed, most of the land was used for grazing and there were available lands as well. Most of the elevated lands are covered in heather, and in the valley, the land is enclosed, and there are carefully managed re-seeded grasslands, which maintain bright green pastures and hay meadows. There are a few dairy farms as well, near the reservoir. There are few corn-fields,but most of the ploughed land is used for growing rape or kale, as autumn and winter feed for lambs or cows. The surrounding elevated lands in the Derwent Valley has plantation, where birch and scots pine grows. To the south side of the dam holding up the reservoir, there is a pleasant view over the Burnhope Valley (which is one mile from POW - HILL) to Muggleswick Park, which is within two miles away from the reservoir. By the burn and Mill-race, there are many alders merging into mixed oak wood, on the steeper slopes. Near Acton Burn (two miles from POW - HILL) is a remanent of oak and birch wood land which must have been common in the valley.

CLIMATE

There is very little precise information about the climate, the only defenite data concerns the rain fall.

RAIN-FALL.

In the Derwent Valley area the average annual rainfall is about 37.5 inches, with 21.5 inches run-off. This figur is higher than those of the lowlands of the county (compare, for example, with the figure for Durham City, 25 inches) and lower than those for the uplands (compare, for example, with the figure for the Moor House National Nature Reserve, 76 inches).

SNOW-FALL.

In the Derwent - Reservoir area, snow fall is erratic, it varies from year to year. In some years, there is no snow at all. During some years, the snow fall has been recorded as 12 to 15 inches. During 1970 -71, the snowfall recorded was 6 inches (This and the following information is obtained from the records of the Derwent reservoir station at Edmondbyers.)

TEMPERATURE.

There is no record about the temperature of the Derwent Valley area. However it must lie somewhere between Moorhouse nature reserve and the City of Durham. (Compare, for example, the figure for Durham City about mean daily maximum 53.2^{o}F. and mean daily minimum 41.3^{o}F.), and with those of average summer and winter temperatures at 55^{o}F and 29.3^{o}F respectively at Moor-House reserve.

FOG.

There is no significant incident of fog in the reservoir.

GEOLOGY

An attempt has been made to collect information about the geology of north west of Durham, by referring to the Geological map, Newcastle-Upon-Tyne 1892, which has not been revised since, and more recent information was obtained from the book "Durham County and City with Teesside", and the rest of the information from the Sunderland Water Company which particularly deals with the geology of the reservoir.

The Derwent Valley and the surrounding area consists of lower carboniferous series which are mainly sandstones and shale and the whole of the area is superficially covered with boulder clay, as well. In the area of the Derwent-reservoir, solid rock lies at approximately 180 feetbelow ground surface at the deepest point and is composed of alternating bands of sandstone and shale. Various morainic lacustrine and alluvial deposits lie above the rock, including a 40 feet thick layer of laminated clay, the top of which is approximately 40 feet below ground surface. The river Derwent, like all upland streams contain many stones. Most are sandstone "The county rock of the District", these stones have round edges as they are rolled by the river.

(d) SOIL.

Part of the information was extracted from the "Durham County and City with Teesside", and the rest was from the booklets from the Sunderland Water Company as it particularly deals with the reservoir area.

The parent material for the soil consists of series of complex drift materials, which are due to the complex ice movements over County Durham. The major part of the area is covered by a heavy grey till derived from the underlying carboniferous rocks, though it also consists of erratics from the Lake District and Cheviot Hills. Fluvioglacial deposits are left in the lower Derwent Valley as the retreat slopes of ice-sheets have left their legacy in course of time. The imperfectly drained brown earth of low base status is the most common soil found on the slopes of the deep valleys. The type of soil that has been there is closely affected by the character of the vegetation. The dominant woodland vegetation of lowland county Durham consists of mixed stands of deciduous trees and under such conditions Brown-Earth of low base status have formed where there is a tradition of coniferous woodland, as for instance, in parts of the lower Derwent Valley, podsolization is pedogenic process and humus-iron podsols have developed.

11. FIELDWORK

A. After the preliminary servey of the bog, it was decided to investigate the stratigraphy along three transects one along the length of the bog, two at right angles to it. (See graph 1 and 2).

The canes were positioned along the transects every five meters apart and when the slope of the ground became steep, canes were pushed into the ground every 2.5 meters.

The idea of the transects was not only to examine the stratigraphy of the bog, but also to find the deepest part of the peat, in the bog.

(b). LEVELLING.

Levelling of the bog was done to find the topography of the bog surface and the results are shown on the graph. (S ee graph 1 and 2).

(c) SAMPLING

A Russian borer was used for investigating the stratigraphy of the bog. The types of peat obtained during the several borings along the long and the cross-transects are shown in the graph 1 and 2. The humification was examined by using Van Post's method.

The deepest part of the peat was at the 40 meters stake on the long transect and at this spot a deep pit of 3 meters deep and 5½ feet long and 2½ feet wide was dug using a spade. The bottom of the pit reached the underlying sandstone. Highly humified peat which became increasingly clayey as one reached deeper parts of the pit.

Peat samples were collected for radiocarbon dating and for pollen analysis, by cutting a monolith of peat approximately 23 x 23 C.M. in cross section, from the side of the pit.

111. LABORATORY WORK.

(a). The peat monolith was cut into 2 c.m. slices and after collecting small samples for pollen analysis from the corner of each slice, were transferred into each labelled polythene bags and were kept in a deep freeze for radiocarbon dating. Although the peat samples from the pit collected were 300 c.m. depth, while slicing them from the monolith, small pieces broke away as a result, peat samples which were sliced came up to 274 c.m. only.

POLLEN EXTRACTION

(b). Was done subjecting the peat to chemical analysis. Peat samples from four levels were taken at a time. Peat was first broken down by treating with sodium hydroxide solution (NAOH)and boiling it nearly half an hour. This was filtered, plant debris and other materials like spore, seeds and plant tissues were kept apart in labelled petridishes for macro-fossils. The remaining was centrifuged and supernataint was discarded. This was repeated again with distilled water. Later acetolysis was done to remove cellulose and other materials and except for upper levels, the peat required hydrogen flouride treatment to remove silica. After acetolysis pollen fixed with safran-in glycerine jelly, and 4-5 slides from each level were prepared for pollen counting.

In most of the levels(except a few lower levels), the slides had plenty of pollen grains, many had plenty of plant debris, which concealed many pollen grains. Many pollen graina were destroyed or folded and this made counting rather tiring.

(c). <u>COUNTING</u>.

A binocular microscope with x 7 eye-piece, x 40 (0.65m.m) objective and vernier stage were used for counting when necessary, closer examination of pollen grains was carried out with a x (1.30m.m) oil immersion objective. Sliding scales on horizontal and vertical ones were used to note the millimeters covered while traverse on the slide. Difficult pollen grains were noted.

on the traverse, carefully marking the readings on scales and recording them in a sheet of paper for later identification. Reference slides were used in identification of difficult grains and on several occasions help of expert palynologists was consulted. Many a time difficult and folded grains were warmed a bit onto a slide by a red hot mounting needle. This made the grains unfold and then identification became easier. Usually more than 150 trees were counted and percentages of individual species of trees were worked out with total trees and the percentages of herbaceous and shrubby pollen grains and spores also worked out with reference to total tree pollen grains. When there were less than 150 tree-pollen grains, 500 or more pollen grains and spores of all plants were counted and their percentages calculated on the basis of tree pollen grains. Slides where there were very few trees, gave very high percentages for different individual species of trees so also herb, shrub and spore percentages showed high percentages as well as tree. Shrubs ratios were worked out to get a clear picture of ratios of trees, shrubs and herbs. (See pollen diagram 5).

1v. RESULTS.

