THE NEOLITHIC WOODEN TRACKWAY XXI (Bou) IN THE RAISED BOG AT NIEUW-DORDRECHT (THE NETHERLANDS)

W.A. Casparie

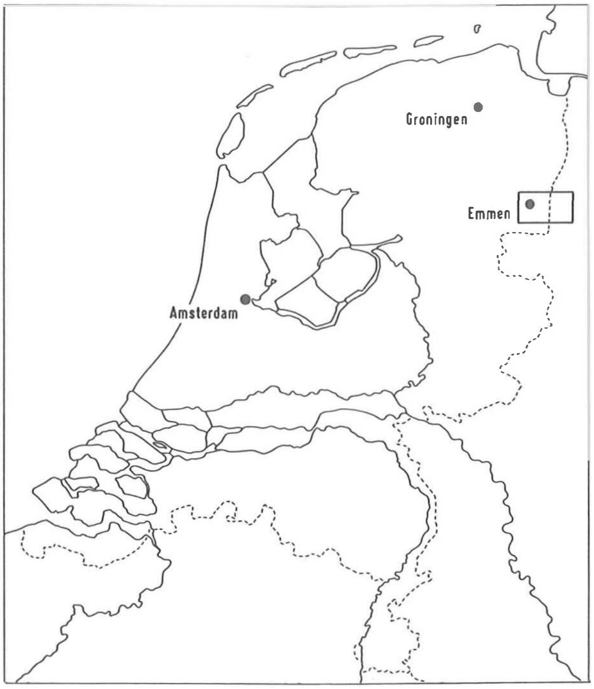
CONTENTS

1. INTRODUCTION

1.1. The Nieuw-Dordrecht area

The small village of Nieuw-Dordrecht (*gemeente* of Emmen, province of Drenthe) lies at the extremity of the southeastern outlying end of the Hondsrug. Formerly it was surrounded on three sides by a raised bog, the Bourtanger Moor, that has now been dug away for the most part (fig. 1). The Hondsrug is the eastern, highest part of the Drents Plateau, that became built up out of– mainly–fluvial sands at the beginning of the Riss Glacial. During the period when sheet-ice was present here in the Riss Pleniglacial a complex of boulder-clay was deposited on top of these sands. This entire sequence subsequently became cut through in many places by the cutting-back action of rivers and stream valleys during the Riss Glacial and the Würm Glacial. A severely dissected landscape has resulted from this. In many of these valleys the formation of fen peat had begun already towards the end of the Würm period and continued more extensively thereafter. In many places the boulder-clay is overlain by cover-sand.

The 'ridge of Nieuw-Dordrecht', the above mentioned southeastern outlying end of the Hondsrug, consists to a considerable extent of a plate of boulder-clay, and for the rest of other deposits including cover-sands. Just from the southern extremity of the boulder-clay plate there runs the Neolithic wooden trackway XXI (Bou)* (that is dated to



*Bou is the abbreviation used hereafter for Bourtanger Moor; numbering of the trackways according to the system developed by Hayen (1957).

Fig. 1. The original peat-bog situation in Southeast Drenthe, with the wooden trackway indicated (arrow). Key: 1. ombrogenous bog; 2, fen peat; 3. higher sandy soils (sand and boulder-clay).

Fig. 2. Nieuw-Dordrecht 1981 (trench 2), general view towards the west; the house on the right stands on the boulder-clay ridge. Photo C.F.D.

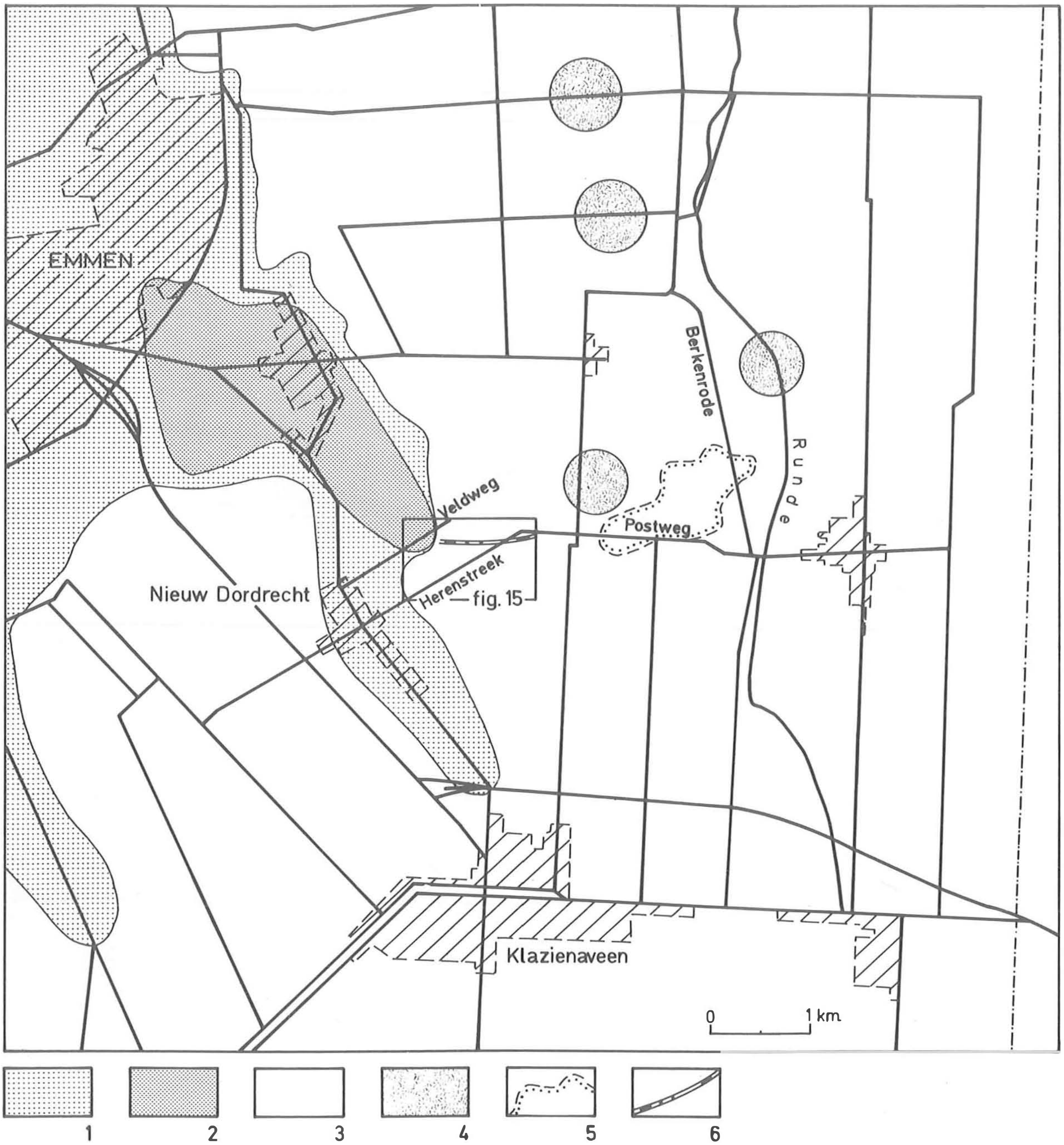


Fig. 3. Nieuw-Dordrecht and surroundings; the roads and streets mentioned in this article are shown here. Key: 1. sand; 2. boulder-clay (1+2. Hondsrug); 3. raised bog; 4. iron ore regions; 5. sand ridge overgrown by peat, consisting of a cover-sand ridge (Postwegrug) and a fluviatile ridge (Berkenroderug); 6. the Neolithic wooden trackway; the excavated parts are indicated by solid black. The rectangle of map fig. 15 is also given.

between 4100 and 4020 C14-years) eastwards into the raised bog, the Bourtanger Moor (fig. 2).

As extensive archaeological research has shown over many decades, Southeast Drenthe was formerly intensively occupied. From the Middle Neolithic on (*Trechterbekerkultuur*= TRB, *i.e.* Funnel-Beaker culture) there appears to have been continuous inhabitation, though also Mesolithic finds in this region are abundant. Many sand-ridges in the valley to the east of the Hondsrug, the Hunze valley, in which the Bourtanger Moor developed, have yielded Mesolithic artefacts (flint) and small hearths. Here and there Upper Palaeolithic material has been found, especially of the Tjonger tradition.

The Neolithic wooden trackway, that was found in the course of peat digging as long ago as the beginning of this century, has been the subject of research at different times. Thus since 1955 during four excavations a total length of 200 m of trackway has been exposed. (fig. 3). In addition, extensive investigations on this region involving pollen analysis and peat research have provided a clear insight into the development of the vegetation and the process of peat formation.

1.2. The aim of the study

This article can be seen as the final report of the great amount of research that has been carried out by various people (1.3.). Chapter 2 deals first of all with the vegetation development on the higher soils in the surroundings of the wooden trackway in the Neolithic, on the basis of pollen-analytical research; also a survey is given of the peat stratigraphy in the region concerned. In this chapter the indications of prehistoric exploitation of this peat-bog region will be discussed and the possible aims of the trackway will be described in some detail. This information forms–broadly speaking–the framework within which the wooden trackway must be placed.

In chapter 3 the actual research on the trackway is described: a number of excavations and reconnaissances, as a result of which the aim of the fieldwork developed in the course of time. Initially attention was focussed on such matters as whether or not it is a road or trackway, its course, its method of construction, its length and its age, while later it was possible to concentrate more on the species composition of the trees used, developments in the method of construction, and the fossil raised bog surface. Finally the investigation was directed more towards the use of wood and the choice of wood, matters concerned with forestry and the history of the forest in relation to human interference. This research is described in chapter 4.

In chapter 5 an attempt is made to integrate all the information dealt with in order to give as clear an insight as possible into the trackway itself and the Neolithic forest history, as well as to understand the activities of prehistoric man, in particular the people of the *Standvoetbekerkultuur* (*i.e.* the Protruding-Foot Beaker culture = PFB), the builders of the trackway.

Abbreviations used in the text:
BAI=Biologisch-Archaeologisch Instituut, Groningen
BB=Bell Beaker (culture)
CFD= Centrale Fotodienst, Groningen
EBA=Early Bronze Age
FM=Fries Museum, Leeuwarden
IPL=Instituut voor Prehistorie, Leiden
IPP=Albert Egges van Giffen Instituut voor Prae- en Protohistorie, Amsterdam
MBA=Middle Bronze Age
NAP= Non arboreal pollen
PFB=Protruding Foot Beaker (culture)
PMD=Provinciaal Museum van Drenthe, Assen
RMO=Rijksmuseum van Oudheden, Leiden
ROB=Rijksdienst voor het Oudheidkundig Bodemonderzoek, Amersfoort
TRB=*Trechterbeker*, *i.e.* Funnel Beaker (culture)

1.3. Acknowledgements

This publication is the result of the research and work of the following staff-members and former staff-members of the BAI. Dr. J.H. McAndrews, Drs. P.H. Deckers, G. Delger, Mrs. L. van Duinen, Drs. H. Fokkens, Drs. O.H. Harsema, K. Klaassens, B. Kuitert †, Mrs. I. van Otterloo, H. Praamstra †, Mrs. J. Ruiter, Mrs. Drs. M.R. van der Spoel-Walvius, Prof. Dr. J.D. van der Waals, Prof. Dr. H.T. Waterbolk, Prof. Dr. W. van Zeist. Both in the research and in the working-out of results cooperation was provided by Drs. J.N. Lanting, BAI (with regard to the bog finds), Mrs. A.F. Smith, Exloo (fieldwork and following-up of reports of finds made), J.J. Brands, Nieuw-Dordrecht (various information), Ing. L. van Dijk, Staatsbosbeheer Emmen (forestry data and fieldwork), Mrs. C.M. Casparie, Groningen (fieldwork), J.R. Beuker (PMD) (data concerning finds), Dr. J.A. Bakker, (IPP) (data concerning finds).

The excavations took place on terrain belonging to the Maatschappij Klazienaveen in Klazienaveen, managing director Ir. K. Meinders and supervisor of the firm G. Hekman, and the Dienst Beheer Landbouwgronden in Assen, directors Ir. H.J. Lamfers, Ir. A.L.M. de Schutter, M. Deddens, of Nieuw-Dordrecht, leaseholder of the field where the excavation took place in 1981, gave permission for the fieldwork and made the field accessible. Drs. R.H.J. Klok (ROB) gave important advice regarding the excavation permit. Four labourers from the *Werkvoorzieningsschap* De Brinken at Emmen, director Ir. S. Hop, took part in this fieldwork.

Dr. W.H. Zimmermann (Wilhelmshaven) made his bog find catalogue available for use. Many aspects of the peat-bog trackway research were discussed with H. Hayen, Staatliches Museum für Naturkunde und Vorgeschichte, Oldenburg.

The large amount of drawing was done by G. Delger. Mrs. G. Entjes-Nieborg, BAI, did the typing. Prof. Dr. J.D. van der Waals, critically read through the manuscript, Mrs. S.M. van Gelder-Ottway translated the text.

All these persons are sincerely thanked for their cooperation.

2. VEGETATION DEVELOPMENT, PEAT STRATIGRAPHY AND ARCHAEOLOGICAL DATA

2.1. Pollen analysis

2.1.1. *The forest history of Southeast Drenthe, c 3000–1700 B.C.**

Concerning the vegetation development in Southeast Drenthe and the influence of (Neolithic) man on the vegetation since c. 3000 B.C. a large amount of pollen-analytical information is available (Waterbolk, 1954; Van Zeist, 1955a; 1955b; 1959; 1967; Walvius, 1964; Casparie, 1972). Especially on the basis of research carried out by Van Zeist (1955a; 1959; 1967) it is possible to discern a number of incidences of interference with the vegetation, including forest clearing; in this connection see also Casparie and Groenman-van Waateringe (1980). This is indicated by means of a number of sections in the pollen diagrams (figs. 4, 5 and 6) that are taken from Van Zeist (1959: fig. 6, Emmen I; fig. 5, Bargeroosterveld I and fig. 9, Nieuw-Dordrecht respectively). A general discussion of these diagrams can be dispensed with here (Van Zeist, 1959; 1967).

For the estimation of the pollen percentages the *Quercetum-mixtum sensu lato* has been taken here; this can be regarded broadly speaking as the components of the natural forest on the higher soils (*Quercus, Tilia, Ulmus, Fraxinus, Fagus, Carpinus, Acer, Taxus*). The distinct changes in pollen values found by Van Zeist concern both tree pollen and herb types. The main theme of this article is not the history of clearance activities but rather the use made of wood. For this reason the diagrams of Van Zeist are illustrated here only in part, namely the trees of the *Quercetum-mixtum s.l.* mentioned above and just a few herbs. To the pollen diagram of Nieuw-Dordrecht (fig. 6) the curves for three trees have been added: *Betula, Alnus* and *Corylus*. The percentages of these have been estimated from the sum of the *Quercetum-mixtum s.l. Betula* and *Alnus* were used to a great extent for the purpose of construction of the trackway (4.1.); *Corylus* is completely absent from the trackway although the tree was abundantly present.

