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## POLLEN ANALYTICAL STUDIES ON DISC WHEELS

*with references to radiocarbon dates.*

(Pl. XXXV–XXXVII; fig. 30)

Six disc wheels have recently been found in peat deposits of the Northern Netherlands. These six wheels are all of the same type (cf. the preceding paper by J. D. van der Waals, pp. 103–146). The first find was at Nieuw-Dordrecht, Gem. Emmen, Drenthe, in 1955 (cf. van Zeist, 1956, 1959); the second at De Eese, Gem. Steenwijkerwold, Overijssel, in 1960. Two wheels were found together in Musselkanaal, Gem. Onstwedde, Groningen, in 1960. It was not until very recently that the find of two more disc wheels was reported; the wheels were found in Midlaren, Gem. Zuidlaren, Drenthe, in 1962. In this paper the results of the pollen analyses of peat monoliths sampled near the three first mentioned find-spots are discussed and a preliminary analysis of the peat adhering to the Midlaren wheels is given. Moreover, radiocarbon dates of the wheels are available; and there are also comparable radiocarbon dates of wheels from Gasselterboerveen found in 1838 and Exloërveen found in 1928/29 (cf. van der Waals, p. 134, 137). It should be noted that the dates given in this article are the corrected Groningen radiocarbon dates (GRN). A wheel of another type, the tripartite disc wheel from Weerdingerveen, Gem. Emmen, Drenthe, found in 1913, could be pollenanalytically dated by the fortunate circumstance that there was still peat adhering to it; this dating evidence is also discussed.

The disc wheel of *Nieuw-Dordrecht* was discovered not far from the starting-point of a Neolithic trackway (see van der Waals, fig. 27), before the scientific excavation of this trackway started. During the excavation of the latter a profile was sampled by Dr. W. van Zeist. The result of the palynological investigation of the trackway has been published previously (van Zeist, 1959, fig. 8, 9). It appeared that the trackway is situated somewhat below the level where the *Fagus* curve shows its first small rise to about 1%. As it has been established that in North-Western Europe the increase of *Fagus* to about 1% corresponds approximately with the transition from the Neolithic to the Bronze Age, the trackway can be dated to the Late Neolithic. Van Zeist pointed out that the diagram of Nieuw-Dordrecht clearly demonstrates the activity of herdsmen (Protruding Foot Beaker Culture, herein-

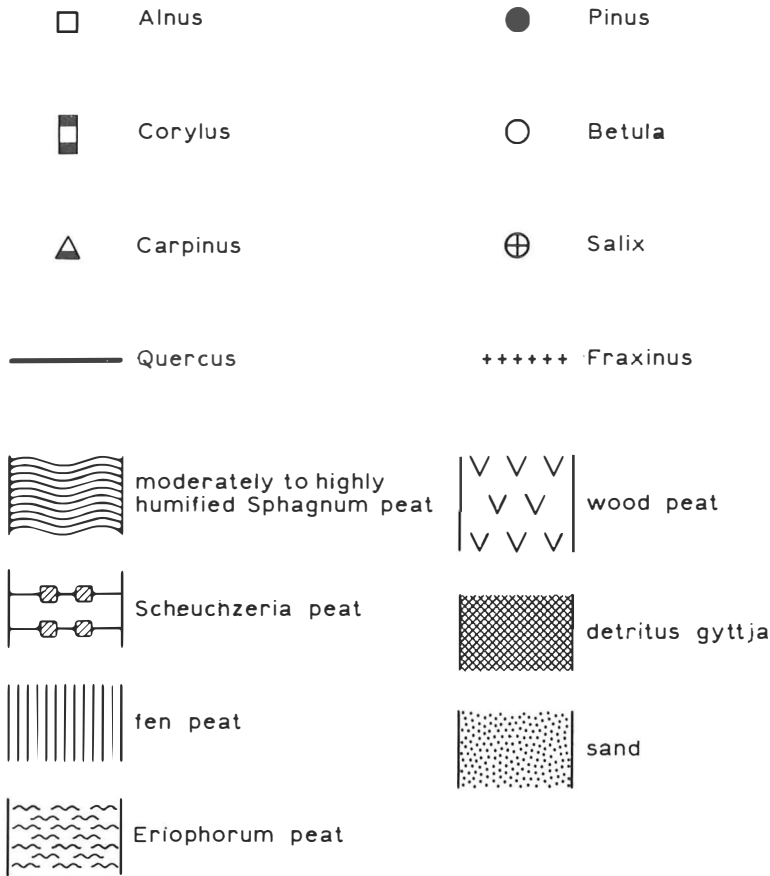


Fig.30. Key to the symbols employed in the pollen diagrams.