Results of pollen analysis of different species of plants with their percentages are shown graphically. (See pollen diagrams 1-4).

DISCUSSION

1V.

(a) Here, an attempt is made to correllate the Pow - Hill valley bog pollen spectra with Godwin's vegetation and climatic zone.

ZONE 111.

Covers in the pollen diagram of Pow - Hill (See pollen diagram 4) from 272 to 230 c.m. depth. Pollen analysis of peat samples indicates a high proportion of herb-pollen. So in this period, open tundra-vegetation must have existed. Herb pollen consisted of high proportions of sedge, grasses, salix, plantago, artemisia,potentilla and rumex.

Very high values of Myriophyllum pollen suggests the presence of aquatic plants flourishing well. Therefore, little pools on the depression of the valley of Pow - Hill, must have been common before peat formation. This is similar to what has been described by Pennington (1969) for the rest of Britain.

The few birch and pine grains in this zone, do not necessarily mean forest. (See pollen diagram and tree/herb ratio).

This late-glacial assemblage cannot be subdivided into zones 1,11 and 111 and it seems likely only zone 111 is represented here, for several reasons. First there is the very low tree pollen frequency typical of either zone 1 and 111.

Secondly, it underlies deposits which are clearly zone 1V in age.

Thirdly, after Younger Dryas period, in zone 111, the transition zone 111 and 1V is considered as one in which Juniper reaches its peak and gradually declines and disappears almost as if it could not tolerate the rapid expansion and shading of the birch trees.

The presence of a few tree pollen grains indicates a few remnant trees which persisted after Allerød. Trees must have been flourishing well during allerød after the improvement of climate, from that of pre - allerød, cold period.

At Pow - Hill, this zone is between 256 to 230c.m. depth. As revealed by the pollen diagram and tree and herb ratio, there is gradual decrease in herbaceous pollen and gradual increase in tree - pollen. Juniper reaches very high proportions at about 256c.m. depth and gradually drops as birch pollen increases at about 230 to 224 c.m. depth (See pollen diagram and tree-herb ratio).

Radio carbon dates for the organic matter at the late-glacial and post-glacial transition, at other sites, fall within the century 8300 to 8200B.C. As yet, no critical dates for the Juniper maxium are available, but at Scaleby Moss, Cumberland it falls between 8203 and 7607 B.C. Pennington (1970).

ZONE 1V. PRE BOREAL

The high values of the ratio non-tree pollen to tree-pollen, which characterised the late glacial period, gives place at the opening of zone 1V, to a rapid decrease which indicates the supression of "Park-tundra vegetation", rich in herbs by closed though not dense, woodland. This zone occurs in Pow - Hill valley bog at 224c.m. depth, where birch pollen is considerable, 84%, and pine is 12%.

Salix is generally high in zone 1V, Godwin (1956), and at Pow - Hill it reaches 224 c.m. 36% (46 grains), at 208 c.m. 43% (68 grains) and at 192 c.m. 59% (39 grains). There is gradual increase from 224 to 208 c.m. and declines at 256 c.m., salix show inflated percentages because of the small number of tree pollen grains (See pollen diagram).

This gradual decline of salix about 192 c.m. might be due to gradual expansion of wood-land as the temperature improves, the drying up of marshy grounds as well. Most parts of Britain, this period lies between 8000 B.C. to 7000 B.C.

ZONE V.

The boundary between 1V and V is usually indicated by the rapid increase in Corylus pollen, Godwin (1956), which is maintained there-after everywhere in Western Europe. This zone does not have tree/herb high frequencies.

At Pow - Hill bog, the transition zone,1V and V corresponds to 208 to 192 c.m. depth. Corylus increases from 192 to 176 c.m. depth.

The absence of mixed oak forest in England is also characteristic of zone V.

At Pow - Hill, the same is true, one grain of oak and one grain of alnus present at this level is not significant.

The radio-carbon date in other parts of England corresponds to 8300 to 7600 B.C.

ZONE V1. BOREAL (Hazel-pine period.)

In this period birch pollen decreases relative to pine, and there are high percentages of hazel as well. On the Pow - Hill diagram, this is between 192 to 96 c.m. depth, where there is an actual increase in pine to 67% and Corylus percentages more or less continue to be high. Oak and elm pollen appear, the latter for the first time in the diagram.

ZONE V1,a, is characterised by two features, the elm pollen frequency is higher than that of the oak and there are high values for hazel pollen, Godwin (1956).

On Pow - Hill, elm also reaches quite high percentages, the value for hazel is 120%. Oak is less than elm. (See pollen digram one). This zone is from 192 c.m. to 176 c.m. depth.

ZONE V1 b, is characterised by an increase in the mixed oak forest trees, sometimes oak exceeds elm. (birch and pine percentages remain more or less the same).

In Pow-Hill, birch drops considerably but pine reaches high values and oak and alnus continue to maintain their percentages (See pollen diagram one). At Pow - Hill, this zone V1b occurs between 160 to 128 c.m. depth.

ZONE V1 c: This marks the boundary between V1c and V11 a. The character of this zone varies from place to place in Britain, Pennington (1970), but the great increases in alnus pollen and decline in birch, Corylus and pine pollen seem to be common in most parts of Britain.

At Pow - Hill, from 112 to 96 c.m. depth, can be correllated to zone V1 c. There is a drop in Corylus and Birch pollen and increase in alnus pollen. However, pine pollen does decline compared with the high values in the preceding zone, but this is not very much.

So zone V1, which covers from 192 to 96 c.m. depth can be sub-divided to a,b and c, however as explained earlier, slight variations do occur.

The radio-carbon date for other parts of Britain is 5100 B.C. for the end of the zone.

<u>ZONE V11a and V11 b, ATLANTIC and SUB-BOREAL period:</u>

This covers a long period of time and is sub-divided into sub-zones "a" and "b". This zone is characterised by high values of alder.

In Britain, the boundary between V11a and V11b is considered to be where the elm pollen percentages should be lower in V11 b than in V11 a. At this level, there is also an increase in alnus pollen and a considerable increase in hazel pollen as well. Broadly speaking, V11 a corresponds to Atlantic period and V11b to sub-boreal of Blytt and Sernander scheme.

At Pow - Hill valley bog, this zone (a and b) covers from 96 c.m. to 32 c.m. depth. The zone V11a is from 96 to 80 c.m. depth and the zone V11b, is from 64 to 32 c.m. depth (See pollen diagram 1), Elm declines from 64 to 32 c.m. depth (See pollen diagram 1). Alder pollen tends to increase from 96c.m. and maintains its high values up to 48 c.m. where it tends to decrease again. These alder values, when compared with those from many other sites in Britain, are not very high at Pow - Hill. This may be due to the lack of many marshy grounds here, as in other parts of Britain.

The transition between the Atlantic and the Sub-boreal periods in many parts of Britain has been carbondated and found to be about 3000 B.C.

ZONE V111, SUB-ATLANTIC PERIOD.

This zone is marked by a drop in tree pollen and the high values reached by the herbaceous pollen. This period in Britain is one of the most fascinating ones, not only in there is climate deterioration, but also man's influence together, playing a major role in affecting the vegetation.

West says (1969), "In Neolithic and Post-Neolithic times, zone V11 b onwards, there developed much diversity of vegetation. Deforestation was accompanied by a rapid spread of weeds and ruderals, a ~~dxxxx~~ decrease in the wood-land flora and development of scrub, and widespread cultivation, resulted in the introduction of alien crop plants and alien weeds. Temporary and extensive clearances have been distinguished by respectively low and high frequencies of grasses. Pastoral activities have been distinguished from arable, the former showing high frequencies of plantago and pteridium pollen, and the latter with marked frequencies of Artemisia, compositae, Rumex, Chenopodiaceae and Ranunculaceae pollen".