The three profiles are derived from the raised bog close to the higher soils (fig. 7). In Neolithic times it was a treeless *Sphagnum* bog; only close to the margin of the bog was there a carr vegetation present, mainly consisting of *Alnus*. At the spot of the Nieuw-Dordrecht profile this carr became overgrown, around 2200 B.C. by treeless ombrogenous *Sphagnum* peat.

In fig. 7 is shown the position of the forests on the higher soils as distinguished by us (1980), on the basis of the data of Van Zeist (1955a; 1959; 1967). On the fertile boulder-clay soils woods were present, in which elm, ash (in a lower-lying zone) and lime were abundant, if not dominant; on the poorer cover-sand soils oak was the most important tree. Most of these woods were exploited from c. 3000 B.C. on by prehistoric man. At the time when the trackway was built these woods had already been degraded, as a result of which the composition had changed (Van Zeist, 1959). The changes in the forest composition also find expression in the choice of wood made for building the trackway, as is shown by the wood spectrum (table 1).

On the left side of the pollen diagrams (figs. 4, 5, and 6) the letters A–H signify a

*C14 dates are given in years B.P.; other dates in years B.C./A.D.

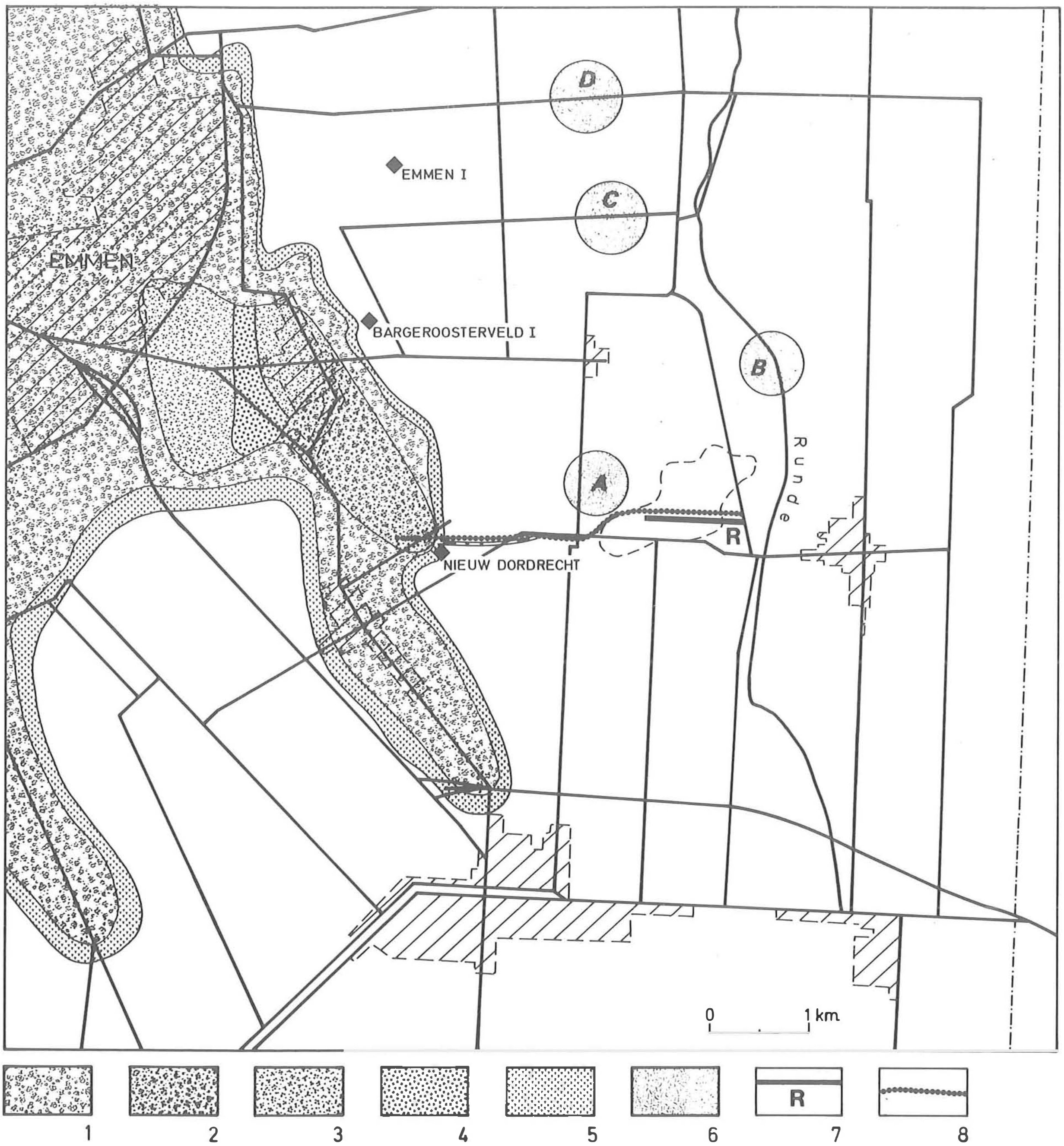


Fig. 7. Sampling sites for the pollen diagrams (◆) illustrated in figs. 4, 5 and 6, and situation of several features mentioned in chapter 2. Key: 1–5: forests on and alongside the Hondsrug, named after the predominant tree species, 1. oak-rich forests, 2. lime-rich forests, 3. elm-rich forests, 4. ash-rich forests, 5. bog-fringing forest (alder carr); 6. the iron-ore regions (A, B, C, D); 7. the vertical peat-face R (see fig. 8); 8. cross-section of the raised bog of fig. 9.

subdivision of these diagrams, indicating the forest clearances that have been discerned. The sections A–D relate to the Neolithic period, which will be dealt with in further detail in this study. In Casparie and Groenman-van Waateringe (1980: pp. 57–60) the arguments are given on which this subdivision is based; in the description that follows here below these arguments are not repeated, though the conclusions drawn from them are mentioned.

The sections E–I relate to the Bronze Age and Iron Age. Here there will be no discussion of the associated forest clearances.

The clearance phases (*landnams*) distinguished have been given time limits. These are of course approximations of the age of the landnams rather than exact datings.

Also on the basis of the extensive archaeological information available it is clear that the region concerned has always been occupied since c. 3000 B.C. or shortly afterwards. This concerns exclusively the higher sandy and boulder-clay soils. The peat-bog was not inhabited although people penetrated the peat-bog area, as is evident from the wooden trackway and a number of other bog finds. As far as we are able to ascertain the 'clearance' of the peat-bog was restricted to the cutting down of the carr (*Alnus* and *Betula*) for the purpose of building the trackway.

The construction of the wooden trackway of Nieuw-Dordrecht was indeed a single event, but this must be placed within the wider context of Neolithic activities as a whole in Southeast Drenthe, as it cannot be excluded that it was precisely the developments in this region that led to this construction. The description concentrates on Nieuw-Dordrecht, particularly because the wood species of the trackway provide extra information as to the forest composition.

It must be borne in mind that in the following no definitive statements are made regarding population density or fluctuations therein. Moreover the time limits given cannot be regarded as starting and finishing points of distinctly separate clearances. Here we are concerned with the pollen-analytical registration of (mainly) deforestation activities of prehistoric man in Southeast Drenthe; only in one case it is possible to show a direct causal relationship: the building of the trackway of Nieuw-Dordrecht.

A: c. 3000–2500 B.C.

Fairly extensive clearance of *Ulmus*- and *Tilia*-rich woods on boulder-clay. No clearance of *Fraxinus* woods; these were situated in a very wet side-valley of the Hunze, that opens out into the large, peat-filled Hunze valley close to the Bargeroosterveld profile. The *Quercus* woods on (cover) sands were felled to only a limited extent. *Plantago lanceolata* is present only with very low values; the boulder-clay soils were not suitable for any considerable expansion of *Plantago*. The regeneration of forest on abandoned fields and/or pastures took place for the most part without a distinct *Betula* stage. The high values for *Betula* and *Alnus* in Nieuw-Dordrecht (fig. 6, spectra 2–5) can be ascribed to the local carr vegetation.

Nearby Nieuw-Dordrecht the *Tilia*-rich forest was felled in part: the *Quercus* forest on sand here was presumable not interfered with. The maximum for Gramineae here (spectra 7–9) could possibly indicate an expansion of grass-rich vegetations on sand or boulder-clay as a result of deforestation (also *Corylus* increases), but local expansion of *Phragmites* in the carr cannot be excluded however.

We can assume that all these activities involving interference with the forest were carried out by people of the TRB culture.

B: c. 2500–2200 B.C.

Once again clearance of the *Ulmus*- and *Tilia*-rich woods. Possibly also some interference with the *Fraxinus*-rich forest. In connection with this *Corylus* increases, though not to an equal extent in the three diagrams.

Plantago lanceolata is initially still low in Emmen I and Bargeroosterveld I (figs. 4 and 5); possible felling activities were still limited here to the region with a fertile boulder-clay soil. In Nieuw-Dordrecht the development seems to be different: the high *Betula* values (fig. 6, spectra 11–13) we see as a reaction to deforestation activities, as a result of which *i.a. Quercus* has somewhat lower values in this zone. The somewhat higher values for *Plantago lanceolata* in comparison with zone A, and the occurrence of various herb species at somewhat higher values are indicative of the felling of forest on sandy soils, whereby the original forest did not immediately regenerate.

The renewed marked expansion of *Betula* (spectra 17–21), following a distinct increase of Gramineae (spectra 15–19) most probably indicates regeneration of abandoned arable land via the extensive spread of *Betula*. *Corylus* has no conspicuous maximum or minima in Nieuw-Dordrecht. The landnam in this region possibly concerned mainly the forest on the somewhat poorer cover-sand soils and to a lesser extent the *Tilia* forest on the rich boulder-clay soil, as was the case at Bargeroosterveld. The landnam activities that took place in this period can be ascribed in part to the TRB culture; to some extent the PFB people may have been responsible for these activities too. The clearance activities near Nieuw-Dordrecht that appear to have been carried out on a wider scale (high *Betula* values) cannot be interpreted as an Iversen-*landnam* of the PFB culture, but is rather a reflection of the quality of the soil (Casparie and Groenman-van Waateringe, 1980: p. 59).

C: c. 2200–1900 B.C.
The felling of the *Ulmus*-rich forest continued; the *Tilia*-rich forest near Bargeroosterveld appears to have been almost completely cleared. The *Fraxinus*-rich forest may also have been interfered with. The extent to which the *Quercus*-rich forest on sand was affected cannot be clearly deduced from the curves for *Quercus*. The values for Cerealia and *Plantago lanceolata* in the diagrams of Emmen I and Bargeroosterveld I indicate relatively intensive agricultural activities, also on sand, that began already before c. 2200 B.C. Near Nieuw-Dordrecht extensive stands of *Betula* were felled, almost certainly for the construction of the wooden trackway. The considerable decrease of *Betula* in the pollen diagram (fig. 6, spectra 21–23) suggests that almost all usable stands of *Betula* disappeared. From the wood spectrum of the trackway (table 1) it is evident that also the oak forest on sand and (in part) the *Tilia*-rich forest were felled, while the *Alnus* carr belt must have disappeared to a considerable extent. This last-mentioned fact cannot be deduced from the curves for these trees, unless the somewhat bigger fluctuations of these curves just below in zone C, *i.e.* approximately at the time when the trackway was built, must nevertheless be interpreted as reactions to extensive felling. The curve of *Corylus* has two maxima in zone C (fig. 6, spectra 21 and 25), that can possibly be ascribed to the felling of forest near Nieuw-Dordrecht. On the basis of the wood spectrum of the trackway it cannot be concluded that *Corylus* was also felled.

The somewhat lower values in this zone for *Plantago lanceolata* near Nieuw-Dordrecht are not necessarily indicative of diminished agricultural activities. It is also possible that as a result of the felling activities the occurrence of *Plantago* became more restricted, *e.g.* by the intensive trampling. The use of wood for purposes other than the building of the trackway (4.5.) is indeed indicative of the presence of people at the spot for a longer period than just the time of construction of the trackway.

Most of the observed occurrences of interference with the vegetation can be ascribed to the PFB culture. This applies to the building of the trackway in particular. In addition from c. 2200 B.C. on the *Klokbeker-kultuur* (*i.e.* Bell Beaker culture = BB) was present in this region.

D: 1900–1700 B.C.
The slight changes in the pollen picture of Emmen I (fig. 4), in contrast to Bargeroosterveld I (fig. 5), where *Tilia* decreases sharply and *Plantago lanceolata* has conspicuously high values, indicates concentration of the occupation on or near that part of the boulder-clay ridge that was covered with *Tilia*-rich forest, close to the margin of the peat-bog near Bargeroosterveld. This part of the *Tilia* forest may well have been felled completely, as may also have occurred with part of the forest on poorer soil, especially soil more susceptible to drought.

Near Nieuw-Dordrecht *Tilia* is able to expand again slightly; *Plantago lanceolata* has fairly low values in this zone in fig. 6. This region may have been only very sparsely inhabited in the last part of the Neolithic. The relatively low values for *Alnus* in zone D of Nieuw-Dordrecht (fig. 6) cannot satisfactorily be ascribed directly to the felling of the alder belt for the purpose of building the trackway. The increase of *Alnus* (spectra 32–33) could indicate the expansion of this belt. Most of the incidences of interference with the vegetation in this period can be ascribed to the BB culture.

On the higher soils of Southeast Drenthe, in the region from Emmen to as far as the ridge of Nieuw-Dordrecht (fig. 3) remains have been found of the TRB, the PFB and also the BB culture, of Early and Middle Bronze Age inhabitation, and also of later periods. From the pollen diagrams (figs. 4, 5 and 6) it is evident that the region has been continually inhabited since c. 3000 B.C. In the Neolithic a number of landnams can be distinguished, such as c. 3000 B.C., c. 2500 B.C., c. 2200 B.C., c. 1900 B.C. and c. 1700 B.C., but also in later periods (2.1.2.). These are extra accentuations of the clearance activities rather than more or less isolated incidences of interference with the vegetation. Precisely because on account of the situation of the region of Southeast Drenthe–surrounded by raised bog on three sides–it could not have had any strategic position, we must regard the Neolithic and Bronze Age cultures distinguished here as successive generations of the same population groups.

2.1.2. *The developments in the younger periods*

The development outlined above of–broadly speaking–increasing pressure on the vegetation continues in the Bronze Age (zones E, F, G and part of H) and the Iron Age (part of H, and I) (Van Zeist, 1959; 1967). Thus in the Emmen I diagram (fig. 4) the influences of the MBA inhabitation of Angelsloo on the northern part of the boulder-clay ridge (zone G) and the Celtic Fields in the same region (zone I) show up clearly. Near Nieuw-Dordrecht there do not appear to have been any conspicuous concentrations of inhabitation present in these periods.

2.2. The peat-bog: subsoil and stratigraphy

2.2.1. *The vertical peat-face R*

The peat-face R (fig. 8) has been investigated within the framework of this project because the sand-ridge present here may have been the intended destination of the wooden trackway (2.4.1.). The peat block is situated in the grounds of the peat museum 't Aole Compas, that gave permission for the research (fig. 7). Detailed information was recorded and drawn over a length of 860 m of the peat-face in the same way as for the vertical peat-faces A–Q (Casparie, 1972); for a full description of the legends, *id:* pp. 30–35. The figures given between brackets in the legend of fig. 8 refer to the symbols used in that same publication. Also the numbering of the points examined (484–528) corresponds to the investigation of the peat-faces A–Q.