after referred to as PF Beaker Culture) at a level just below the trackway (relatively high percentages for *Plantago lanceolata*)<sup>1</sup>. A radiocarbon dating of a piece of wood from this trackway gave an age of  $4110 \pm 55$  B.P. (GRN 1078). In Pl. XXXV the lower part of the Nieuw-Dordrecht pollen diagram (*Corylus* included in the  $\Sigma$ AP) and the spectrum of a peat sample derived from the wheel are reproduced. The wheel was discovered about 40 m from the site where the peat monolith was sampled. As to the diagram and the spectrum from the wheel, it must be borne in mind that for a long time this part of the bog was formed by swamp forest. As a consequence of this, the lower part of the Nieuw-Dordrecht diagram published here and the spectrum from the wheel were influenced considerably by the bog vegetation, which would have differed from place to place. Moreover, the vegetation on the sandy soil just along the border of the bog would have increased the local and variable character both of the lower part of the diagram and the spectrum from

the wheel. Consequently it is not surprising that the spectrum of the wheel cannot be fitted exactly into the Nieuw-Dordrecht diagram. With regard to the tree pollen spectra the absence of *Fagus* is obvious. On account of the value of *Plantago lanceolata* in the spectrum from the wheel, the wheel can presumably be dated in the period of the herdsmen of the PF Beaker Culture, and the trackway and the wheel can be considered as belonging to the same period.

The disc wheel of *De Eese* was found toward the end of July 1960 on the De Eese estate near Steenwijk. Labourers discovered the wheel while digging out a small peat deposit, filling a narrow bowl-shaped depression. When this find was reported the greater part of the peat had already disappeared, and the wheel had been removed. It was therefore impossible to check the position of the wheel in the profile. In any case, the wheel was said to have been found on the sandy subsoil. A peat monolith of this lower part (the only part then left) was collected by A. Meijer and Dr. W. van Zeist. The topmost sample of this peat monolith was fixed at a depth of 0 cm, since the altitude above sea-level could not be measured. The lower part of the deposit (17 cm) consisted of a coarse detritus gyttja, while the remaining layers (74 cm) were composed of highly humified fen peat. The deposit appeared to have been formed during early post-glacial time. The diagram (Pl. XXXVI) has been represented according to the method introduced by Iversen (1942) for late-glacial diagrams. The bottom part of this diagram (90–45 cm) is very much like the upper part (410–315 cm) of the diagram of Waskemeer, at a distance of some 30 km, province of Friesland (cf. Casparie and van Zeist, 1960). The three lowermost spectra of the De Eese diagram can be considered as belonging to the Preboreal (zone IV after Jessen 1934, 1938, cited after van Zeist, 1955 and Iversen, 1941), as is clearly shown by the behaviour of the curves for *Corylus*, *Betula* and the NAP-curves, among others the *Artemisia*-curve. As is to be expected in gyttja deposits, the curves for the aquatic plants show rather high percentages. The Preboreal/Boreal border (IV/V after Jessen) is to be placed between sample 3 and 4 (first increase of *Corylus* and at the same time rise of *Pinus* and fall of *Betula*). There is a well developed Boreal, with most of its curves following a regular course. The Boreal/Atlantic border (VI/VII after Jessen) can be localised just at sample 18 (intersection rising *Alnus* curve with the falling *Pinus* curve). It is true that because of the rather high *Betula* percentages the values for *Tilia* in sample 18 and 19 are lower than is usually found in the early Atlantic period; moreover *Fraxinus* is only once noticed. On the other hand, however, *Quercus* reaches percentages in sample 19 that just surpass those of *Pinus*. The border between zone V and VI after Jessen is very difficult to indicate, as the curve for *Corylus* is very regular without distinct rises and maxima. This border might be placed near sample 13 at the beginning of a continuous curve for *Alnus* and a nearly continuous one for *Tilia*. Wheels are not, however, likely to be of Boreal age. Radiocarbon dating of a piece of wood from the wheel

gave an age of  $4025 \pm 75$  B.P. (GRN 2368). It is, therefore, the author's opinion that the wheel may have been buried in the peat (as it was found on the sandy sub-soil). It is regrettable, however, that it has not been possible to see the exact situation on the spot, since the wheel was already dug out and cleaned when reported. Moreover, there was no peat still adhering to the wheel, so that the situation could not be verified by pollen investigation.