At Pow - Hill, there are indications of the influence of man on the vegetation as elsewhere in

Britain, in addition to climate deterioration.

There is a great drop in the tree/shrub/herb ratios, this is evident from 32 to 16 c.m. depth. (See pollen diagram 5). The individual herb frequencies reach very high values between 16 to 1c.m depth. Calluna, Gramineae, Cyperaceae reach very high values and herbaceous pollen like Potentilla, Plantigo, Leguminosse, A rtemisia and Pteridium spores make their appearence. (See pollen diagram two)

Apart from the vegetation, there are other indications of man's activity and also of the worsening of climate. For example, there are pieces of burnt-charcoal in the peat as a proof for the former and there is also a recurrence surface, that is, unhumified lower peat, above a highly humified lower peat, a clear indication of deteriorating climate. Due to lack of time not much attempt was made to study these aspects.

(b) One very interesting feature is that the pollen spectra of the Bow - Hill valley bog, show very high frequencies for pine pollen. This high value is maintained from the bottom to top layers in the stratigraphy of the bog. However, there are considerable declines in one or two layers and complete absence at 256c.m. depth (See pollen diagram one).

An attempt is made to discuss the probable causes for these particularly high pine values.

While one is counting the slides, the large size of pine grains relative to other grains of different species make it easy to identify and the possibility of over-looking some of the smaller grains on the slides, might give mis-leading high values to the pine. To eliminate this possibility, the entire slides from different levels were recounted very carefully and the same high values were found. I am confident the counts are correct.

According to POHL'S production figures a pollen spectrum registering 33%, each of pine, oak and Beech should represent a vegetation consisting of 5% pine, 35% oak and 60% beech, Faegri and Iversen (1966). This is because pine grains are preserved well and have greater carrying capacity when compared with other types of pollen grains.

If the same criteria are applied to the pollen diagrams from differnt parts of Britain and particlarly North-west of County Durham (Pow - Hill is at North - West of Durham), the pine values are still less than at Pow - Hill. So, at Pow - Hill pine values are still very high and must be accounted for. An attempt is made to discuss the situation of pine in several of the following places, in zone V1 and V11b.

ZONE:V1.

Pine achieved its greatest frequency throughout the British Isles, as a whole in zone V1, Godwin (1956).

At the upper- valley bog and the bog-hills, at the Moor-House National Nature Reserve it is however birch which shows dominance over pine. This is quite acceptable because they are situated at much higher altitudes, (1,800 feet) as a consequence there the climate is worse than at Pow - Hill.

According to Tansley, birch gives way to pine in direct competitions on soils favourable to both, but maintains itself better on less favourable climates and less favourable soils.

Many sites around Widdy Bank fell, like Tinklers Sike, Weelhead Moss and Deadcrook, at altitudes varying from 1400 to 1600 feet, with lime stones grasslands, in the area do show high frequencies of pine. The climate must be slightly better than at Moorhouse, but the soils are far better and the pine may well have flourished on the lime stone at this time.

Pine, therefore was common in this part of western pennines on a whole range of soils over a range of altitudes, including Pow - Hill, except at the very highest altitudes like the Moor-House.

<u>ZONE V11 b</u>. But when one comes to zone V11b, it is quite different. Pine remains common at Pow - Hill but has disappeared from other sites, like those in the pennines at sites like Widdy bank and Tinkler's Sike.

The only other diagrams which show it, are two from Weardale, Bollihope particularly and Steward Shield Meadows, (Robert Turner and Ward, in press). They are situated at 11,00 feet altitude.

Therefore, pine was present in the pennines at the middle range altitudes between 800 to 11,00 feet at V11 b.

The high values of pine can be attributed to easy dissemination, low competitive power against high deciduous forest and the tolerance of both dry and wet soils of low nutritional status, Godwin (1956).

At Pow - Hill, the soil is mostly sandy and has very low nutritional value. It must also be dry as well, as sandy soils are noted for high drainage.

This has enabled the pine to compete successfully with the mixed oak forest at these medium altitudes. So the pine forests continued to flourish well, right in a zone V11 b. Perhaps, the presence of Podsol in the lower Derwent valley today also indicates the presence of coniferous forest.

CONCLUSIONS.

1. The pollen spectra at Pow - Hill valley bog, starting from the late-glacial (zone 111) and going through to zone V111, run almost paralell to Godwin's scheme of pollen assemblage zone.

2. The high values of pine particularly at V11 b, the existence of flourishing pine forest in the Derwent valley, at that time.

3. This is thought to be due to lack of serious competition by the mixed oak forest, due to the interactions of poor soil and an upland climate.