Here we shall limit ourselves to a short description of the peat stratigraphy. The pits 484–510 indicate, as far as the subsoil is concerned, the podsolized Postwegrug; the pits 511–528 the Berkenroderug; here the subsoil includes a top layer of fluvial loam (2.2.2., G and I). The fen peat layer can perhaps be dated between 5000 and 4500 B.C. The highly humified *Sphagnum* peat presumably began to grow here c. 4500 B.C. Also visible here is the normal development of highly humified *Sphagnum* peat, via the intermediate deposits, with highly humified hummocks and hollows with poorly humified to fresh *Sphagnum* peat. The intermediate deposits can possibly be dated to between 2000 B.C. and the beginning of the Christian era.

The time at which the Postwegrug (pit 495) ultimately became overgrown is dated to 3370 B.C. (GrN-10.759: 5320±35 B.P.); indeed considerably older than we had initially assumed; between 3000 and 2000 B.C. This clearly shows that the sand-ridge itself could not have been the destination of the wooden trackway. Pit 523 indicates an erosion gulley, of the type that we have described previously (1972), filled with fresh *Sphagnum* peat. A dating of c. 500 B.C. seems to us to be well possible.

The area of peat-face R, in particular the eastern part, has been intensively used since c. A.D. 1850, as a result of which a significant proportion of the upper fresh *Sphagnum* peat has disappeared. In the pits 484–491 the peat has been dug away, except for a remnant layer. The gap resulting from this has been refilled with peat for the purpose of the use of this peat-bog area as a museum.

2.2.2. *Cross-section through the peat-bog close to the trackway*

Fig. 9 shows an outline cross-section through the mineral subsoil and the peat sequence, in the same longitudinal direction as the trackway (fig. 7). The data available were not all of the same quality; the information (fig. 9) is therefore rather uneven and variable in terms of detail. However, this does not affect the overall picture outlined here. Most of the data are from Casparie (1972).

In the cross-section we have distinguished a number of subareas, on the basis of differences in subsoil, height, peat stratigraphy, *etc.* The following discussion deals with each of these subareas in turn.

Subarea A. The Hondsrug, with the boulder-clay plate, of which the southern point is present precisely here. The trackway begins here slightly higher than 19 m+NAP. The maximum height of peat here reached about 21 m+NAP. The eastern part of this subarea includes the excavation trenches 1 (1955), 2 (1981) and 3 (1955); for a description of the trenches see 3.1. In the mineral subsoil evidence of wash-out is fairly abundant. The overlying fen peat formed mainly as an alder-rich bog marginal forest that crept upwards steadily further along the Hondsrug with the rising peat forming level. The most western part of that section of the trackway excavated in 1981 lay in this alder carr. At the time when the trackway was in use it must have been very wet here. This also applies to that part of the trackway lying in highly humified *Sphagnum* peat.

Subarea B. The flank of the Hondsrug. The presence of the trackway is certain; the precise level in the peat profile has only been established at one point, namely trench 4 (1955). Here the mineral subsoil still shows a pronounced relief, so it can be assumed that this is the slope of the Hondsrug, covered over with a presumably thick complex of washed-out mineral material. Overlying this is fen peat. Here, as in subareas C and D, the trackway lies completely in the highly humified *Sphagnum* peat.

Subarea C. The western part of the Hunze depression, consisting of fluviatile sands. These are covered over with Late Glacial *Braunmoostorf* (Hypnaceae peat), as could be ascertained in trench 5. On top of this Late Glacial material lies the non-ferruginous fen peat, that fills up the lower parts of the Hunze depression. The transition to subarea D is formed by trench 7 (1964), where the peat stratigraphy is well known. Especially the highly humified *Sphagnum* peat was formed here under extremely wet conditions.

Subarea D. The bed of the Hunze, here most probably the deepest part, consisting of fluviatile sands. These are covered over with a fairly thick complex of Late Glacial *Braunmoostorf;* otherwise the peat development is as in subarea C. The pronounced relief on the left side (excavation trench 7) possibly does not continue any further to the east, but we cannot be certain of this. The trackway is only definitely present in the left part (trenches 7 and 8).

Subarea E. The flank of the cover-sand ridge, that cuts off the Hunze bed to a considerable extent. Here the wooden trackway clearly lies alongside to the highest part of the cover-sand ridge.

Subarea F. The spillway in the cover-sand ridge. It was no longer possible to determine the precise depth, but this would have been slightly below 13.40 m+NAP. as can be deduced from *i.a.* peat-stratigraphical information (Casparie, 1972). Landweer (1912) provides information concerning the peat stratigraphy. However, this author makes no distinction between different sorts of fen peat, so it is not known whether Late Glacial deposits were also present in the spillway. A considerable part of the Hunze depression drained through this low spot; here conditions must have been particularly wet.

Subarea G. The west flank of the cover-sand ridge Postwegrug, that is regarded in the first place as a possible destination of the trackway (2.4.1.). This flank slopes from east to west as well as from south to north. The relief is well known; in the flank several shallow east-west gulleys are present. The peat stratigraphy is not well known; it is no longer possible to ascertain where any Late Glacial deposits and the fen peat wedged out exactly. The slope is partly covered with Boreal gyttja deposits; partly also with ferruginous peat deposited in a seepage environment.

Subarea H. The cover-sand ridge Postwegrug of which the mineral subsoil consists of podsolized cover-sand. The precise peat stratigraphy of this subarea and subarea I is shown in fig. 8, peat-face R; for a more detailed discussion see 2.2.1.

The cover-sand ridge is covered over with ombrogenous peat; fen peat is absent. In view of the abundant presence of *Sphagnum cuspidatum* layers in both highly humified *Sphagnum* peat and the lowest layers of fresh peat, it can be assumed that in the period when this ridge became overgrown with peat conditions here were extremely wet. The highest point of the cover-sand ridge, about 16.60 m+NAP, lay slightly north of the highest point of subarea H. The cover-sand ridge became completely overgrown with peat before 3000 B.C.

Subarea I. The fluviatile ridge Berkenroderug, formed in the last phase when during the Würm period the precursor of the River Ems dried up here. The fluviatile sands are covered over with a layer of fluvial loam. Overlying this is fen peat, that formed presumably between 5000 and 4500 B.C. This fen peat is covered over with ombrogenous peat, as is also present in subarea H.

2.3. The entering of the peat-bog

2.3.1. *General*

The trackway did not cross the raised bog–a distance of about 13 km (5.1.3.). An end-point has never been found. We assume, however, that a destination was present in the peat-bog, to which the trackway led. We do not have any indication of what this may have been. The stratigraphy of the peat-bog region in which this trackway lies is well known (Casparie, 1969; 1972; Casparie & Smith, 1978; 2.2.2.). Together with the considerable amount of archaeological information that is available it nevertheless allows us to gain some insight into the destination and function of the trackway.

The definitely known length is about 800 m (from trench 1 to trench 9) (3.1.; fig. 3). We can assume, however, (5.1.3.) that it was longer, thus that the end-point was further away.

East of the trackway, further on in the definitely known direction, we find 3 particular phenomena that could possibly be its end-point: the cover-sand ridge, several spots with bog iron-ore in the peat and the bog stream, the Runde (fig. 10). These will be discussed in further detail below (2.4.).

Despite the difficulty of access to the raised bog, in prehistoric times it was nevertheless regularly penetrated. W.H. Zimmermann compiled between 1963 and 1970 a catalogue of finds from peat-bogs and river valleys. He has been so kind as to put at our disposal data from this catalogue; we are most grateful to him for this.

2.3.2. *Bog finds*

In the raised bog of Southeast Drenthe hundreds of bog finds have been made in the last two centuries in the course of peat-digging and other reclamation activities. It is impossible to estimate what fraction this is of the total amount of objects that have been lost, deposited, left behind and sacrificed in the peat. The oldest material in the Hunze depression is Upper Palaeolithic flint, largely of the Tjonger tradition. This lies mostly at the base of the peat or just below. On many fluvial ridges and cover-sand ridges, that became overgrown with peat in the course of the Holocene, flint of Mesolithic age has been found, at some places in connection with hearths.

These finds made in the peat itself are nearby all of Neolithic age and younger, in fact up until the 20th century A.D. (*i.e.* from World War II). We know that the peat of Southeast Drenthe was exploited already in the MBA; *i.a.* iron-ore has been found. We have asked ourselves the question whether it can be reasonably assumed, on the basis of the bog finds, that the potential destination areas (2.4.) were entered and also exploited before this period, namely in the (Late) Neolithic and EBA.

To provide an answer to this question we have selected from the bog finds catalogue of W.H. Zimmermann all the Neolithic and EBA finds that have been found in the area of the possible end-points of the trackway, and thereabouts. The finds that were made in connection with the trackway have been added to these. The total number of items in these two categories is about 20. In as far as the sites are known with sufficient accuracy, these finds are indicated on the map, fig. 10.

The description of the finds is given below. To J.A. Bakker, J.R. Beuker, H. Fokkens (IPL), P.H. Deckers and J.N. Lanting–I am most grateful for supplementary information, including the archaeological dating, concerning these finds. Here no description will be given of the finds themselves; this study is concerned primarily with the site, the circumstances of the finds made and the stratigraphical situation. As far as possible we have kept to the text of W.H. Zimmermann, that has been partly derived from the inventory data in the museum depots. This implied that quite a lot of local site-indications are used that are not shown on the map (fig. 10). For all those finds concerned that belong to a museum the name of the museum and the inventory number are given between brackets. This number usually indicates the year in which the find was made.

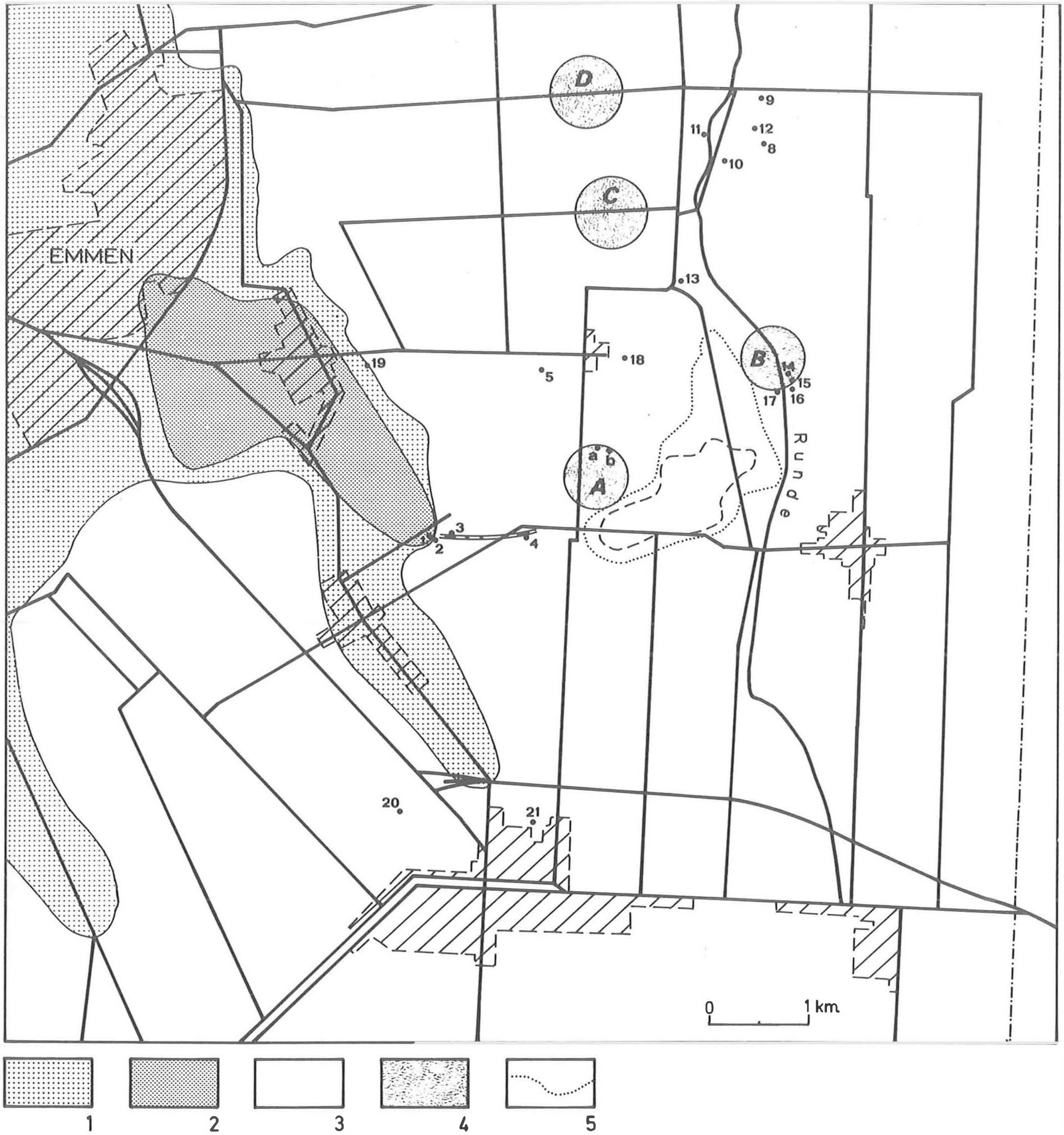


Fig. 10. Bog finds and possible destination areas. Key: 1. sand; 2. boulder-clay; 3. raised bog; 4. iron-ore areas; in the iron-ore area A the wooden trackways referred to as a [XIX (Bou)] and b [XX (Bou)] by Landweer (1912) are indicated, see 2.4.2.; 5. contour of the Postwegrug and Berkenroderug. The bog finds for which the find-spots are known are indicated by numbers.

Where this was not the case, this is mentioned separately in the text. This has also been done for those finds that are owned privately. The name of the owner (not of the finder) is then mentioned between brackets.

For nos. 6, 7, 13, 20, 21 and 22 the site-indication was so vague that these numbers could not be shown on the map. Nos. 10 and 13 property of the PMD are exhibited in the Oudheidkamer Emmen' (curator J.G. Jeuring).

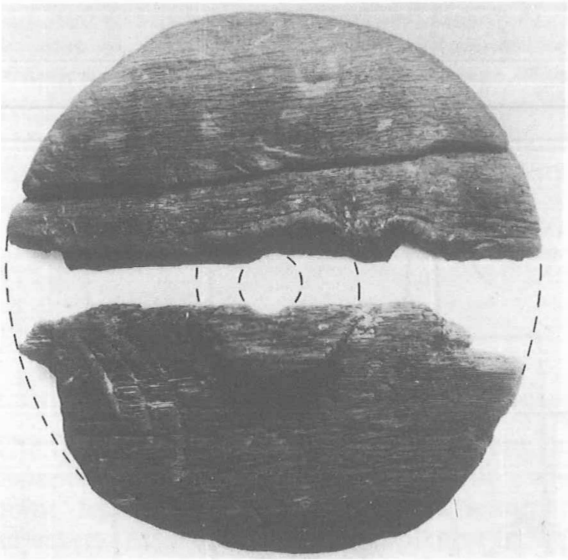


Fig. 11. Nieuw-Dordrecht 1955, the broken Neolithic disc wheel of *Quercus*-wood (Van der Waals, 1964). Diameter 75 cm. Photo B.A.I.