The two wheels of *Musselkanaal* were found together, one on top of the other, on 8 and 10 October 1961 in the hamlet Dertienhuizen near Musselkanaal. The wheels were discovered in a small peat deposit that had to be removed for building activities. The peat deposit had been formed in a channel about 50 m wide; this channel runs, in a northeasterly direction, in between two sandridges and 'empties itself' in the Mussel-A (see for description the article of van der Waals). Immediately after the reporting of this find the situation on the spot was seen by J. D. van der Waals. The lower wheel was still *in situ* and was taken out by van der Waals; moreover, the peat directly under this wheel was sampled. Only a few days afterwards a peat-monolith was collected at a distance of 1 m from the finding spot by W.A. Casparie and the present writer. The peat deposit was covered by a heavy layer of recently disturbed and upcast soil. The peat itself was composed of very humified fen peat interrupted by a small sand layer (7.22 to 7.24 + N.A.P.<sup>2</sup>) and a wood layer (7.40 to 7.50 + N.A.P.<sup>2</sup>). Since the peat was formed in a small channel, the influence of the vegetation of the border zone must have been great. Especially the values for *Betula*, *Alnus* and *Salix* show a large fluctuation, presumably as a result of local circumstances. Therefore *Betula*, *Alnus* and *Salix* are left out of the basis of calculation; the pollen frequencies represented in the diagram (Pl. XXXVII) are expressed as percentages of the sum of the remaining tree pollen (*Corylus* included in the  $\Sigma$ AP). The spectra A and B in the diagram represent the samples collected at the find-spot, 4 and 0.5 cm below the undermost wheel respectively. From this diagram it is seen immediately that this peat layer must have been formed during the Subboreal<sup>3</sup> period (low values for *Ulmus* and *Tilia* and the presence of *Plantago lanceolata*). The percentages for both *Fagus* and *Plantago* are still rather low, which is characteristic for the Neolithic in the northern part of the Netherlands (van Zeist, 1955). The curves for *Fagus* and *Plantago* do not rise until sample 12 and 13; in sample 13 *Fagus* reaches a value of about 1 per cent, calculated on a tree pollen sum with all trees included. Consequently the level of sample 13 should correspond approximately with the transition from the Neolithic to the Bronze Age (van Zeist, 1955).

In many diagrams of the north of the Netherlands two different 'landnam' types can be distinguished. The oldest 'landnam' type to be noticed is that of a farmer culture, presumably the Funnel Beaker Culture; and the younger type is that of herdsmen, presumably of the PF Beaker Culture. As has been pointed out by van

Zeist, the influence of the herdsmen on the vegetation is generally characterized by rather high values for *Plantago lanceolata*, *Rumex* and *Gramineae* (Iversen, 1941; Waterbolk, 1954, 1956; van Zeist, 1959; among others; cf. the diagram of Nieuw-Dordrecht republished here). Concerning the influence of man perceptible in the diagram of Musselkanaal, the following can be said.

Sample 6 and the following samples show a somewhat higher value for *Plantago* than the lower samples; besides, the curve for *Rumex* reaches higher percentages. As to the *Gramineae*, nothing can be said, since the peat was built up for the greater part by grasses. The rise in the curves for *Chenopodiaceae* and *Pteridium* likewise demonstrates human activity. Although the percentages for plantain are not as high as those observed in the diagram of Bargerooosterveld I and Nieuw-Dordrecht (van Zeist, 1959), these values are, however, too high to be ascribed to a farmer culture. Certainly these values are the result of the activity of herdsmen of the PF Beaker Culture. The rather low plantain values in the bottom samples of the diagram may perhaps be considered as the expression of the farmers of the Funnel Beaker Culture; on the other hand there is also the possibility of the activity of these herdsmen at a greater distance. So far, not much trace of Neolithic man has been found in the immediate vicinity of the findspot. In South-Eastern Drenthe, however, at a distance of about 15 km from Musselkanaal, a considerable Neolithic activity is noticed. Not only the Funnel Beaker Culture is present there, but also the remains of the two Late Neolithic Beaker Cultures, the PF Beaker and the Bell Beaker Cultures (van Zeist, 1959; van der Waals and Glasbergen, 1955).