4. There are clear indications of man's influence and climate deterioration in the upper parts of the diagram.

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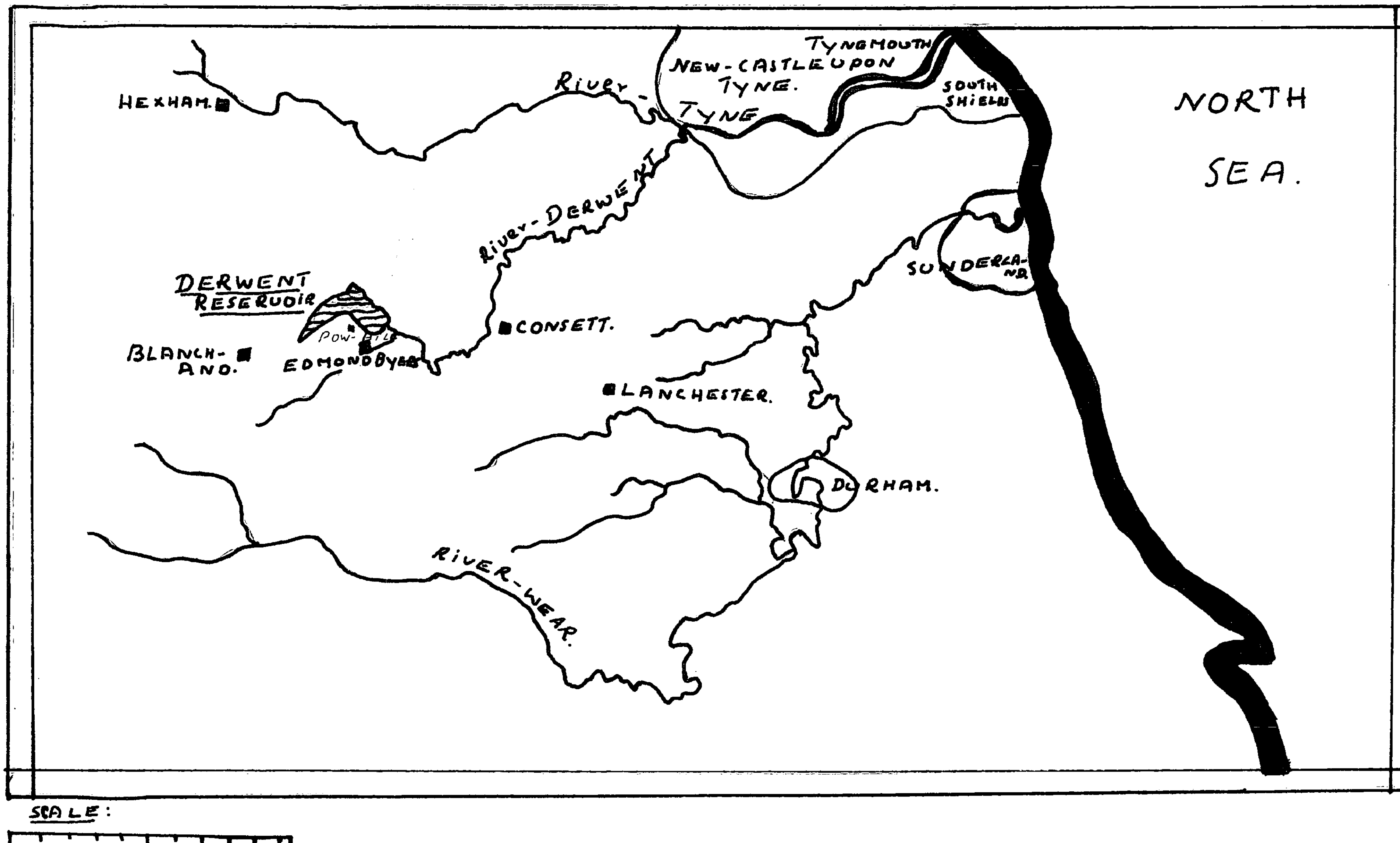
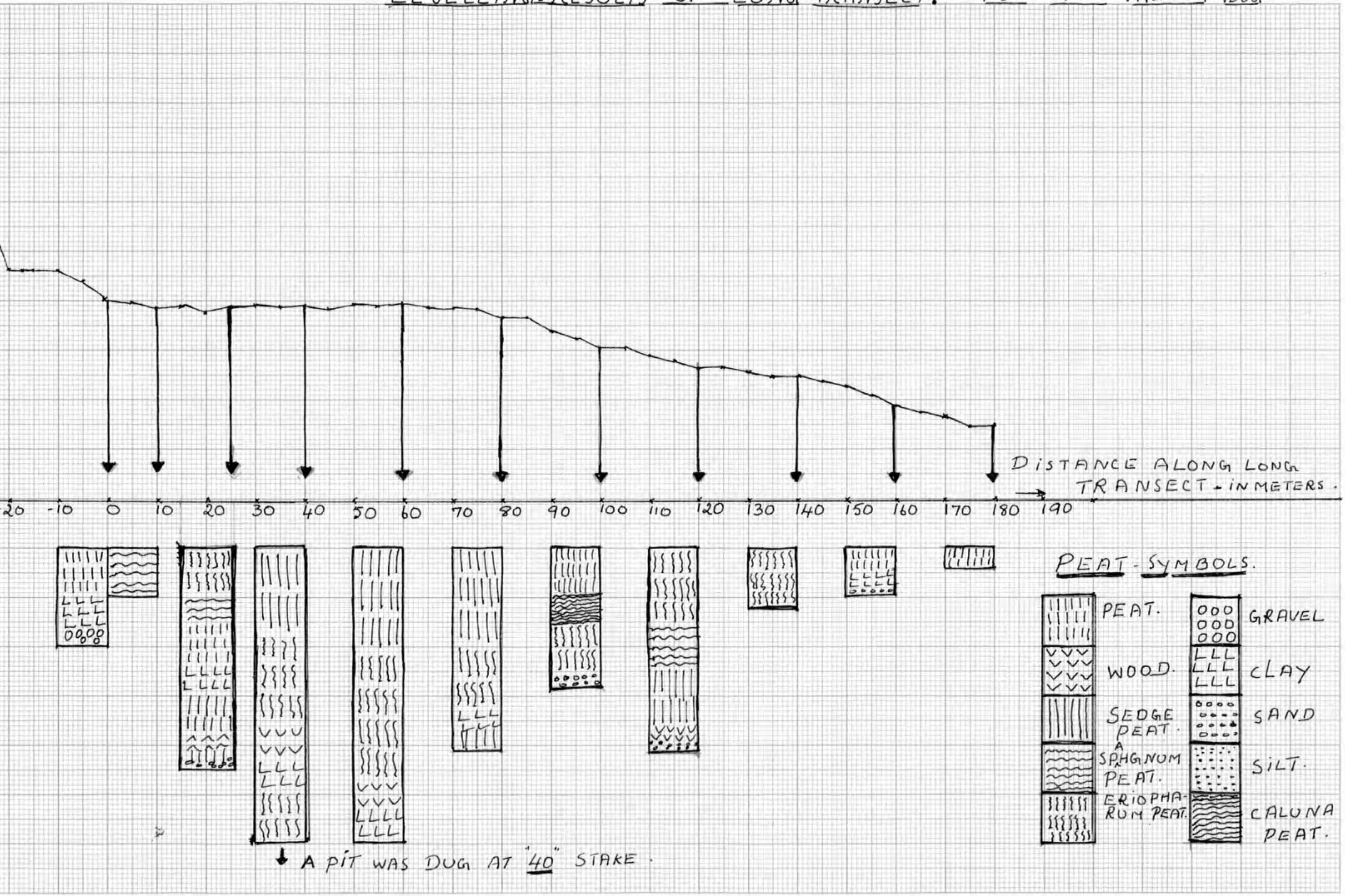
MAP OF **NORTH-ENGLAND.**

SHOWING POW-HILL.

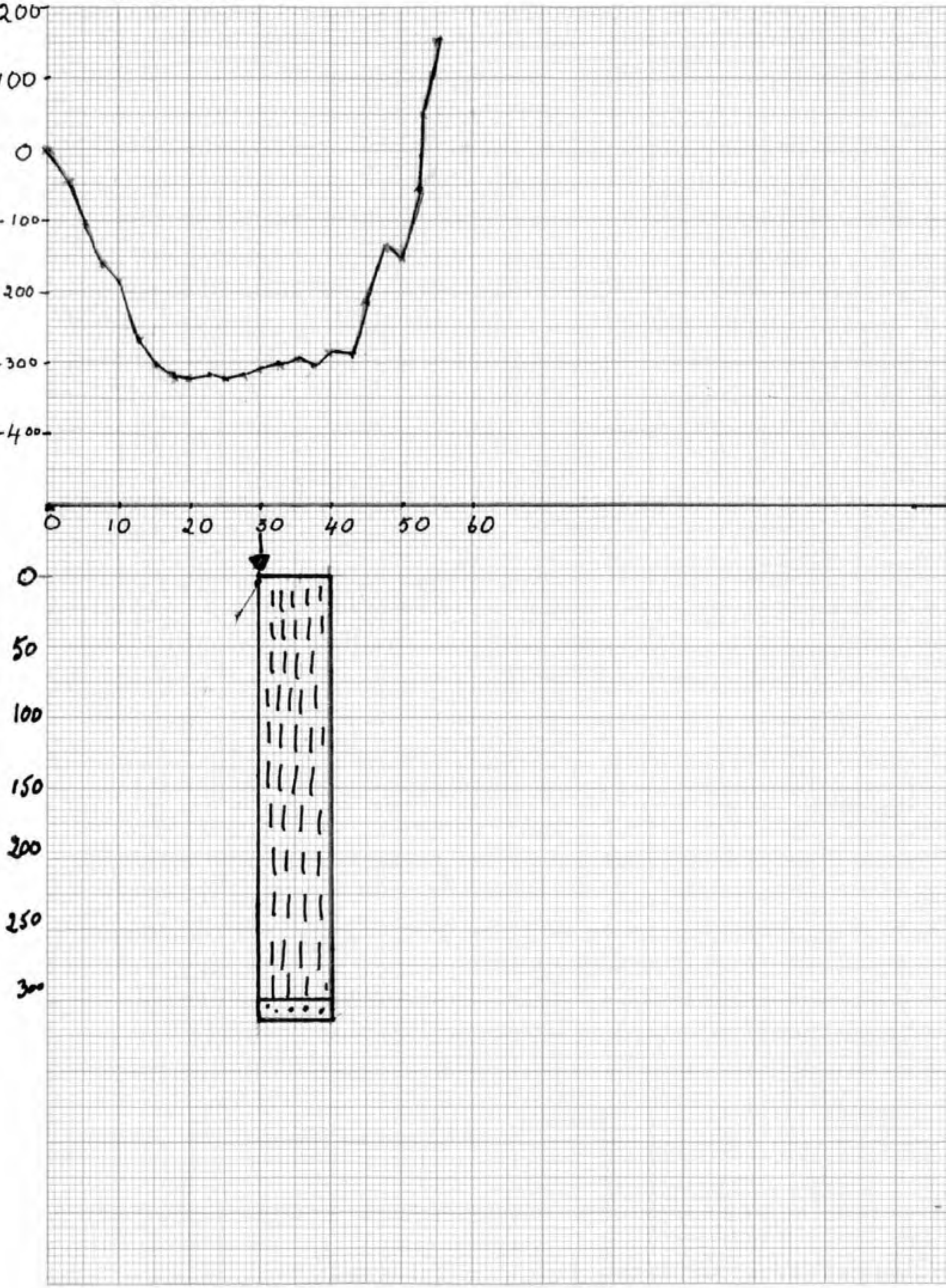


TIMETERS.