Fig. 12. Nieuw-Dordrecht 1955, the *Taxus*-wood axe haft (Van Zeist, 1957). Length 42 cm. Photo B.A.I.

2.3.3. *Description of the bog finds*

1. *Flint hoard*, consisting of one partly polished axe and (at least) 7 blades, found at Nieuw-Dordrecht, near the Veldweg (RMO, c. 1955/7, 1–8); see Harsema (1981) who considers it possible that this is PFB material, possibly associated with the wooden trackway. The material was probably found at the sand-peat transition, only several tens of metres to the north or northwest of the beginning of the trackway. Harsema thinks that this could be a ritual hoard, but we do not share his view. If the information about the site is exact and reliable, then this spot must have lain so close to the beginning of the trackway that at the time when the trackway was built there must have been much traffic here in connection with the building operations. A 'flint atelier', as suggested by Zimmermann (pers. comm.), is more probable.
2. *Oaken disc-wheel*, of which a part is missing, found close to the beginning of the wooden trackway of Nieuw-Dordrecht (PMD 1955/10–la) (Van der Waals, 1964; Van Zeist, 1956; 1967; fig. 11).
3. *Axe haft made of Taxus wood,* found under the trackway-surface of excavation trench I (PMD 1955/10–1) (Van der Waals, 1964; Van Zeist, 1956; 1957; fig. 12).
4. *Haft of Sorbus wood*, found under the trackway-surface of excavation trench 8 (PMD 1960/9–71) (Van der Waals, 1964; fig. 13).

   The association of nos. 2, 3 and 4 with the wooden trackway can be regarded as certain; for the discussion of the excavation trenches see 3.1.
5. *Oaken disc-wheel* (complete), found in the Smeulveen at *veenplaats* (parcel of peat) 51 at a depth of c. 2 m, in June 1923 (Maatschappij Klazienaveen, now in the peat museum 't Aole Compas). The site–c. 1300 m to the north of the trackway not far from the MBA footpath XVIII (Bou)–is difficult to comprehend. It seems very likely that we are here concerned with a ritual depot; there is undoubtedly a relation with the PFB (Van der Waals, 1964).
6. *Rössen wedge* (*durchlochter Breitkeil*), with its completely decayed wooden haft found at Emmer-erfscheidenveen, in the lowermost peat, just above the sand (PMD 1915/9–1) (Elzinga, 1962). This *'donauländische Axt'* (according to Brandt, Schwabedissen, 1966) can probably be dated in the earlier Neolithic. The exact site is not mentioned, but could well be on the northern part of the Berkenroderug, the fluviatile ridge 4–6 km northeast of the Nieuw-Dordrecht trackway. The find is in no way connected with the trackway; it probably indicates some human activity here,

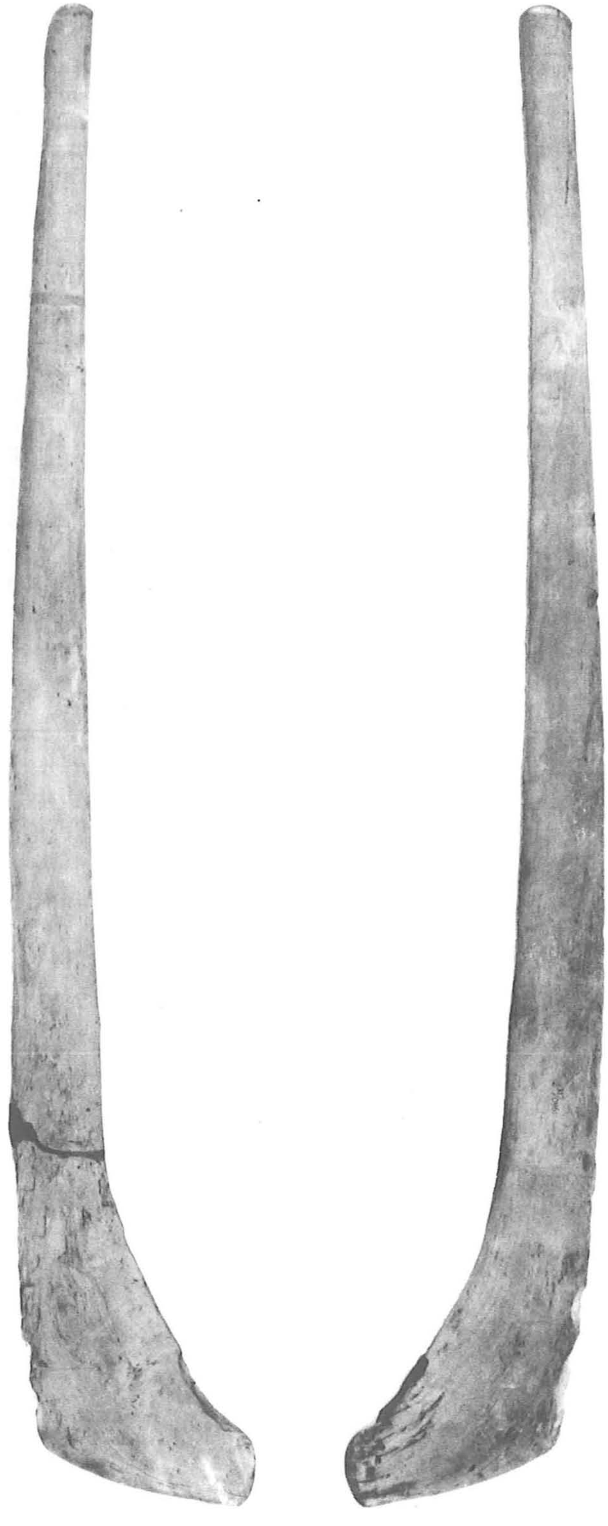


Fig. 13. Nieuw-Dordrecht 1960, the *Sorbus*-wood haft. Length 101 cm. Photo C.F.D.

before the area became overgrown with peat.

7. *Battle-axe* of light yellow stone with a wooden haft (*Sorbus*), found at Emmercompascuum, at a depth of about 2 m (PMD 1908/3-3) (Glasbergen, 1957). The exact site is no longer known, but may have been 1-2 km north of nos. 8-11. The battle axe can be dated in the EBA.
8. *String of (at least) 42 amber beads and 2 blue glass beads*. found in the Westelijke Doorsnede, *veenplaats* 10, at Emmercompascuum (PMD 1923/6-1), at a depth of 1.90 m. On the basis of this depth and the stratigraphical situation indicated (±1 m below the level of footpath XV (Bou), dated to 2480±40 B.P.): a dating in the late Neolithic of possibly the EBA is very well possible. The presence of the blue glass beads makes a somewhat younger dating more possible.
9. *Flint dagger or lance-point*, found in the Westelijke Blokplaatsen (= Westelijke Doorsnede) *veenplaats* 10 (or 16) at Emmercompascuum (PMD 1918/6-1), at a depth of ±1.5 m. The lance-point, type Bloemers II, can be dated in the late BB, the late Neolithic or the EBA. A connection with no. 8 (above) is not impossible.
10. *Flint dagger or lance-point*, found in the Westelijke Blokplaatsen at Emmercompascuum (possibly *veenplaats* 10), together with various wooden logs (PMD 1924/6-3). The lance-point, type Bloemers III, can be dated in the EBA ±1500 B.C.
11. *Stone axe*, found on the sand in the Rundestukken between Emmercompascuum and Emmererfscheidenveen in the neighbourhood of the former Runde, close to the footpath mentioned above under 8 (PMD 1909/3-6); late Neolithic. It is not clear whether the formation of peat was already under way here, or whether the find-situation was different to what has been reported.
12. *Battle axe*, found at *veenplaats* 12 to the east of the former Runde between Emmercompascuum and Emmererfscheidenveen, at a depth of 1-1.2 m below the surface in a bog iron-ore layer (PMD 1930/10-1). EBA. The mention of the presence of bog iron-ore, in combination with the depth given is an indication of the exploitation of bog iron-ore in this period.
13. *Flint dagger or lance-point*, found near the eastern bend of the Willemsvaart (canal) in 1938 or 1939, c. 1 m above the sand at a depth of c. 1.50 m (J.G. Jeuring). Type Bloemers II, EBA.
14. *Dish of tiefstich pottery*, found near the Runde at Bargercompascuum in 1930 under a 3-m-thick peat layer on top of the sand (M. Kalverkamp). TRB. This find merits a few additional remarks.
    a) As a general rule pottery is poorly preserved in peat; this object appears to be in good condition. It does show the dark coloration that is characteristic of all bog finds, except for stone.
    b) The situation of the find-spot is well known to us from peat research (Casparie, 1972). The peat-forming level, on top of which the dish was found, can be dated at 4500-4000 B.C. At the spot a seepage centre (B) was present with concentrations of bog iron-ore (siderite) (2.4.2.).

This material was formed between c. 5200 and 3100 B.C. The (scarce) information that is available concerning the circumstances of the find includes no mention at all of this bog iron-ore, unlike *e.g.* no. 15.

15. *Battle-axe* found in the Rundeveen at Bargercompascuum in the 1920-s, 'on top of the lowest peat layer', in the course of digging operations in search of bog iron-ore (PMD 1959/3-3). This must be the seepage centre B mentioned in no. 14, that is situated on the flank of the fluviatile Berkenroderug, that is indicated in fig. 10. Probably PFB. We can see this as an indication of the exploitation of bog iron-ore in the Neolithic, as the level of the bog find can be dated to between 4500 and 4000 B.C. This object could have been left behind on this low level in the peat.
16. *Stone axe with shaft-grooves*, said to have been found in the Rundeveen at Bargercompascuum in the course of peat-cutting (M. Kalverkamp). Concerning the circumstances of the find no further details are known. This is a very exceptional axe, for which there is no known counterpart in the Northern Netherlands.
17. *Battle-axe*, found in the Rundeveen at Bargercompascuum (FM, Vp., book p. 302). Also this find was situated exactly in the seepage centre B mentioned under no. 14. This object could be PFB, but could also be EBA.
18. *Battle-axe* with hammer bult, made out of black gabbro-like stone, found at *veenplaats* 46, ±250 m east of Cato's vaart at Smeulveen, at a depth of 1.25 m in the so-called *dosterd* layer (*Pinus*-wood peat) (Maatschappij Klazienaveen, now in the peat museum 't Aole Compas). EBA. The axe has a surface coating of iron oxide, possibly Fe_2O_3, indicating prolonged exposure to an oxidized iron-rich environment. The (precisely indicated) find-spot is located 500–700 m north of what we assume to be the seepage centre A. This seepage centre possibly extended thus far north. It can hardly be doubted that there is a connection between this object and bog iron-ore. The axe could have been left behind in bog iron-ore that was exposed to the air (having been dug up).
19. *Small broad-topped axe and fragment of a broad-topped axe*, found in the peat near Bargeroosterveld at a depth of 20–25 cm (PMD 1940/4, 1 and 1a). Datings probably PFB and EBA, respectively.
20. *Battle-axe*, found in the Oosterveen near Klazienaveen, in May 1960, at a depth of 40 cm (J.G. Jeuring). Can be ascribed to the PFB.
21. *Flint dagger or lance-point*, found at *veenplaats* 28 of Bargeroosterveen, south of Nieuw-Dordrecht (in the extended direction of this sand-ridge), on 20-4-1911, at a depth of 1.50 m in the highly humified *Sphagnum* peat (Maatschappij Klazienaveen, now peat museum 't Aole Compas; replica: PMD 1924/6-4). This dagger, type Bloemers III, can be dated in the EBA.
22. *Battle-axe*, found in or under the ombrogenous peat near Klazienaveen (PMD 1905/1-3). No further details are known about the circumstances of the find. PFB.

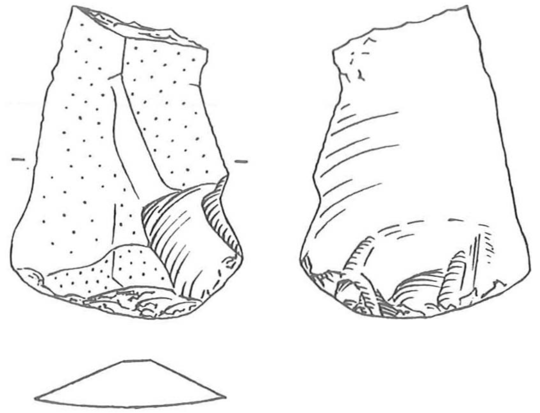


Fig. 14. Nieuw-Dordrecht 1981, scraper no. 656, 1:1. Drawing J.M. Smit, B.A.I.

23. *Stone axe*, found at Weerdingerveen in the bog iron-ore (PMD 1916/1–4). This axe, that belongs to the PFB, is mentioned here because the find is said to have been made "in a lump of bog ore (*oer*)". It is true that this axe does not come from the surroundings of the Nieuw-Dordrecht trackway, but in view of the fact that also in the peat region concerned the formation of bog iron-ore had come to an end already before c. 3000 B.C.we see this find as an indication of the exploitation of bog iron-ore in the Neolithic.
24. *Flint scraper*, found in the course of the 1981 excavation (trench 2) between the trackway-surface logs (fig. 14). Discussion: 3.2.4.

2.3.4. *Conclusions*

There is certainly no doubt that the peat-bog region in the surroundings of the possible destinations was entered by people already in the Neolithic. From the distribution of finds there is no obvious evidence to suggest that any particular route was followed over a long period of time. This is hardly surprising, for the wooden trackway was in use for only a relatively brief period: at most for only a few years (5.2.4.).

It is also fairly certain that the peat-bog was accessible in the Neolithic and EBA not exclusively via this or some other wooden trackway. This is indicated by nos. 5, 8–12, 18, 20 and 21. This may well have been the general rule, with the trackway being merely an adaptation to the locally very wet situation (Casparie, 1972). Here it should be mentioned that after c. 2000 B.C. the entire raised bog region gradually became wetter. This must have had consequences for the accessibility of the region in the EBA and later.

There appear to be two concentration areas with regard to the finds (fig. 10); a northern (nos. 8–12) and a southern one (nos. 14–17). For the northern one the majority of datings–inasfar as it is justifiable to follow this approximation–are after 2000 B.C., for the southern concentration area the datings fit in somewhat better with the wooden trackway, as a few PFB finds are included in this group.

These two concentrations of finds could, however, also be illusory; in various regions peat-digging was first carried out a long time ago, when no attention was paid to any archaeological finds. Besides there was then no systematic procedure for the acquisition of finds by the various museums and other interested persons.

The absence of finds on or very close to the cover-sand ridge (fig. 10), can be ascribed to a significant extent to the fact that a considerable part of the peat has not yet been dug away there.