Returning to the find itself, it is hardly any problem to fit the two spectra A and B into the diagram. As mentioned before, the spectra A and B were obtained from samples collected just below the wheel. These two spectra are distinguished by the high value for *Quercus* in sample A and the decline of these percentages for *Quercus* towards sample B; this fall in the *Quercus* curve coincides with a rise in all other curves. Sample 5 of the diagram shows a locally very high value for *Quercus* and at the same time all other curves are very low. Hence it is obvious that the spectra just below the wheel correspond with the samples 5, 6 and 7 of the profile. In consequence the level of the wheel is exactly the level of the rather high plantain values, and the wheel coincides with the very traces of the activity of the people of the PF Beaker Culture. Radiocarbon dating of a piece of wood from each wheel gave dates of  $4070 \pm 70$  B.P. (GRN 2879) and  $4015 \pm 65$  B.P. (GRN 2878). In this connection it should be noticed that presumably both the wheel of Nieuw-Dordrecht and the wheel of Musselkanaal correspond in age and that the pollen diagram points in both cases to the PF Beaker Culture.

The disc wheels of *Midlaren* were found in 1962 in the peat of a small and deep depression; nothing is known as to their original stratigraphical position in the peat (cf. van der Waals, p. 140-1). From one of these wheels, peat adhering to the disc

and peat adhering to the hub was analysed (see table I). The two spectra derived from the adhering peat correspond rather well, apart from some recent pollution in the spectrum of the disc (*Secale* 14.2%, *Rumex* 7.7%, *Centaurea cyanus* 0.2%, *Solanum nigrum* 0.2%, *Spergula* 0.2%). In this connection it is important to know that the wheel was placed in a barn for half a year. Thus the mentioned aberrant values in the spectrum of the disc are presumably originated from recent pollen. As the excavation near the find-spot has not yet started, no peat monoliths were available for study.

The fact that the percentages for *Ulmus*, *Tilia* and *Fagus* are rather low (the values for *Fagus* do not reach 1 per cent) indicates that the Midlaren disc wheel can be dated to the Neolithic period. Moreover, the rather high values for *Plantago lanceolata* point to the influence of herdsmen (PF Beaker Culture), as was the case with the wheels of Nieuw-Dordrecht and Musselkanaal. Radiocarbon dating of wood from one of the Midlaren wheels gave a date of  $4000 \pm 70$  B.P. (GRN 4154). The correspondence of the Midlaren wheel with the wheels just mentioned seems indisputable.

TABLE I

Pollen spectra of the following disc wheels; I. Spectrum disc wheel Midlaren (hub); II. Spectrum disc wheel Midlaren (disc); III. Spectrum tripartite disc wheel Weerdinger veen.

	I %	II %	III %
<i>Alnus</i> . . . . .	27.4	29.1	46.5
<i>Betula</i> . . . . .	22.6	25.5	17.6
<i>Corylus</i> . . . . .	19.4	17.0	13.9
<i>Quercus</i> . . . . .	21.3	18.9	9.7
<i>Tilia</i> . . . . .	1.5	1.1	0.3
<i>Ulmus</i> . . . . .	2.1	3.2	0.4
<i>Fraxinus</i> . . . . .	2.0	0.6	2.3
<i>Pinus</i> . . . . .	3.0	3.7	5.4
<i>Fagus</i> . . . . .	0.3	0.2	2.8
<i>Carpinus</i> . . . . .	—	0.1	0.2
<i>Salix</i> . . . . .	0.3	0.3	0.7
<i>Picea</i> . . . . .	—	—	0.1
<i>Juniperus</i> . . . . .	—	—	0.1
<i>Acer</i> . . . . .	—	—	0.2
<i>Hedera</i> . . . . .	0.1	—	—
<i>Rhamnus</i> . . . . .	0.1	—	—
<i>Myrica</i> . . . . .	—	0.1	—
<i>Humulus</i> . . . . .	—	0.1	—
$\Sigma$ AP . . . . .	974	945	1137
<i>Calluna</i> . . . . .	12.0	15.6	16.2
<i>Ericaceae</i> (— <i>Calluna</i> ) . . . . .	0.9	1.2	0.2