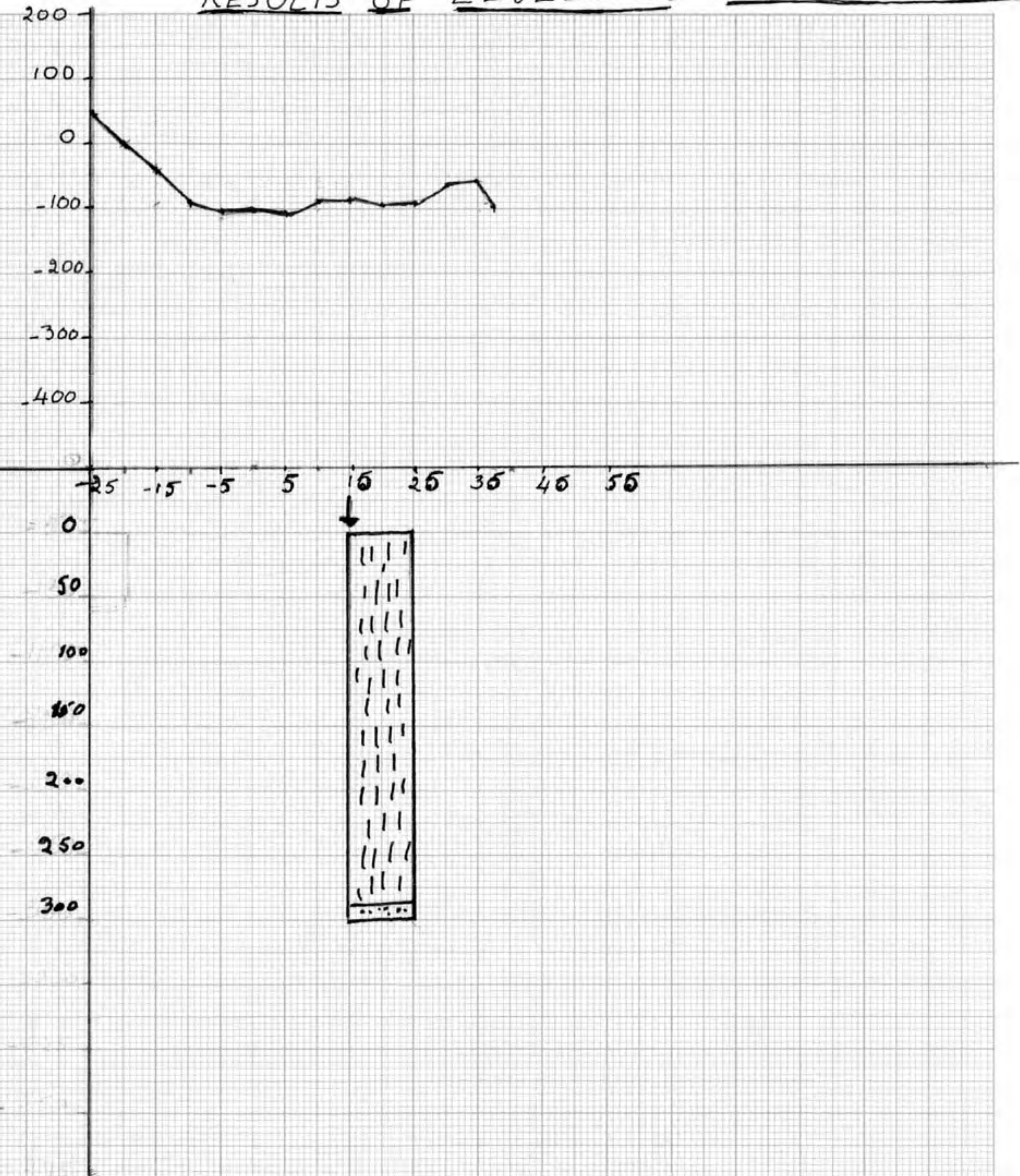
LEVELLING RESULTS OF LONG TRANSECT. POW-HILL VALLEY-BOG.