The absence of the finds in the southernmost iron-ore region (A) is presumable a consequence of this peat having been dug away already at an early stage. The relatively large raised bog region between the Hondsrug on the west side, the iron-ore region A on the south side and the region of the cover-sand ridge, the iron-ore region B and the Runde on the east side, is almost completely devoid of finds. Peat was dug here up until relatively recently (c. 1960). A few finds from younger periods are indeed known to have come from this peat region. We must therefore not exclude the possibility that in the Neolithic and EBA this region was not attractive or perhaps dangerous. Sand islands are absent here and bog iron-ore is hardly or not at all present.

East of the peat region, in which the Runde has developed, bog finds are lacking. Considerable parts of this region were dug away already very long ago, but part of the peat disappeared only in the course of this century. We venture to assume, however, that here hardly any or no use was made of these parts of the bog in prehistoric times.

In four cases (nos. 12, 15, 18, 23) the find description indicates a distinct connection with bog iron-ore; this matter is dealt with in further detail in the discussion about the possible destination (2.4.2.).

Analysis of the available information makes it clear that the peat-bog in the region to which the trackway presumably led was not only entered but possibly was also exploited. Moreover, in view of the presence of bog finds it is not impossible that precisely the region of the cover-sand ridge, bog iron-ore regions A and B and the Runde was in fact the destination of the trackway.

2.4. The potential destination areas

2.4.1. *The sand island Postwegrug*

This ridge, shown in fig. 3 and 10, consists of a cover-sand ridge (Postwegrug), that lies approximately perpendicular to the Hondsrug, and a lower fluviatile ridge (Berkenroderug), that with its NW-SE orientation is parallel to the Hondsrug. The cover-sand ridge has a peat podsol; the fluviatile ridge has a fluvial loam deposit at the top. Both ridges are still partly covered with peat. In fig. 8 is shown the cross-section of this peat, as recorded in vertical peat-face R (2.2.1. and 2.2.2.), the exact position of which is indicated in fig. 7. The peat symbols used are described extensively in Casparie (1972). The stratigraphy of the peat corresponds well to that established previously.

In the eastern part of peat-face R, pits 508–528 (fig. 8), the fluviatile ridge has been cut into. Here fen peat overlies fluvial loam. The time at which fen peat formation came to an end can probably be dated at c. 4500 B.C. At that time the fluviatile part of this sand island was probably not completely overgrown.

The cover-sand area–with a peat podsol–has been overgrown by highly humified *Sphagnum* peat; the same type of peat as that in which the trackway is present. To determine the time at which this cover-sand ridge finally became overgrown with highly humified *Sphagnum* peat, a C14-sample was taken, a few metres just west of the highest point of this ridge, at c. 16.40 m+NAP (fig. 8). From the dating of this peat at 5320±35 B.P. (GrN–10.759) it follows that this sand island could not have been the possible destination of the trackway. The highest point had been overgrown for 1000 years already. The thickness of peat at this spot at the time when the trackway was built, in an undrained state, was possibly more than 1 metre.

In the peat present here, that has been dug through in different places to make ditches and small peat cuttings no wooden remains of a trackway have ever been found.

2.4.2. *The bog iron-ore locations*

Between 5200 and 3100 B.C., to the north of the cover-sand ridge a ferruginous peat sequence developed in an environment of iron-rich seepage, that contained, especially near the spots where ferruginous water appeared out of the ground (seepage centres), large quantities of siderite (bog iron-ore) (Casparie, 1972; 1978). We can assume that these spots were exploited already in the MBA (Casparie & Smith, 1978). The location of several such spots (A, B. C, D) is shown in fig. 10. The siderite concentrations were clearly visible and recognizable from a distance. They were dome-shaped and must have had a completely different vegetation.

Initially– c. 3100 B.C.–the domes most probably stuck out almost 2 m above the surrounding peat vegetation. Only well after c. 2000 B.C. did they ultimately become overgrown by highly humified *Sphagnum* peat.

2.4.3. *The bog stream the Runde*

This rivulet, the final course of which is shown in fig. 10, is a true raised bog river. No bed is present in the mineral subsoil or in the underlying fen peat. It started to develop only after c. 3100 B.C. Probably it was only well after 2000 B.C.–when the cover-sand ridge had been completely covered for some time with a sequence of *Sphagnum* peat and domed bog complexes had arisen in the Southeast Drenthe region (Casparie, 1972)–that a true stream was present. At the time of the wooden trackway it could only have been at most a very insignificant brooklet.

3. THE TRACKWAY

3.1. Overview of the field research

The trackway has been the object of research at different times in various places. This research has varied from a simple observation (without any location having been established) to systematic excavations. Here below a list of these activities is given in chronological order, together with details of a few characteristic facts. The location of the various excavation trenches and observation points is indicated in fig. 15. The trenches are numbered from the west (no. 1) in an eastward direction. This numbering is still kept to further on. The observation points are indicated by an asterisk. The parts of the trackway that have been excavated are illustrated in figs. 16 and 17.

1910
Reconnaissance by G.J. Landweer Jz.

Situation: in the process of deepening a dividing ditch alongside the road, or rather peat-bog dike, from Nieuw-Dordrecht to Klazienaveen-Noord, ±1.5 m below the surface. Landweer had a small part exposed; with regard to the method of construction he mentions that trunks of *Pinus* trees had been used. This identification is very probably not correct however. Landweer does not mention the exact location and that is why we have not given this observation a trench number. The spot is situated between trenches 5 and 6 (pers. comm., J.J. Brands, Nieuw-Dordrecht). Landweer was probably reacting to the report of a find; in addition he documented the find and made various observations. G.J. Landweer Jz (1912).

1955, trenches 1, 3, 4, 6, 9
Excavations and observations in the months of September and October 1955 by H.T. Waterbolk, W. van Zeist, G. Delger and H. Praamstra. The trackway was investigated at 6 points: A, B, C, D, E and F. Trench 1(A) extended over a length of 27 m of the trackway; trench 3(B) 3.50 m; trench 4(C) 2.50 m; trench 6(D) 3.20 m; the spot E concerns an observation made in the side of a ditch; trench 9(F) is an observation in a vertical peat action. This is the most easterly point at which it has been established that the trackway is definitely present, and for this reason we have assigned a trench number (9) to this observation (figs. 18 and 19). The aim of this investigation was to ascertain the construction method, the course of the trackway, the species of wood used and the dating. For the purposes of a palynological investigation a peat section was sampled on the west side of trench 1.

Finds: the remains of a solid *Quercus*-wood disc-wheel (fig. 11) just west of trench I, found

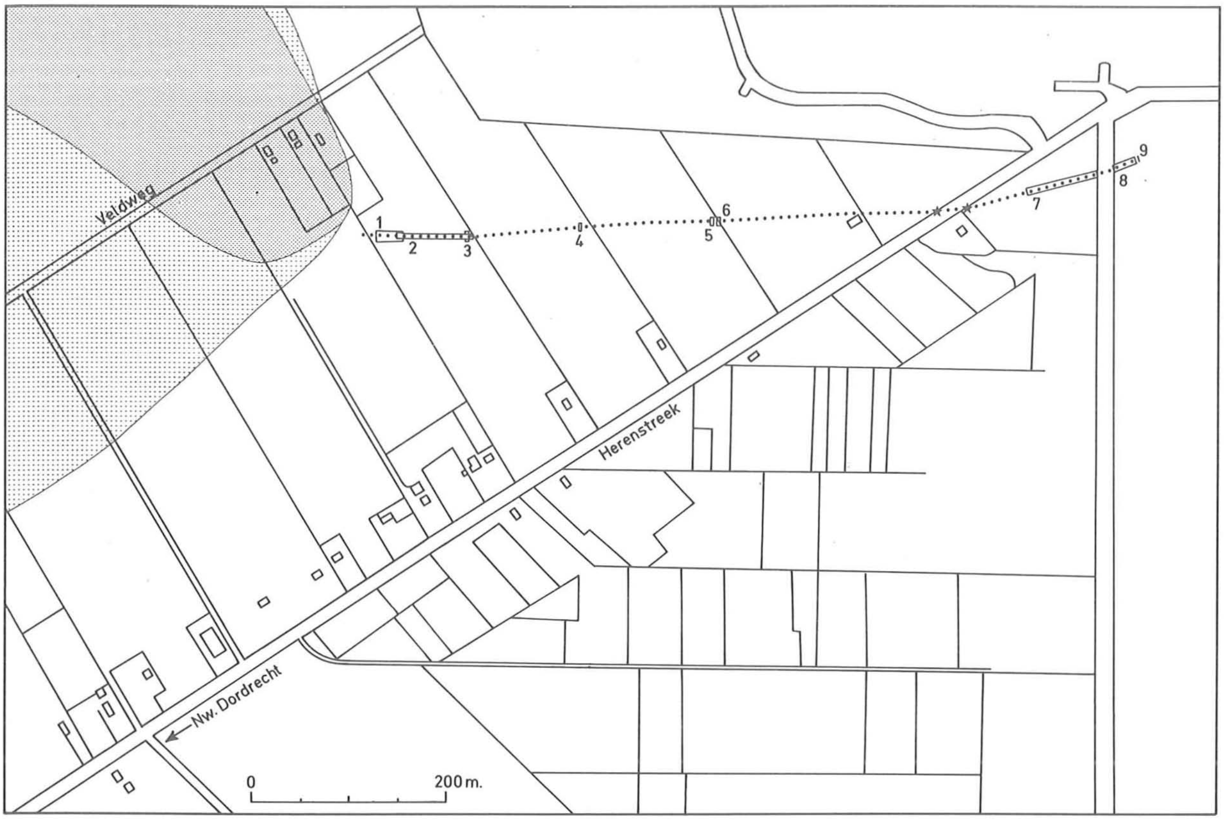


Fig. 15. Nieuw-Dordrecht, situation and numbering of the excavation trenches. The observation points are indicated by an asterisk. For the precise location of this map, see fig. 3. Key: 1. sand; 2. boulder-clay; 3. peat.

Fig. 18. Nieuw-Dordrecht 1955 (trench 1), general view towards the west. Photo B.A.I.

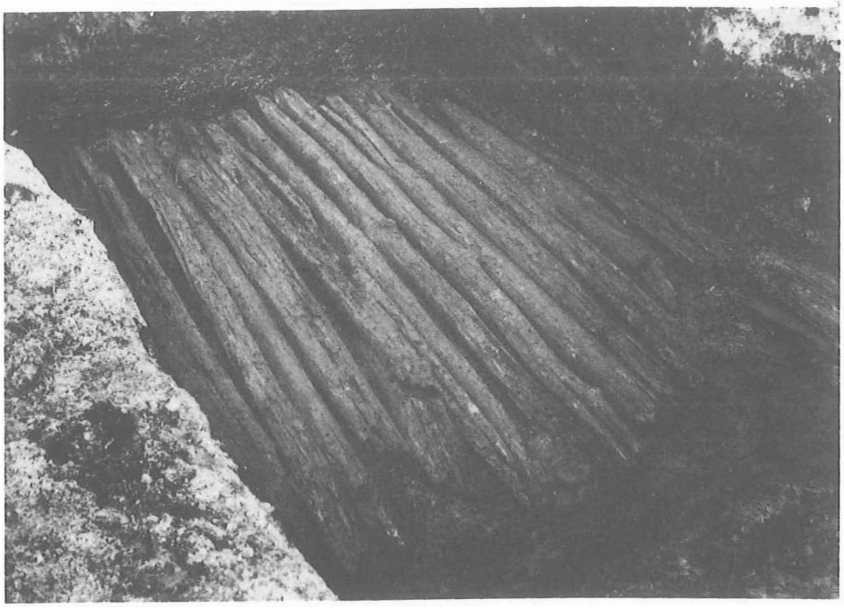


Fig. 19. Nieuw-Dordrecht 1955 (trench 6), view towards the east. Photo B.A.I.

Fig. 20. Nieuw-Dordrecht 1960 (trench 8), view towards the east. Photo H.T. Waterbolk.

prior to the excavation; a *Taxus*-wood axe haft (fig. 12) in the eastern part of trench 1, under the trackway-surface. C14-dating: 4080±55 B.P. (GrN–1087). Van Zeist (1956; 1957; 1959; 1967).

1960, trench 8
Excavation in August 1960 by W. van Zeist, Mrs. L. van Duinen and H. Praamstra. Excavated length 24 m (fig. 20). The aim of the investigation was to gain a clearer insight into the method of construction, the species of wood used and a more precise dating.

Finds: a haft, c. 1 m long, of *Sorbus*-wood (fig. 13). C14-dating: 4100±55 B.P. (GrN–2968), Casparie (1972).

1964, trench 7
Excavation in March and April 1964 by J.H. McAndrews, Mrs. J. Ruiter, H. Praamstra

Fig. 21. Nieuw-Dordrecht 1964 (trench 7), view towards the east. Photo C.F.D.

and W.A. Casparie. Excavated length 75 m (fig. 21). Aim: to gain clear insight into the hummock and hole patterns of the fossil bog surface (peat research), the construction method, the species of wood used.

Finds: a few large pebbles, diameter 8–10 cm, and a few pieces of wood, that may be fragments of a haft. Casparie (1972).

1980, trench 5
Small-scale reconnaissance in June 1980 by G. Delger and W.A. Casparie, in cooperation with L. van Dijk. Exposed length 0.6 m Aim: To gain some idea of the state of preservation in connection with plans for protection of the trackway. Casparie (1980).

1981, trench 2
Excavation in June and July by G. Delger, K. Klaassens and W.A. Casparie. Excavated length 75 m. The western part of this trench coincides with the eastern part of trench 1; trench 3 is present in trench 2. Aim: to gain some idea of the choice of wood and use of wood in connection with the forest history of the ridge of Nieuw-Dordrecht. The excavation report is given in 3.2. Casparie (1981).

3.2. Excavation report for trench 2 (1981)

3.2.1. *Introduction*

The field research was carried out between June 9th and July 3rd 1981. The excavation was directed by G. Delger, K. Klaassens and the author. Assistance was also provided by Mrs. A.F. Smith and Mrs. C.M. Casparie. L. van Dijk provided cooperation, both in the form of some technical assistance from his department in the preparation and execution of the excavation, and by his study of aspects of forestry and wood technology. The results of his effort are very much appreciated by us.

The owner of the terrain, the Dienst Beheer Landbouwgronden, gave permission for the excavation. The necessary arrangements

Fig. 22. Nieuw-Dordrecht 1981 (trench 2), view towards the east. The trackway is also present in the peat under the small house in the background. Photo C.F.D.