	I %	II %	III %
Gramineae . . . . .	13.2	25.2	5.6
Cyperaceae . . . . .	1.6	3.8	7.6
Secale . . . . .	—	14.2	—
Cerealia . . . . .	—	—	0.1
Plantago lanceolata . . . . .	1.6	0.8	0.5
Chenopodiaceae . . . . .	0.2	0.6	0.5
Rumex . . . . .	0.7	7.7	1.1
Artemisia . . . . .	0.1	0.3	0.4
Compositae lig. . . . .	0.1	—	—
Compositae tub. . . . .	—	0.2	0.1
Caryophyllaceae . . . . .	—	0.1	—
Trifolium repens . . . . .	—	—	0.2
Genista type . . . . .	0.1	0.2	—
Lotus . . . . .	0.1	—	—
Lathyrus type . . . . .	0.2	0.2	—
Spergula . . . . .	—	0.2	—
Centaurea cyanus . . . . .	—	0.2	—
Solanum nigrum . . . . .	—	0.2	—
Thalictrum . . . . .	0.1	0.1	—
Jasione . . . . .	0.2	—	0.1
Ranunculus . . . . .	0.2	0.1	—
Potentilla type . . . . .	0.2	0.1	—
Succisa . . . . .	0.2	—	—
Mentha type . . . . .	—	—	0.1
Cruciferae . . . . .	—	0.1	0.1
Umbelliferae . . . . .	0.4	0.6	—
Hydrocotyle . . . . .	—	0.1	—
Galium type . . . . .	—	0.3	—
Sparganium type . . . . .	—	0.2	—
Myriophyllum cf. verticillatum . . . . .	—	0.2	—
Pteridium . . . . .	1.4	1.2	0.5
Dryopteris . . . . .	0.4	0.1	2.9
Equisetum . . . . .	—	0.1	0.3
Sphagnum . . . . .	10.0	23.3	33.9

To make the present article as complete as possible, the publications of Cassau (1938) and Schneider (1938) should be mentioned. Presumably this publication of Schneider is the only one up till now concerning pollen investigations on disc wheels of more or less comparable type. It discusses the diagram of a profile sampled near the findspot of the disc wheel of *Beckdorf* (Kr. Stade, Germany; regarding the type of this wheel, cf. van der Waals p. 124). The wheel was found in 1937 in the sandy bottom part of this peat deposit. Palynological research was, however, less perfect in 1938 than it is now. It is therefore difficult to indicate clearly the pollen zones in this diagram, and it is thus not desirable to give more details than are needed for comparison. Considering the low values for *Tilia* and *Ulmus* in this diagram

and the fact that the value for *Fagus* is c. 1 per cent in the bottom part of the diagram (closer investigation of a number of diagrams of north west Germany proved that in these regions also the course of the *Fagus* curve must be considered an important criterion), one may suppose that the disc wheel of Beckdorf is Late Neolithic or Early Bronze Age. Schneider in 1938 arrived at the same conclusion, though he based his opinion on other criteria.

A disc wheel of another type, a tripartite disc wheel, was found in 1913 in the *Weerdingerveen*. At a distance of about 100 m from this find spot two bodies were uncovered in the peat in 1904; through pollen investigation the bodies could be dated to shortly after 200 A.D. (van Zeist 1956). It is a fortunate circumstance that some peat fragments (*Sphagnum cuspidatum* peat) were still adhering to the wheel segments, making pollen investigation possible. On account of the percentages for *Fagus*, *Carpinus*, *Tilia* and *Plantago* and other herbs in the spectrum derived from the adhering peat (Table I), it is obvious that the wheel is to be dated in the beginning of the Subatlantic period (c. 800 B.C. to c. 200 A.D.). The fact that the percentages for *Carpinus* and *Fagus* are still rather low (*Carpinus* is only 0.2% and *Fagus* 2.8%) indicates that the wheel is certainly to be dated before c. 200 A.D. On that account, a connection between the wheel and the bodies is very unlikely.