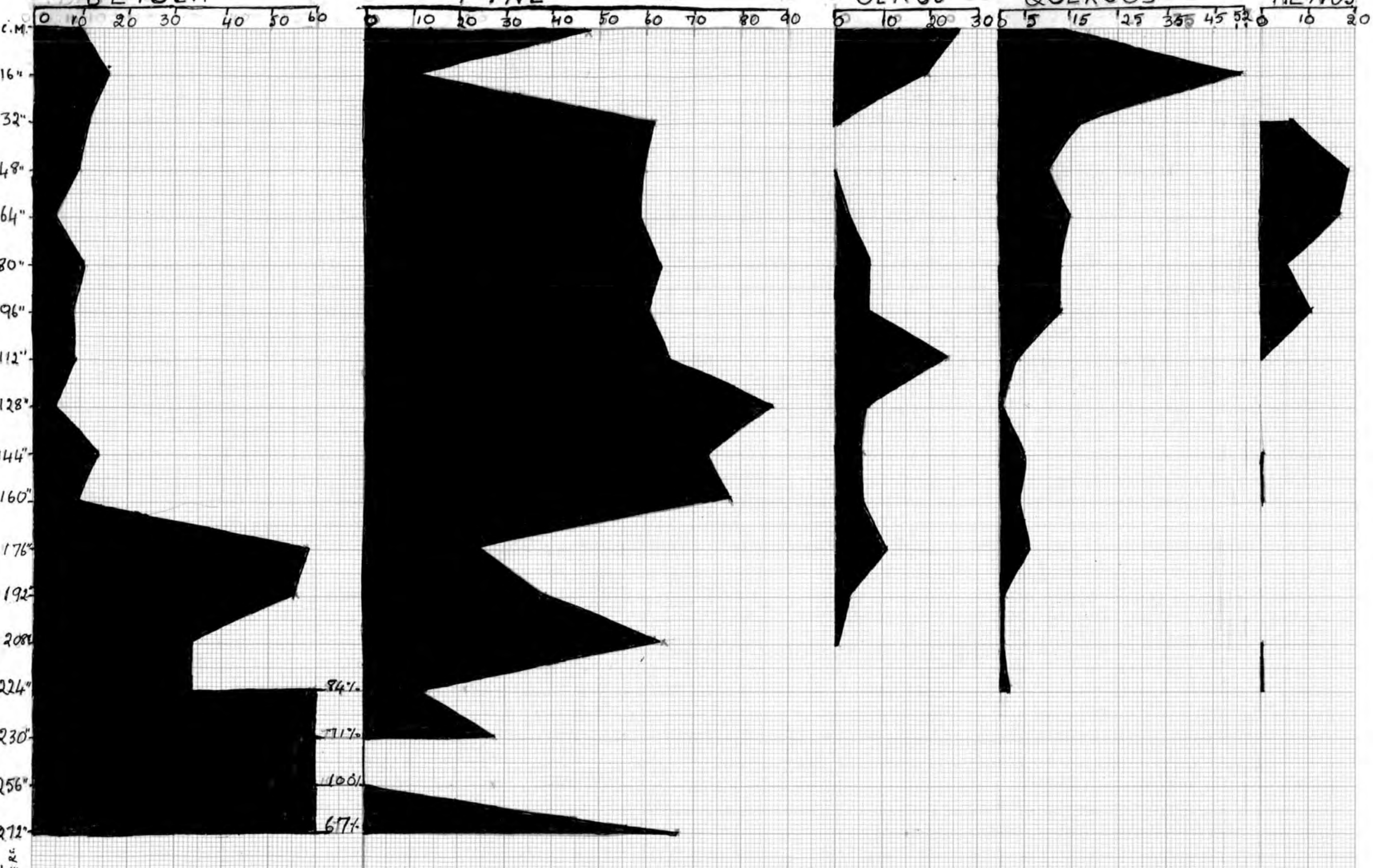


LEVELLING RESULTS OF CROSS-TRANSECT

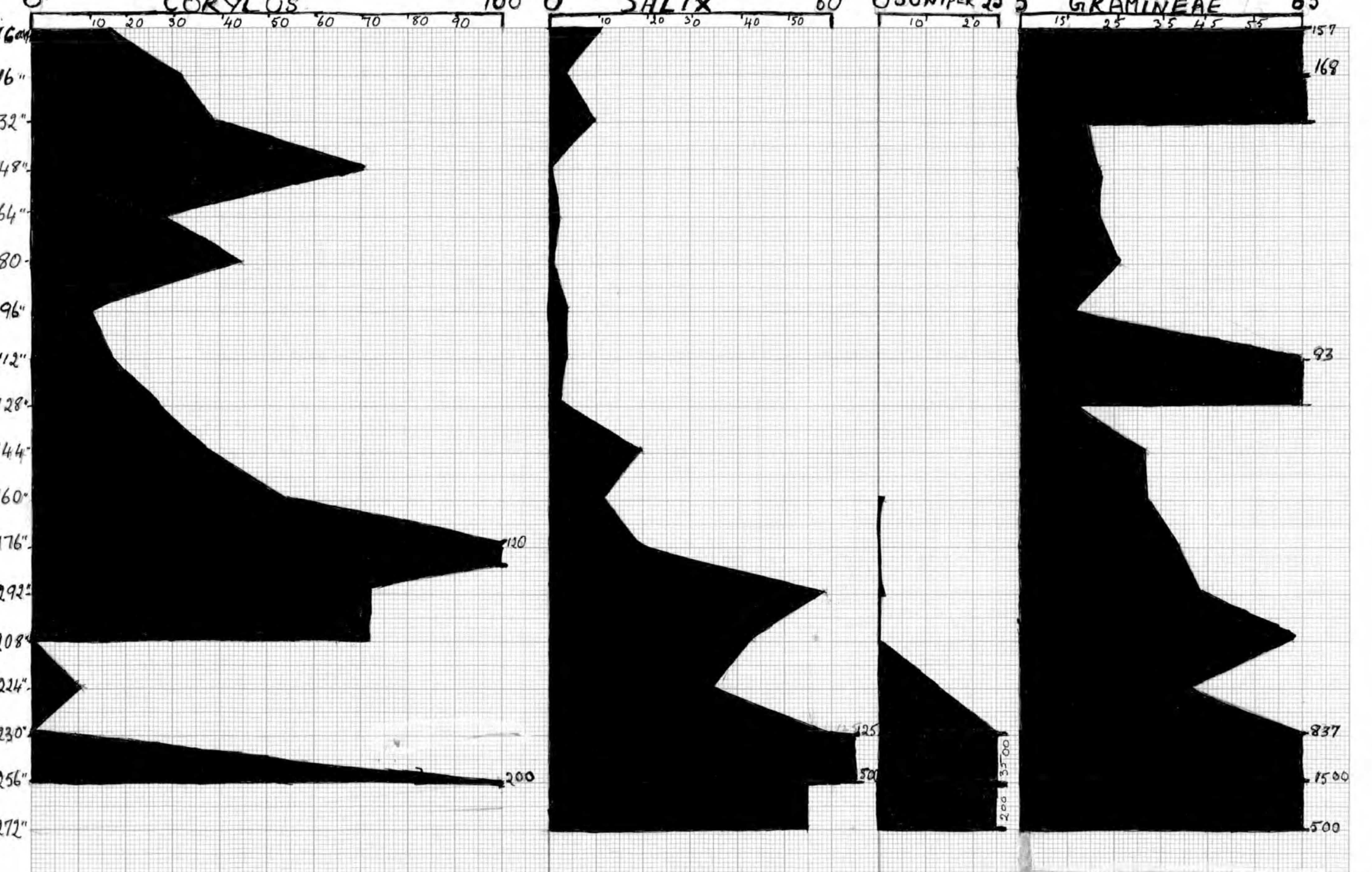


RESULTS OF LEVELLING CROSS-TRANSECT