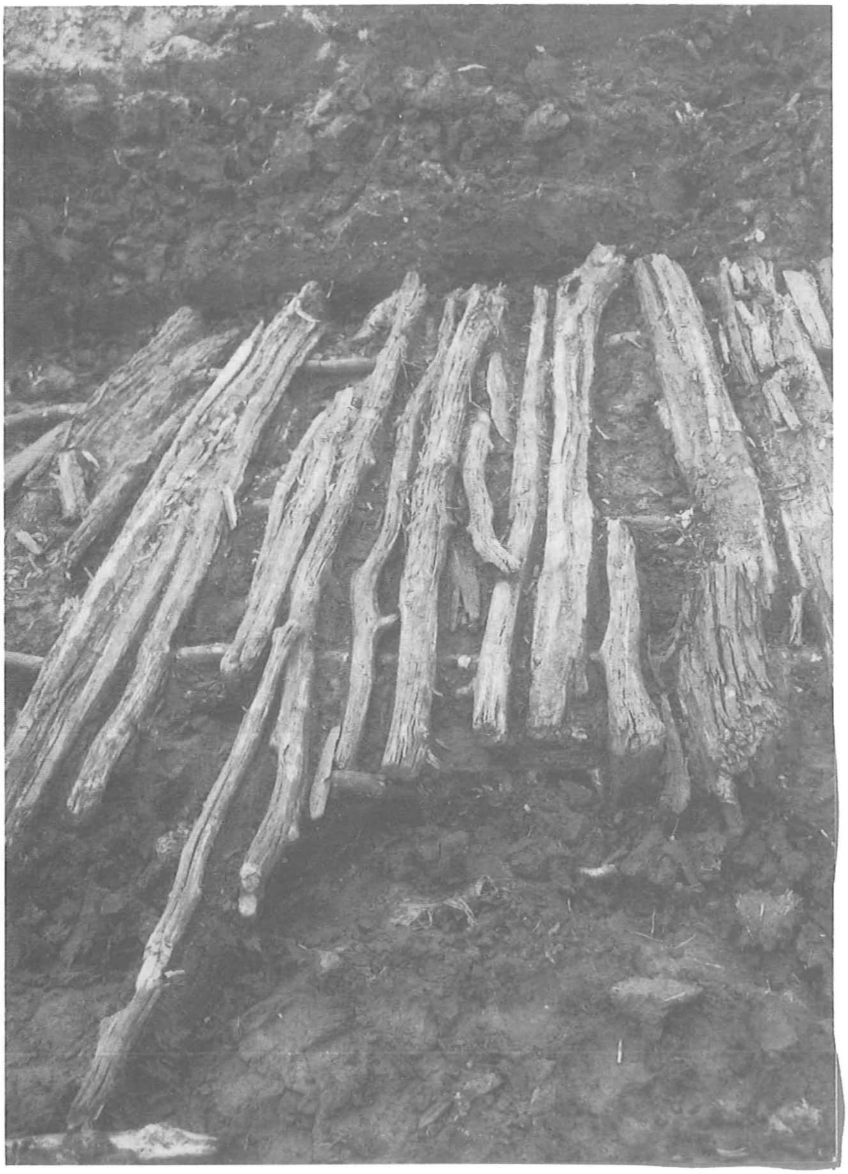


Fig. 23. Nieuw-Dordrecht 1981 (trench 2), detail of the trackway (between 49 and 52 m), towards the north, with clearly visible substructure. Note the use of rather rough pieces of wood as trackway-surface, Photo C.F.D.

concerning the mode of excavation and subsequent delivery were made with the leaseholder of the terrain, M. Deddens, Nieuw-Dordrecht, who was prepared to permit the investigation to be made in his field. We are most grateful to both the Dienst Beheer Landbouwgronden and Mr. Deddens for their willingness and cooperation.

The *werkvoorzieningsschap* De Brinken provided labour for carrying out the fieldwork. For soil-moving operations a digging machine was hired from the firm Gebr. Fühler BV of Bargeroosterveld. The assistance of both these organizations is very much appreciated.

3.2.2. *Method of work*

The topsoil and the upper undisturbed peat were dug away by the digging machine. Subsequently the wooden trackway surface was exposed using shovels. The trackway was cleaned using paint-scrapers and brushes. Work was commenced on the eastern edge of the field. From the investigation of 1955 (trenches 1 and 3) the location of the trackway in the peat was known with sufficient accuracy, so it was not necessary to search for it. All logs and other wood remains were recorded in field-drawings at a scale of 1:20, numbered and subsequently their levels were determined. The excavation drawings are shown in fig. 17.

The following categories of wood remains are distinguished: trackway-surface logs, surface-levelling wood to make the trackway-surface even, substructure and 'natural wood'. The last-mentioned comes from the woodland at the margin of the bog. It consists mainly of branches and (fallen) tree-trunks, that were not used for building the trackway. All the wood found has been identified. When it was not possible to do this in the field, a wood sample was taken for investigation in the laboratory. Apart from the species of wood used, for each piece of wood further details were recorded, such as diameter, whether or not cleft (*i.e.* split in two longitudinally), whether it is a base end or top end of trunk, the shape of the ends of the trunks felled, *etc.* This information was collected for a large part by Van Dijk.

After the trackway had been photographed (figs. 22 and 23), the logs were removed so that the substructure became visible. Also these elements were recorded in the drawings, levelled, *etc.* Finally the peat subsoil was dug over one spit deep. After the excavation the trench was filled up again with the wood that was not collected being left at the bottom of the trench.

3.2.3. *Sampling*

From 99 logs a sample was taken for species identification in the laboratory. Close to log 414 (fig. 17, 73.7 m) a complete peat section was sampled by B. van Geel, Hugo de Vries-Laboratorium, Department of Palynology and Palaeoecology, University of Amsterdam, for the purposes of macroscopic and microscopic peat research. Of log 413 (73.5 m) the outermost 10 annual rings (sap-wood) were sampled for a C14-dating: 4020±35 B.P. (GrN-10.760). These two logs are indicated in fig. 17.

About 70 logs as well as 20 so-called levelling boards (pieces of slab wood) were transported to the peat museum 't Aole Compas in Bargercompascuum. Here they are exhibited under water in a large tank, while awaiting further conservation.

3.2.4. *Finds*

Apart from the wood that belongs to the trackway itself only one artefact, a scraper, has been found (fig. 14). We are grateful to P.H. Deckers for the following description and conclusion. The flint artefact was found between the logs of the trackway-surface close to an alder stump (fig. 17, 4.10 m).

No. 656: basal (proximal) end of a blade-like flake. Length 41 mm. breadth 32 mm, thickness 7 mm. Dorsal end almost completely covered with patina. Quite severely damaged striking platform (edged). This sort of flake occurs in TRB, but also in BB.

The possibility that more artefacts were present on the trackway-surface, between the elements of the trackway or in the underlying peat, can be excluded. The excavation method was such that even very small objects could not have been overlooked.

The artefacts found in the course of earlier excavations are described in 2.3.3., nos. 2-4. The wood from the 1981 excavation (trench 2) is discussed together with that of the 1964 and 1960 excavations (trenches 7 and 8 respectively) in chapter 4.

3.3. Starting-point and direction of the trackway

From excavation trench 1 it can be deduced that the beginning of the trackway must be placed slightly west of this trench just on the Hondsrug. The actual spot is not known precisely, because no appropriate investigation has been carried out. It is possible that this starting-point of the wooden trackway disappeared in the reclamation that took place here in 1955.

The southeastern outlying end of the Hondsrug–the ridge of Nieuw-Dordrecht–narrows here from ±1500 m to less than 1000 m (figs. 15 and 10). This is the southern extremity of the boulder-clay ridge of Angelsloo, Barger-oosterveld and Nieuw-Dordrecht, that here extends up to the surface (fig. 3). The trackway begins as it were from the south flank of this extremity.

The trackway runs approximately perpendicular to the Hondsrug into the peat. Therefore the trackway was not intended as an extension of the Hondsrug, for then its orientation would have had to have been south-east, like the ridge of Nieuw-Dordrecht. The starting-point could then have been 2.5 km further south, just at the end of this ridge (fig. 3). In the course of the trackway a few slight bends are present, see trenches 2 (fig. 17) and 7 (fig. 16). Broadly speaking, however, the trackway can be described as straight. We can therefore assume that the trackway was intended to run from the south point of the boulder-clay ridge straight into the peat in a direction perpendicular to the margin of the raised bog. For further details on direction and destination see 2.4., 5.1.1. and 5.1.2.

3.4. Method of construction

3.4.1. *Substructure*

In the trenches 1, 2 and 3 a substructure is present consisting of birch trunks laid lengthwise (figs. 16 and 17); in the other trenches no substructure is present.

The longitudinally placed trunks are characterized by relatively great lengths–up to c. 8 m–together with small diameters. In the first place no clear system of ordering could be established that could be connected with the type of peat surface: wood peat on the margin of the bog or treeless ombrogenous *Sphagnum* peat. We nevertheless assume that the quality of the peat-bog surface, in particular its carrying capacity, was a determining factor for the numbers of trunks that were laid out and the distance between them. It is certain that the placing of the substructure was planned beforehand (in view of the kind of birch trunks that were used), but that matters such as the number of trunks and the distance between them were not strictly regulated.

3.4.2. *The trackway-surface*

The trackway-surface was found to be present in all the trenches. This trackway-surface consisted of transversely placed logs, *i.e.* tree trunks–in some cases cleft–of oak, lime, birch and alder. The length of these varied quite considerably (figs. 16 and 17); often it was c. 2.50 m to c. 3.50 m. The presence also of relatively much shorter logs (sometimes barely 2 m long) cannot be immediately explained. The overall intention appears to have been to build a trackway with a functional width of about 2.50 m, but in a number of places this was definitely not achieved (fig. 16, trench 7 at 33–35 and 49–50 m; fig. 17, trench 2 at 28 and 39 m). Where the trackway-surface is absent here and there, as in trench 2 at 48–49 m, trench 7 at 7, 35–36, 50–51m, and trench 8 at 19 m, we presume that the wood here has disappeared partly or perhaps to a great extent as a result of erosion (water). In a few places it could not possibly have been preserved, due to the process of rotting. Whether there were originally also stretches of the trackway without any wood cannot be demonstrated; we consider it unlikely.

Inasfar as round-wood (*i.e.* undressed tree trunks) was used for the trackway-surface, the diameters of these logs were from 10 to ± 25 cm, with thicknesses of 15-20 cm predominating. Almost all of the cleft logs came from trunks with diameters of more than 20 cm. No real planks were present. A few slabs of wood were found that came from considerably thicker trees, probably up to more than 1 m.

Not only well-formed straight trunks were used. There are also some markedly curved fragments present, sometimes still with side branches. In addition stems were also used with a diameter of less than 7 cm. In such cases the length was often slightly less than 2.5 m.

On a large number of trunks the bark was still present, even to some extent on top of the trackway-surface. This applied especially to birches and alders. The tree trunks, with the bark still attached, were used for building the trackway. The disintegrated remains of this bark were regularly found between the trunks or were still attached to the trunks on the underside of the trackway-surface, held in place by the underlying peat.

Between the logs of the trackway-surface of trenches 1 and 2 alder stumps were found in situ (figs. 16 and 17), indicating fen wood vegetation at the margin of the raised bog. The eastern limit of this was at 45–46 m in trench 2 (fig. 17). The trackway was built partly just alongside these stumps, *e.g.* 14–15, 19, 31–32, 34–35, 45 m, which indicates that these were still (living) trees at the time. In a few cases the trackway runs more or less over stumps *e.g.* at 2, 5, 25, 28–29, 39 m. It is not clear whether the trunks belonging to these stumps had already disappeared or whether the trees were felled expressly to allow the trackway to be built. The latter possibility cannot be excluded. In any case, from trenches 1 and 2 the width of the fen wood zone fringing the peat-bog could be fairly well established: slightly more than 75 m.

3.4.3. *Surface-levelling wood*

In trench 2 it could be established with certainty that extra wood was used to make the clearly very irregular trackway-surface somewhat more even. For this purpose small pieces of wood were laid in the gaps between curved trunks, that were sometimes rather big, but also between fairly straight trunks. To some extent branches were used for this purpose, or thin trunks with diameters of 3–8 cm. The length was always appreciably less than 2.5 m; usually c. 1–1.5 m. This type of 'surface-levelling wood' we have distinguished from the logs of the trackway-surface on the basis of its considerably smaller length and sometimes on the basis of its position, *i.e.* not so much in the middle part of the trackway, but more in the periphery. The species of wood found are oak, birch and alder.

A different type of surface-levelling wood was made from so-called slabs, that we can regard as the pieces of wood left over when square posts are made out of round trunks, (fig. 24). These outer planks, often hardly more than 1 m long, but usually c. 10 cm wide, were very suitable for levelling the trackway-surface because on one side they were flat while on the other they had the gentle curvature of the fairly thick trunk. They could easily be lain between the round trunks. Most of this surface-levelling wood was used rather towards the outside of the trackway than in the middle. Wood species; oak and alder.

The presence of this surface-levelling wood was positively confirmed only in the course of the excavation of trench 2. This was because a considerable proportion of the slabs had slipped down between the logs of the trackway-surface, possibly already soon after the trackway was built, but to some extent undoubtedly as late as during the recent shrinkage of the peat, that resulted in some displacement of the elements of the trackway-surface with respect to one another. Only when the trackway-surface logs were removed did it become clear how extensively this surface-levelling wood had been used in building the trackway. In the drawing of the trackway surface (fig. 17) the presence of this surface-levelling wood is therefore not precisely indicated, but it consists of the shorter pieces of wood among the trackway-surface logs between 2.5–3 m long.

Similar surface-levelling wood was also found in trench 7, though it was not recorded as such in the drawing. Going through the field data of the 1964 excavations we were also able to establish with certainty the presence of this surface-levelling wood. Here it was less abundant than in trench 2, however. We may assume that this system of making the trackway-surface even was part of the predetermined method of construction.

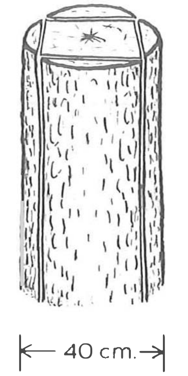


Fig. 24. Slab-wood or slabs, as they are produced by making a square post out of a tree-trunk.

3.4.4. *Constructive aspects*

No connections between pieces of wood were found. We may assume that the builders of the trackway were aware that considerably greater stability could be achieved by attaching the various construction elements to one another (substructure, trackway-surface logs, surface-levelling wood) or by clamping the trackway-surface down on to the peat surface with the aid of wooden pegs. Consequently that carrying capacity of the trackway could have been greatly increased. Evidently the builders of the trackway did not find it necessary for their purposes, to make a construction that was as solid as possible.

We can say with certainty that the trackway-surface was not covered with turves, sods, bunches of twigs or litter. In preparing the trackway-surface during excavation we paid special attention to the presence of any such material. If this had been present then we would certainly have noticed it. In building the trackway no sand or stone (pebbles) was used. It is not known whether the builders of the trackway were aware that these materials are completely unsuitable for the construction of a trackway on (undrained) raised bog, or whether this material was not used for reasons to do with the organization of building activities.

The trackway was not provided with any drainage system in the form of ditches. In view of the high water level in the peat-bog in this region at the time when the trackway was built (many holes contained open water), we may assume that ditches on either side of the trackway would not have had any effective drainage function in this waterlogged peat.

With the exception of the westernmost part of trench 2, the trackway ran over a slightly undulating surface with hummocks and holes, as ascertained in trench 7 (Casparie, 1972; fig. 25). The carrying capacity of the hummocks must have been fairly great. By this we mean that at the time when the trackway was built it would have been possible for several people to stand together on the oval hummocks, some 3–6 m across, without any danger of sinking into the bog. The situation was different in the holes with waterlogged peat. Anyone attempting to walk here would certainly have sunk down to a depth of some decimetres. In that part of the trackway with a substructure–trenches 1, 2, 3–the hummock and hole system may have been less well developed; here, with the exception of the bog-fringing fen wood, it was presumably wetter. The presence of the substructure here may be connected with the absence of the somewhat drier hummocks.