In conclusion the following may be said. The radiocarbon dates of the wheel of De Eese ( $4025 \pm 75$  B.P. GRN 2368), of the trackway of Nieuw-Dordrecht ( $4110 \pm 55$  B.P. GRN 1087; a connection between the wheel and the trackway is very probable) and of the wheel of Midlaren ( $4000 \pm 70$  B.P. GRN 4154) fall almost within the interval of the two wheels of Musselkanaal, which certainly belong together ( $4015 \pm 65$  B.P. GRN 2878 and  $4070 \pm 70$  B.P. GRN 2879). Namely there is the common probability of circa 70% that the dates of Musselkanaal fall between 3950–4080 B.P. and 4000–4140 B.P. respectively, whereas the dates of De Eese, Nieuw-Dordrecht and Midlaren fall between 3950–4100 B.P., 4055–4165 B.P.<sup>4</sup> and 3930–4070 B.P.<sup>4</sup>. The difference in dating between the two wheels of Musselkanaal can be explained by the above mentioned probable variation in the radiocarbon dating. Besides, the youngest year rings of the wheel do not correspond exactly with the youngest year rings of the tree of which the wheel was made. The samples for radiocarbon dating were taken from the youngest year rings of each wheel. As the range of the probable variation of the radiocarbon dates obtained from the wheel of De Eese and the trackway of Nieuw-Dordrecht does not exceed the range of the probable variation of the two wheels of Musselkanaal (which belong together) it can be assumed that these four wheels are all of the same age (c. 2050 B.C.). Moreover, the dates of disc wheels of the same type found respectively in Gasselterboerveen and Exloërveen (cf. van der Waals) also fall within the same period (resp.  $3960 \pm 80$  B.P. GRN 3238 and  $3940 \pm 60$  B.P. GRN 4155). Pollen investigation proved likewise that the disc wheels of Nieuw-Dordrecht, Musselkanaal and Midlaren can



be dated to the Late Neolithic period. The disc wheel of De Eese, on the contrary, was found on the sandy subsoil of a small peat deposit which started forming in early postglacial times (Preboreal/Boreal). As in the Netherlands wheels are not of Boreal age, the wheel may have been buried in the peat, perhaps as a votive offering. As for the wheels of Nieuw-Dordrecht, Musselkanaal and Midlaren the pollen evidence points strongly to the activity of the herdsmen of the *PF Beaker Culture*. Considering the last mentioned evidence and the radiocarbon dates, one may attribute these one-piece disc wheels to a developed stage in the development of the *PF Beaker Culture*.

On palynological grounds a tripartite disc wheel from Weerdingerveen could be dated to the period round the beginning of our era.

### *Zusammenfassung*

In den letzten Jahren wurden in vier nordniederländischen Mooren sechs Scheibenräder gefunden die alle aus einem Holzstück gefertigt sind: Nieuw-Dordrecht (Drenthe), De Eese in der Nähe von Steenwijk (Overijssel) Musselkanaal (Groningen) (wo zwei Räder zusammen zutage gekommen sind) und Midlaren (Drenthe) (wo ebenfalls zwei Räder gefunden sind). In diesem Aufsatz sind die Ergebnisse der pollenanalytischen Forschung und die C<sup>14</sup>-Datierung behandelt worden (ein Moorprofil ist von Dr. van Zeist (1959) untersucht worden, die übrigen vom Autor). Danach müssen die nordniederländischen Scheibenräder dieses 'Types eine zeitlich geschlossene Gruppe bilden und wahrscheinlich der „Standvoetbeker Cultuur“ (Einzelgrab Kultur) zuzuweisen sein. Ausserdem konnte ein dreiteiliges Scheibenrad von Weerdinge (Drenthe) auf Grund einer Pollenanalyse der Zeit um Christi Geburt zugeschrieben werden.

### LITERATURE

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## NOTES

<sup>1</sup> Cf. infra the description of the palynological study of the wheels of Musselkanaal.

<sup>2</sup> Amsterdam Ordnance Datum.

<sup>3</sup> Zone VIII after Jessen.

<sup>4</sup> It should be noticed that there is always a probability of c. 5 % that the variation of the radiocarbon dates is twice the range of the given possible variation.