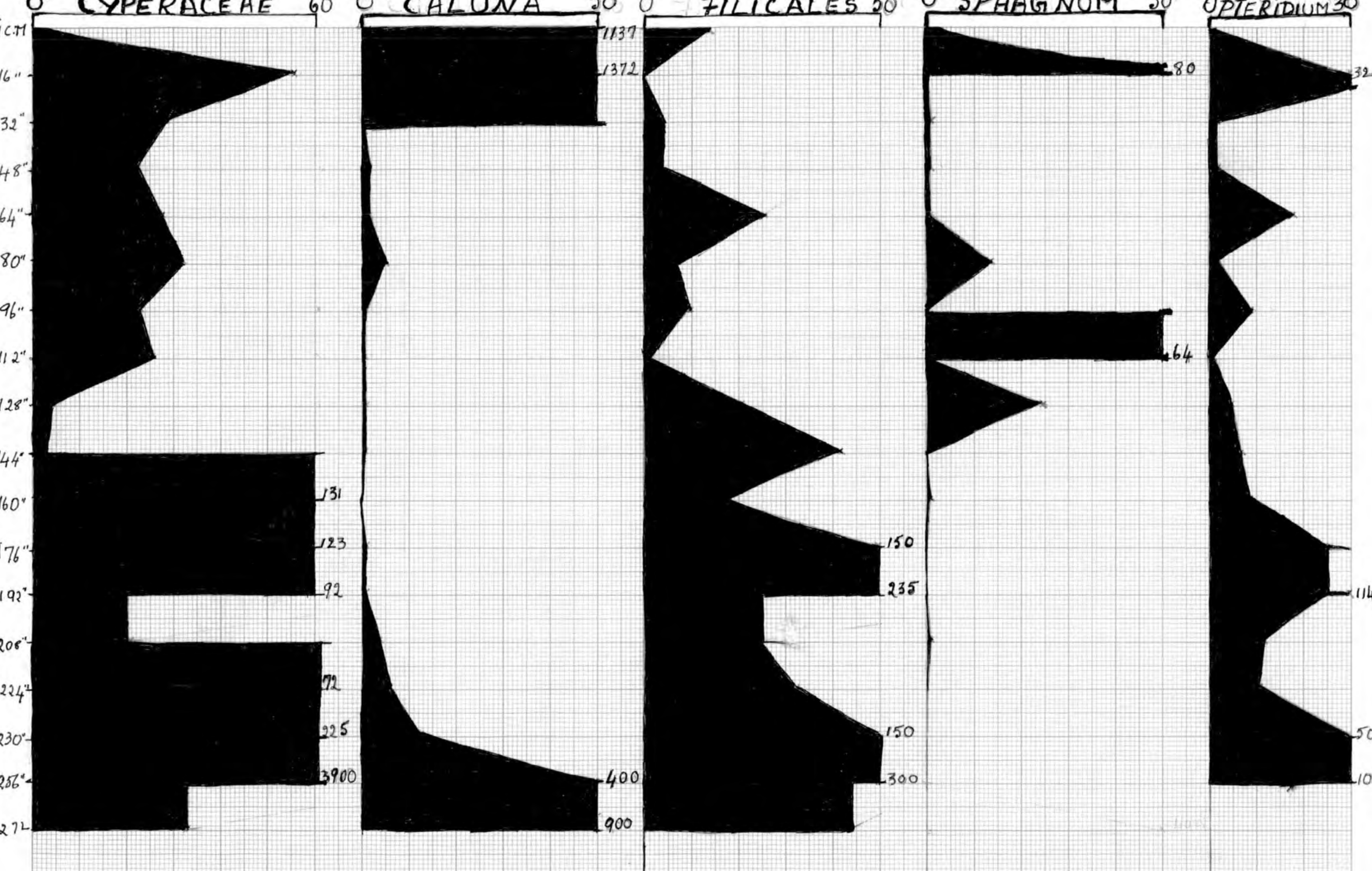


ARBOREAL POLLEN % TOTAL TREE POLLEN

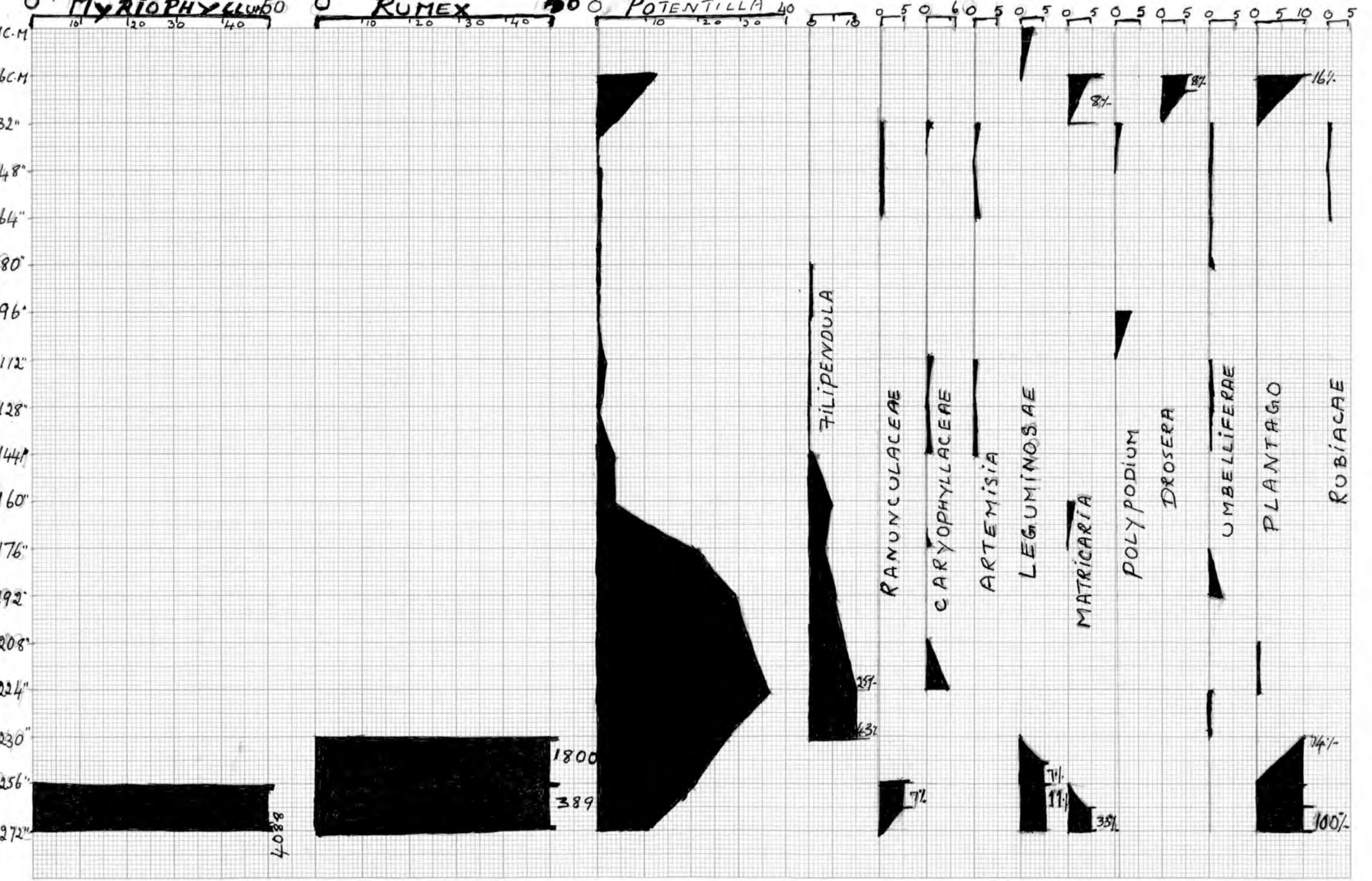


SHRUB POLLEN AS % TOTAL TREE POLLEN.