In the bog-fringing fen wood large pools would undoubtedly have been present. The large quantities of tree roots and stumps would certainly have made this peripheral area somewhat firmer, but we can assume that it could not have been made use of easily without a trackway-surface.

The trackway has many characteristic features that indicate that it was built for wheeled traffic. Such features include in particular the width of almost 3 m and the use of surface-levelling wood. An important and in fact necessary constructive aspect for driving wagons over the peat surface is the attachment of transversely lain elements to the longitudinally lain building elements; carrying capacity and the stability are greatly increased in this way. This applies especially to this peat-bog region. Many spots can be pointed out, *e.g.* in trench 7, where use of the trackway-surface by wagons must have resulted in the wagons overturning on account of the great difference in carrying capacity between hummocks and holes. This applies especially where the trackway-surface logs rest on one side on a hummock and on the other side in a gully or a hole (figs. 17 and 25).

We have not been able to establish the presence of (secondary) adaptations to the (origninal) construction method, in the form of additional layers of wood, stakes driven into the subsoil, bunches of twigs, other constructions, *etc.* We therefore assume that the building of the trackway took place in a single phase, and that after this no (extra) provisions were made to repair or improve any damaged parts or weak spots.

With many of the logs it was still possible to see how the trees from which they came had been felled, even though the state of the wood had deteriorated considerably before becoming overgrown by peat. These technological aspects and certain points concerning the construction method will be dealt in more detail in chapter 4 (4.4.2.), in connection with the tree species represented, the choice of wood, *etc.*

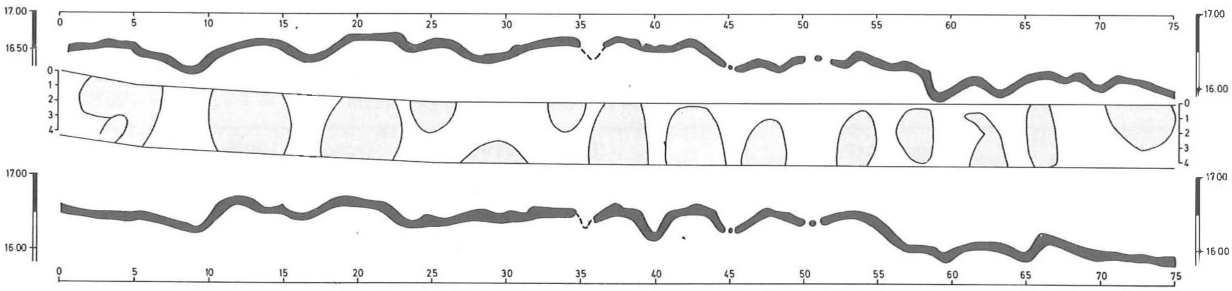


Fig. 25. Nieuw-Dordrecht 1964 (trench 7), the trackway-surface relief (in black) on both sides of the trackway, and the pattern of hummocks (stippling) below the trackway-surface. Note the relation of the trackway-surface relief and the presence of hummocks, after Casparie, 1972.

3.5. Dating

The age of the trackway is evident from three C14-datings, for logs from the trackway surface of three different trenches:

Trench 2, log 413 (*Quercus*), the outermost 10 annual rings:
4020±35 B.P. (GrN–10.760)=2070 B.C.;

Trench 4, log 39 (*Alnus*), although not separately mentioned, presumably the outermost 5–10 annual rings: 4080± 55 B.P. (GrN–1087)=2130 B.C.;

Trench 8, log no. not known (*Alnus*), here also presumably the outermost 5–10 annual rings:
4100±55 B.P. (GrN–2986)=2150 B.C.

The distance between the first and the second dated log is c. 130 m, and between the second and the third dated log 480–500 m.

The datings are relatively close to one another; there is no reason to assume that a number of phases could be distinguished. We therefore assume that the building of the trackway was a single event, that we can date at c. 4050 B.P.=2100 B.C. The information derived from pollen analysis (Van Zeist, 1959; 1967; Walvius, 1964) fits in well with this dating.

We regard the construction of this trackway as an activity of the PFB culture, that had become established in this region already c. 2200 B.C. (Harsema, 1981; Van der Waals, 1964).

4. THE WOOD

4.1 The wood species identified

All the wood from trenches 2 (1981), 7 (1964) and 8 (1960) has been identified (table 1). In the case of trench 2 two separate categories of wood are distinguished; part of the wood found there originates from the bog-fringing fen wood ('natural forest'). This was not used for building the trackway.

The wood species represented are *Quercus*, *Tilia*, *Betula* and *Alnus*. For each trench there are distinct differences, that will be discussed in detail. The wood species used all occur in the region close to the trackway. *Quercus* was generally present, both on the (cover-)sands and the boulder-clay soils as well as in the highest part of the bog-fringing forest. *Tilia* occurred mainly on the boulder-clay ridge, and would also have been present on the poorer sandy soils. *Betula* was an important component of the severely degraded forest on sand, but also grew in the bog-fringing forest, in which *Alnus* predominated.

Comparing the wood species identified with the pollen-analytical information (2.1.1.) about the tree species present in these surroundings, it is evident that the builders of the trackway restricted themselves to a relatively assortment. For further details see 5.2.1.

4.2. The wood species for each trench

Most of the wood constitutes the trackway-surface: the transversely lain logs. In the case of trench 2, as previously mentioned, also a substructure, consisting of longitudinally placed tree-trunks, and surface-levelling wood are distinguished. The latter is made up of smaller elements, that served to make travelling along the trackway more comfortable. This surface-levelling wood consists partly of branches, and partly of slabs. This division made for trench 2 is shown in table 2. The column headed 'trackway-surface logs' of this trench can be directly compared with the data of trenches 7 and 8 in

Table 1. Nieuw-Dordrecht. Wood identifications for trenches 2 (1981), 7 (1964) and 8 (1960), together with the totals for these trenches. Here the identifications for the bog-fringing forest are not taken into consideration.

	Trench 2 (1981)				Trench 7 (1964)		Trench 8 (1960)		Trenches 2, 7, 8	
	Bog-fringing forest		The trackway		The trackway		The trackway		The trackway	
	N	%	N	%	N	%	N	%	N	%
Quercus	28	40.6	239	40.0	37	10.7	–	–	276	26.2
Tilia	–	–	10	1.7	–	–	–	–	10	1.0
Betula	8	11.6	254	42.6	20	5.8	2	1.8	276	26.2
Almus	33	47.8	94	15.7	289	83.5	107	98.2	490	46.6
Total	69		597		346		109		1052	

Table 2. Nieuw-Dordrecht. Wood identifications for the categories distinguished for trench 2.

	Bog fringing forest		Trackway-surface logs		Surface-levelling wood				Sub-structure	
					Slabs		Branches			
	N	%	N	%	N	%	N	%	N	%
Quercus	28	40.6	176	42.1	39	59.1	20	46.5	4	5.8
Tilia	–	–	10	2.4	–	–	–	–	–	–
Betula	8	11.6	182	43.5	3	4.5	8	18.6	61	88.4
Alnus	33	47.8	50	12.0	24	36.4	15	34.9	4	5.8
Total	69		418		66		43		69	

table 1. In the discussion on the wood catalogue these matters are dealt with in more detail.

Trench 2. For the substructure *Betula* was used for the most part, but also occasionally *Quercus* and *Alnus*. In the case of the trackway-surface logs *Quercus* and *Betula* predominate, but also *Alnus* was regularly used. Noteworthy is the use of *Tilia*. The slabs, that were used to make that trackway-surface more even, consisted almost exclusively of *Quercus* and *Alnus*; in addition branches of *Quercus, Betula* and *Alnus* were used.

Trench 7. The proportion of *Quercus* and *Betula* is considerably less; *Tilia* is absent. The most important tree species for the trackway is now *Alnus*.

Trench 8. Here the trackway consists almost exclusively of *Alnus*, while *Betula* is very occasionally present. In addition to *Tilia* also *Quercus* is absent from this part of the trackway.

The variable composition of the trackway in terms of wood species is a question of wood choice, that to some extent is related to the supply of wood available. In the following sections we shall deal with various aspects of this choice, with the use of the wood and the way in which it was worked, and with a few technological aspects.

4.3. The use made of the wood: the substructure of trench 2 (fig. 17)

Of these longitudinally placed logs almost two-thirds have their thick end towards the west, from which direction the trackway was built. The distance between the logs varies quite considerably, and is mostly between 20 and 50 cm. Fig. 26 shows a number of characteristic features of the logs forming the substructure. The thick end of the logs varies from 4 to 14 cm; for two-thirds of the logs this is between 7 and 9 cm. The average diameter of the thick end is 8 cm, and of the thin end 4 cm. The thinnest top end measured 2 cm across, the thickest 12 cm. Three-quarters of the logs had a top end between 3 and 5 cm thick. The variation in diameter is linked rather closely to the length of the logs.

From fig. 17 it is evident that there is no regularity in the way in which the logs of the substructure were laid down. Only in one place can a distinct change in style of construction be ascertained, namely at 25 m in trench 2. To the west of this line most of the 27 complete logs of the substructure (fig. 26) measure 1–5 m in length; only 2 logs are considerably longer: more than 7 m. In the eastern part of trench 2 most of the 32 logs are between 4 and 8 m long. 9 logs are shorter and 1 log is longer. In terms of method of construction the eastern part is somewhat more regular than the western part (fig. 17). The differences between the two parts are to a considerable extent related to the quality of the bog surface: in the western part there are still a lot of stumps of the bog-fringing forest. The more regular picture presented by the eastern part is not necessarily indicative of greater efficiency or a more systematic method of building, but could also be merely an adaptation to the less problematical state of the peat-bog surface.

For this substructure mainly remarkably thin, relatively long trunks of *Betula* were used (table 2). These trunks were presumably of little value for constructive purposes, but they could be used effectively for the substructure. Maximum use was made of these trunks, *i. e.* they were felled immediately above the roots, after which in fact only the branches of the canopy were removed. As mentioned previously, the thin end of the trunks was in many cases only a few centimetres thick. In the case of two logs the thick end was cut in the shape of a 'pencil point'. This phenomenon is dealt with more fully in the discussion about the trackway-surface logs. The use of *Betula* may have been determined by technical reasons relating to transport; entire trees were used. Heavier

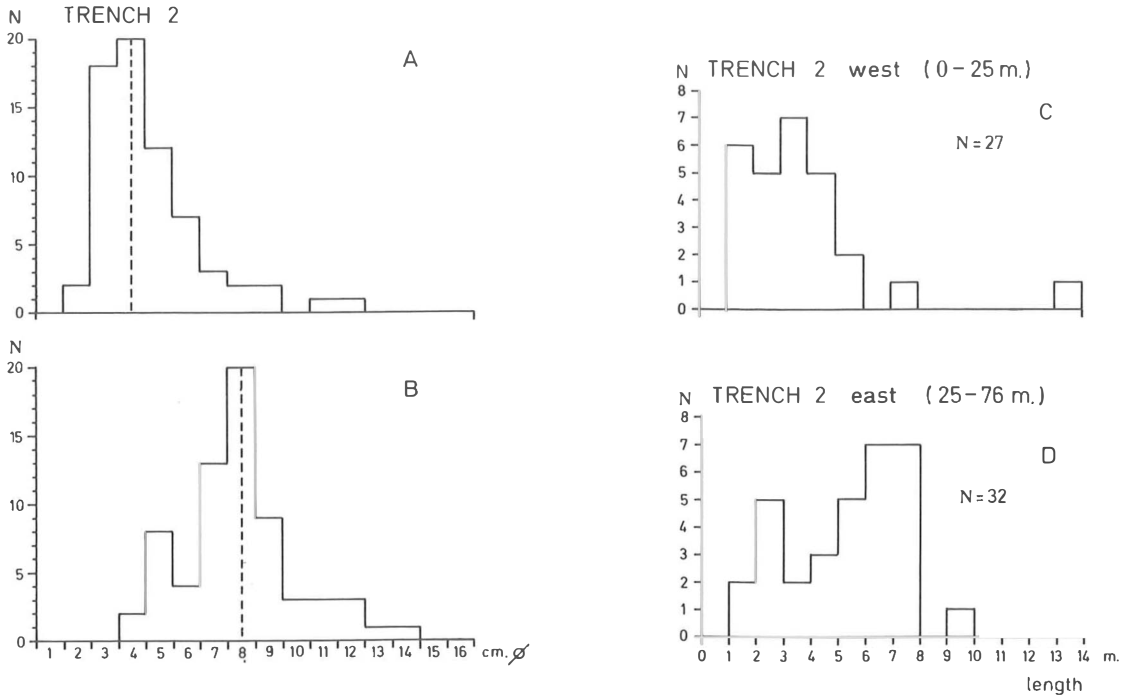


Fig. 26. Nieuw-Dordrecht 1981 (trench 2), several characteristics of the substructure wood. A. diameters of the topmost ends of the logs, in cm (average 4 cm); B. diameters of the bottom ends of the logs in cm (average 8 cm); C. the length of the underlying timbers in metres in the western part of trench 2 (0-25 m); D. the length of the underlying timbers in metres in the eastern part of trench 2 (25-76 m).

timber of the same length would undoubtedly have been much more difficult to transport.

The four *Alnus* logs are also slender trunks; they are all situated east of the construction change at 25 m. For the substructure of the most western part of the trackway no *Alnus* was used, although it grew at this spot.

The substructure elements of *Quercus* are in three cases probably branches, perhaps originating from oaks present in the immediate vicinity. In one case we find a very long, somewhat thicker *Quercus* trunk, which we assume to have come from the local bog-fringing forest. *Quercus* was used as substructure only in the most western part of the trackway

The *Betula* logs with a thick end of 7 cm or more (*i.e.* most of the logs) had reached an age of some 10-20 years. We assume that they did not grow on the peat-bog, but on the open sandy soil, where conditions were favourable for rapid, straight growth. The wood showed no signs of having been damaged by insects, nor were there many traces of curl wood or other diseases. The timber would have been cut down especially for constructing this substructure, and would have been worked as fresh-wood. Presumably the alders that were used grew near the birches.

The substructure logs to the east of the construction change at 25 m do not come from the same place as the substructure wood to the west of the construction change. This is indicated by the differences in log length (fig. 26) (and in diameters) and the exclusive occurrence of *Alnus* east of the construction change and *Quercus* to the west of this line. The construction change can therefore be regarded as a boundary between two separately built parts of the trackway. The length of these two separate units of the trackway could not be determined.

4.4. The use made of the wood: the trackway-surface logs

4.4.1. *Introduction*

The identification results for trenches 2 (1981), 7 (1964) and 8 (1960) are shown in tables 1 and 2. For trenches 7 and 8 all the identified wood is ascribed to the trackway-surface logs.

For a discussion of the wood species used for trackway-surface logs and surface-levelling wood the data that have been collected are presented in a wood catalogue (fig. 27). Occasionally it was difficult to distinguish clearly between trackway-surface logs and surface-levelling wood, because some logs were distinctly shorter than ±2.5 m (the width of the trackway surface) (3.4.3.). As a general rule this did not cause any insoluble problems, as the surface-levelling wood was almost always shorter than 1.5 m.