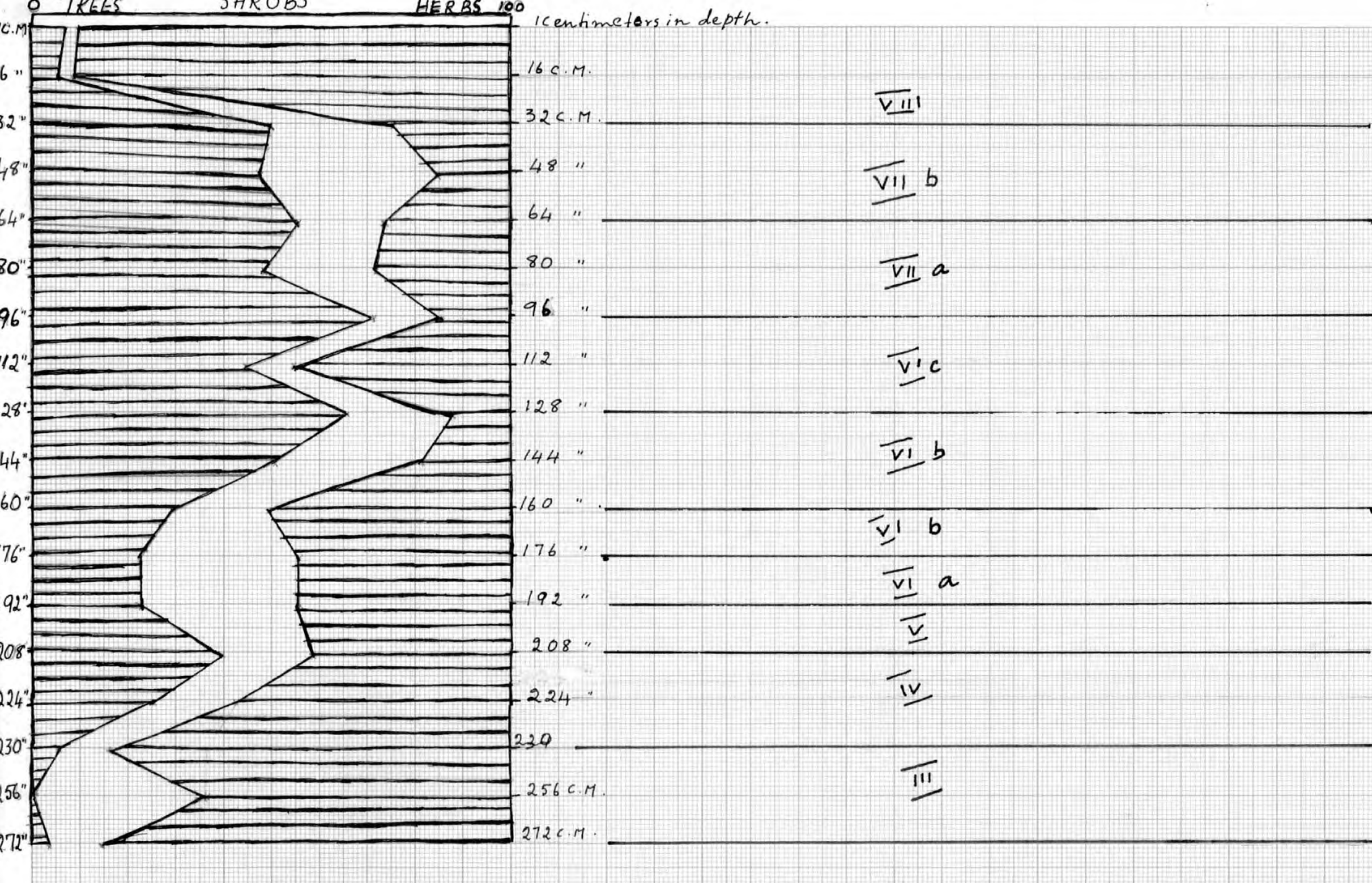
POLLEN AS % TOTAL



HERBACEOUS POLLEN AS % TOTAL TREE POLLEN.



MYRIOPHYLLUM
RUMEX
POTENTILLA
FILIPENDULA
RANUNCULACEAE
CARYOPHYLLACEAE
ARTEMISIA
LEGUMINOSAE
MATRICARIA
POLYPODIUM
DROSERA
UMBELLIFERAE
PLANTAGO
RUBIACAE
1C.M
16C.M
32"
48"
64"
80"
96"
112"
128"
144"
160"
176"
192"
208"
224"
230"
256"
272"
4088
1800
389
25%
43%
7%
11%
35%
8%
16%
74%
100%

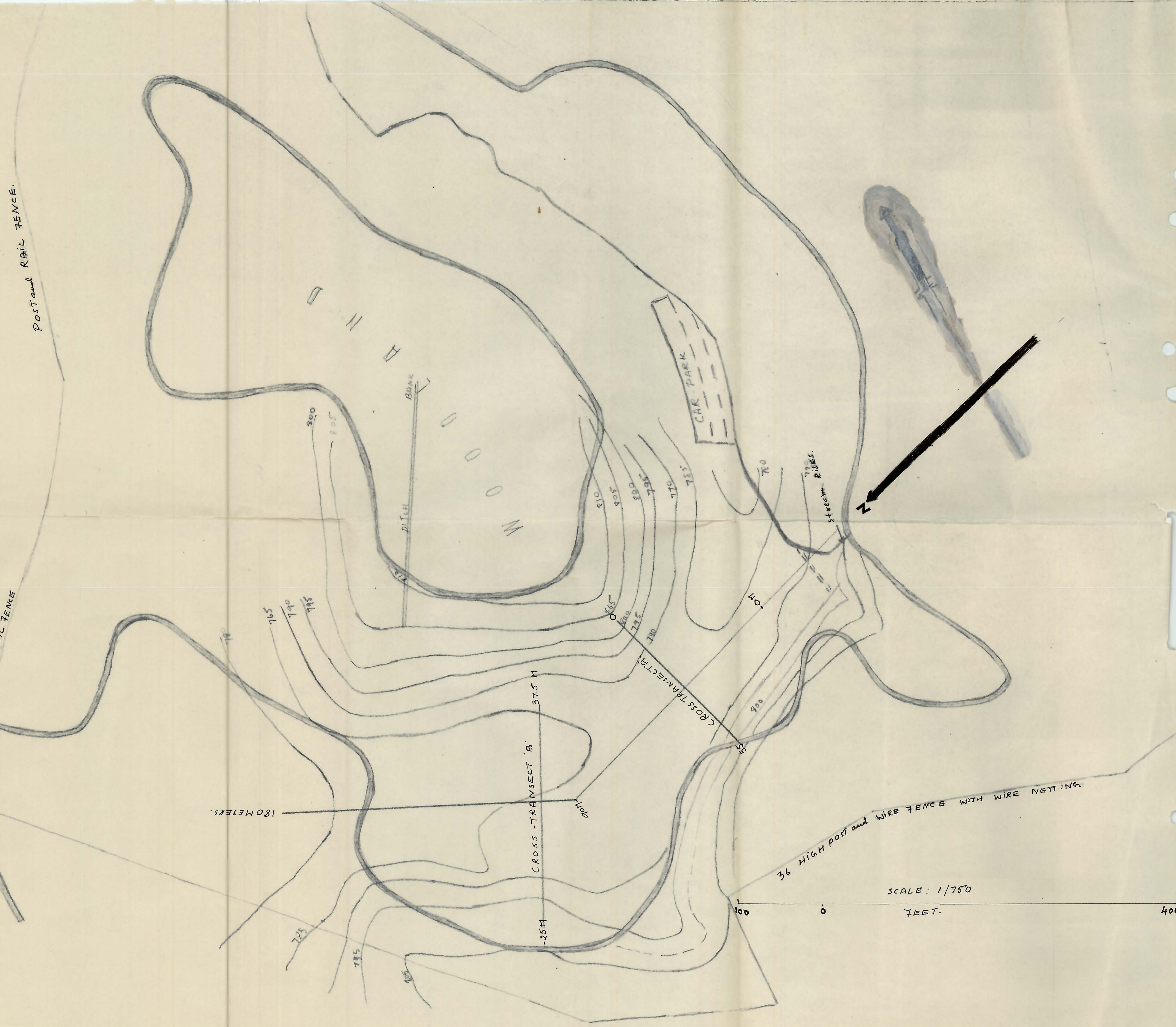


TREES/SHRUBS/HERBS.

Table showing pine pollen grains relative to other arboreal grains and their percentages.

Depth in c.m.	number of grains: betula.	pine.	elm.	oak.	alder.	percentages: betula.	pine.	elm.	oak	ald
1	4	17	9	5	0	11	48	26	14	0
16	4	3	5	13	0	16	12	20	52	0
32	19	95	2	27	11	12	62	1	17	7
48	16	92	17	0	29	10	60	0	11	19
64	8	94	5	24	27	5	59	3	15	17
80	19	110	13	22	10	11	63	7	13	6
96	13	92	10	19	11	9	61	7	13	11
112	9	101	37	7	1	6	65	24	4	1
128	8	140	11	2	0	5	87	7	1	0
144	22	112	10	8	1	14	73	6	5	1
160	16	119	10	6	1	14	78	6	4	1
176	48	21	9	5	0	58	25	11	6	0
192	37	26	2	1	0	56	39	3	1	0
208	54	100	1	1	0	34	64	1	1	0
224	108	16	0	3	2	84	12	0	2	1
230	5	2	0	0	0	71	28	0	0	0
256	1	0	0	0	0	100	0	0	0	0
272	6	3	0	0	0	67	33	0	0	0
Total	397	1243	151	143	93					

Number of grains.

 POST and RAIL FENCE
CAR PARK
BANK
DITCH
Stream Rises.
N
CROSS TRANSECT 'A'
CROSS-TRANSECT 'B'
37.5 M
-25M
180METERS.
40M
36 HIGH post and WIRE FENCE WITH WIRE NETTING
SCALE: 1/750
100
0
400
FEET.