4.4.2. *Catalogue: the trackway-surface wood of trench 2 (fig. 27)*

In the wood catalogue the data that have been collected are presented in the serial order of the logs in the trackway-surface. For trenches 7 and 8 this concerns only the species of wood present; for trench 2– both trackway-surface logs and surface-levelling wood–this concerns a number of additional characteristics.

In fig. 27 the wood catalogue of the surface-levelling wood of trench 2 is placed right at the top, although this wood is discussed later (4.5). The data are placed directly above the trackway-surface logs of trench 2, between which the surface-levelling wood was found.

The characteristics that have been distinguished are as follows:

No. The logs are numbered from west to east in this catalogue; only every tenth log is indicated with a number. These are not the field numbers. The numbers of the surface-levelling wood are not given.

The wood species. For each of the four wood species there is a separate line; the wood species is indicated by means of a dot.

Diameter. This was measured near the thick end of the log, in centimetres. This measurement thus indicates approximately the original diameter of the tree. Usually the bark had disappeared as a result of cleaning the log in order to measure the diameter exactly. In this way the optimal measurement was obtained for estimating the wood mass (5.2.2.). As far as the cleft wood is concerned, the thickness that was measured is not always equivalent to the diameter of the trunk. Apart from a few exceptions the cleft wood was from tree trunks that had been split in two, so the thickness measured still gives an approximate indication of the trunk diameter.

Slow growth. A number of oaks have conspicuously narrow annual rings, indicative of slow growth, that was however very regular. Here we are concerned with trees that stood in rather dense forest stands. Conspicuously slow growth is indicated by means of a small tree symbol.

Cleft wood. A proportion of the trackway-surface logs consisted of cleft wood; in almost all cases this came from trunks of some thickness that had been split in two (see above). In the wood catalogue a solid semicircle indicates that the trackway-surface log is a cleft piece of wood.

Top end. Some of the logs, in particular those of *Quercus*, consisted of smooth trunks; other

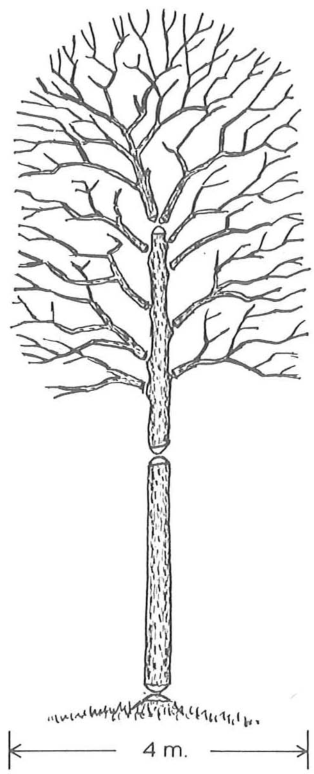


Fig. 28. The production of two trackway-surface logs from one tree-trunk. The lower log, without any traces of side-branches: base end. The upper log with side-branches cut off: top end (Dutch: *spilstuk*). The base end could often be cleft into two logs.

logs had side-branches, carefully cut off. The smooth logs were usually rather large in diameter. Here we are concerned with (oak) trunks of sufficient length for them to be cut into two parts (fig. 28). The lower smooth part is thus the base end, while the upper part, from which side branches of the canopy have been cut away, is called the top end. The latter is indicated by an S (Dutch: *spilstuk*). This situation occurs in fact only with trees from a more or less dense forest. With free-standing trees branch formation also occurs at a lower level. Such trees do however have a base end of the trunk, that as a general rule can be clearly distinguished from a top end. A proportion of the base ends of *Quercus* consisted of cleft wood. In such cases one whole tree trunk can provide three trackway-surface elements.

'*Pencil point*'. Most of the pieces of timber had short, blunt points, a feature that is characteristic of the Neolithic and that indicates the use of stone axes for felling the trees. About thirty posts had at the thick end much longer, sharper points. These were almost exclusively birch trunks. These trees had clearly been felled in a different way. We do not think that some other kind of axe, *i.e.* of metal, was used here, although the points concerned do indeed indicate this possibility. The most probable explanation is that this way of felling can be ascribed, as an individual characteristic, to the particular working practice of one or several wood-cutters, seeing that most of the soft wood (*Betula, Alnus*) did not have a 'pencil point'. These sharply pointed extremities of felled trunks are indicated in the catalogue by means of a separate symbol in the shape of a pencil point.

The subareas, in which the wood catalogue can be subdivided per trench on the basis of the origin of the wood, are indicated by capital letters.

4.4.2.1. *General remarks concerning the wood*

The selected thicknesses: Most of the logs are between 10 and 25 cm thick. This points to a certain selection procedure as regards trunk thickness, although no clear preference is evident for any particular thickness. 70 logs are thinner than 10 cm; 24 logs have a diameter that is greater than 25 cm. Within the range of 10–25 cm diameters of 15-20 cm predominate.

The wood that is thicker than 20 cm is often cleft wood. This applies particularly to diameters greater than 25 cm. With such thicknesses we are usually concerned with tree-trunks that also could be cut into a base end and a top end. These measurements apply to trunks without bark; for oaks–with a bark thickness of 1 cm–the thicknesses given in the wood catalogue should be increased by 2 cm to obtain values that are directly comparable to trees with bark; for birch and alder this additional thickness is 1–2 cm.

Only in a limited number of cases were the annual rings counted to ascertain the age of the trees that had been felled. Most of the oaks measuring 15–20 cm were 50–70 years old; birches of the same diameter were mostly 30–40 years old; alders measuring 15–20 cm varied in age from 20 to 50 years. Also a few considerably older trees were used; in these cases exclusively cleft wood was concerned, see below.

The processing of the wood: The absence of insect damage in the wood, on which the bark is often still present, indicates the use of fresh timber, that was undoubtedly felled specifically for this purpose. Only in one case was a log worm-eaten, on the underside. It is not clear whether a dead tree was used here, or whether this is secondarily used wood. Two logs form a clear exception in another way: firstly no. 39, a slab of *Betula*, with traces of burning on the underside. The trunk thickness of this tree must have been more than 75 cm. Secondly there is no. 412, a slab of *Quercus*, of which the trunk thickness of the tree must have been at leat 125 cm. The pieces of wood had rotten to an extreme degree. Both pieces are undoubtedly refuse from wood-working activities elsewhere. In the case of the piece of oak-wood we think this may have been left over after the manufacture of a disc-wheel, for which trees with a diameter of more than 1 m are required. Two logs show traces of burning (nos. 376 and 378), in both cases at the thick end. We think it is possible that this is the result of a forest fire and not of the use of fire in the peat-bog at the time when the trackway was being built.

The preparation of the tree-trunks to make trackway-surface logs did not take place on the peat; during the excavation no traces of wood cutting activities (chips, shavings, *etc.*) were found. The process of cleaving the wood always produced good surfaces. No connecting devices for wood (pegs and holes, tongue-and-groove joints) were found. Evidently there was no need for these; this is also an indication of the use of timber felled especially for this purpose.

The order in which the various species of wood were found in the trackway-surface (fig. 27) indicates that no supply-depot of wood was involved here, but that the trees were worked into trackway-surface logs immediately after they were felled (by removing side-branches, and by cleaving or cutting the wood to the required length where necessary), after which these logs were transported straightaway to the trackway, presumably in the form of loads of several logs. Loads of large numbers of logs would have been impossible to transport on account of the great weight. Additional evidence for the supposition that we are concerned here with as it were a single processing system of labour (felling, removing branches and cutting to the right length, cleaving, transport) is the occurrence in small groups of a few other characteristic features of the wood: slow growth, long trunks, the joint occurrence of top ends and (cleft) base ends of trunks of trees that apparently grew together in the same place, the presence of 'pencil points'.

The quality of the wood: The wood showed only few traces of curl wood or other diseases. Frost scars on the wood were absent. We may assume that the forests that were exploited for the supply of timber had already been quite severely degraded (see further on), but were nevertheless in a healthy state. This also applies to the forests on poorer soil. The absence of frost scars could also be ascribed to mild winters with less severe frost. The change in climate that is thought to have occurred c. 2000 B.C. (Casparie, 1972) would therefore be a matter not only of increased precipitation, but also a decline in (winter) temperature.

For a number of oaken logs it was possible to ascertain remarkably slow growth. This phenomenon partly goes together with greater trunk length. Here we are concerned with timber that originated from fairly to extremely dense forest.

As previously stated, some of the birch timber had been felled in such a way that 'pencil points' were produced. This way of felling, that is remarkable for the Neolithic, was possible here because birch-wood is fairly soft. To what extent the presence or absence of pointed ends produced in this way is directly connected with differences in hardness of the birch-wood is difficult to ascertain. In any case the logs with 'pencil points' were not in a poorer state of preservation than the rest of the birch timber. We think it most probable that individual differences in the working method of wood-cutters are involved here.

4.4.2.2. *The choice and use of the wood*

The trackway was built from the west towards the east. As we can assume that the process of converting standing trees into elements of the trackway took place as a series of immediately consecutive activities, the wood catalogue provides information, from left to right, about the choice of wood and any changes therein.

From a large number of tree species that were available, as is evident from the pollen-analytical information (2.1.1.), four were used, of which *Quercus* and *Betula* predominate in trench 2. The frequent occurrence of the latter species indicates that the durability of the wood did not play any predominant role. Looking over the wood catalogue of trench 2 (fig. 27), for the nos. 241–242 (36–37 m), a clear transition in the use of wood can be ascertained. In the western part (1–36 m) *Betula* predominates;. in the eastern part (37–75 m) *Quercus*. This distinct change in the choice of wood is accompanied by a number of other changes, that will be discussed more fully further on. As explanation for this change we assume that in the first place extensive birch stands aged 20–40 years were made use of before changing over to the exploitation of oaks. These birch-stands were undoubtedly the result of the wide-scale clearance activities in this region, after which birches had the opportunity to spread on fallow arable soil or deforested soil. This may have been the previously mentioned large-scale clearance, that can be dated c. 2200 B.C. (2.2.1.).

The oaks in the eastern part of trench 2 (37–75 m) are of somewhat greater age, often some 50–70 years. They could originate partly from forest regeneration, *e.g.* on abandoned pasture, and partly from natural forest, that was of course already degraded. We shall deal with this aspect more fully further on. The oaks are on average somewhat thicker than the birches; the greater weight of the oaken logs would undoubtedly have necessitated a different approach to the task of transportation compared with the birch logs.

Notable features of the oak logs include the fairly frequent occurrence of cleft wood and use of top ends. This indicates an efficient use of wood.

4.4.2.3. *Origin of the wood*

The direct processing of standing trees into trackway-surface logs implies that the trackway-surface contains 'work units', that are to be found in the wood catalogue. In the first place it remains an open question whether these were units in time (*e.g.* daily production), in transport, or human production. From these units the forest composition cannot be directly deduced, as by far not all tree species were made use of for building the trackway. Nevertheless it is possible to get some idea of the state of the forest, especially regarding the degradation of the forest and the type of soil (figs. 3 and 7). Here we assume that *Quercus* occurred both on sand and on boulder-clay, and that it was not absent from the bog-fringing forest. It probably also occurred on abandoned, fertile pasture. In this type of soil *Quercus* germinates well, better than in fallow arable soil. *Tilia* would have been present mainly on boulder-clay. *Betula* grew especially as the first phase of forest regeneration on abandoned fields; in addition it occurred–sparsely–in the bog-fringing forest. In this forest *Alnus* predominated. The pollen-analytical results provide information on the tree species present in this region (2.1.). Here we shall not go further into the aspect of forest composition on the basis of this information (5.2.).

We presume that the trees were felled in the first place at as short a distance away as possible from the planned course of the trackway, to avoid (unnecessary) transport problems. Felling was not done exclusively to meet the needs of building the trackway, as we can see from the choice of wood for the surface-levellers (4.5); we therefore assume that those parts of the forest that were being cleared were maximally exploited, *i.e.* felling activities resulted in (local) deforestation.

For this discussion we have divided the wood catalogue of trench 2 into 10 sections, that are discussed here from left to right, as it were following the construction of the trackway (fig. 27).

A. Very severely degraded forest, possibly on or near boulder-clay; possibly an abandoned field, where *Betula* was able to expand considerably, not very far from the margin of the bog. Log no. 39, a slab of *Betula*, width 46 cm, is undoubtedly refuse from (other) wood-cutting activities. Some of the birches and alders have 'pencil points', possibly indicating the work of an individual wood-cutter.

B. Here too a severely degraded forest, but possibly not in the immediate vicinity of the boulder-clay ridge; not very far away from the margin of the bog. The groups of oaks could have been forest remnants between the field complexes, whereby birch became established on the abandoned fields. Here too are birches and alders with 'pencil points'. Possibly both species of tree grew together in one and the same forest. The oaks with top-end characteristics could have been free-standing trees, for cleft oak timbers are almost completely absent here.

C. The original forest must have previously disappeared here for the most part or completely. The spread of birch was probably not located in the neighbourhood of the boulder-clay ridge, but not close to the margin of the peat-bog either. The group of oaks (nos. 138, 141, 144, 145) may have been a boundary dividing fields. Some of the birches and an alder have a 'pencil point'.

D. Largely depleted original forest, replaced by birch, close to the margin of the bog. The few oaks–that show top-end characteristics–may come from a boundary dividing fields.

E. Spread of birch on abandoned arable land or possibly part of the bog-fringing forest of birches and alders, with a few oaks.

F. Spread of birch on abandoned arable, presumably close to the bog-fringing forest, in which alders were present. 'Pencil points' predominate with birches as well as alders. Therefore one single felling activity of a restricted working area is presumably represented here.

Between A-F on the one hand and G-J on the other the differences are so great, particularly a sharp transition regarding the choice of wood, that G-J clearly must have resulted from other felling activities and possibly also other forests.

G. A stretch of generally dense forest, on or very close to the boulder-clay ridge, not close to the margin of the peat-bog. In a few places the forest may already have been degraded. This was presumably not the original forest. Some of the oaks show slow growth; this together with the other features such as regular, straight, long trunks is possibly indicative of forest regeneration on fairly fertile soil, some 50–70 years before these trees were felled.

H. Dense oak forest, very similar to that of G, *i.e.* trees 50–70 years old, partly cleft, partly consisting of top ends and to some extent also having grown remarkably slowly. All the trees almost certainly come from the same place, not the original forest, but forest regeneration on fairly fertile soil (possibly boulder-clay), not close to the margin of the bog.

I. Forest possibly corresponding to G and H, but then already degraded; not close to the margin of bog.

J. To some extent (nos. 390–403) a possibly not yet degraded oak-lime forest on or near boulder-clay, in the vicinity of the margin of the bog, with relatively many thinner trees. Originating from a different place than the wood of subareas H and I. Nos.
on average somewhat thicker; presumably not in the vicinity of the bog-fringing forest, felled in an oak-lime forest that had not yet been degraded. No. 412, a slab, *Quercus*, 62 cm wide, is undoubtedly refuse from other felling activities, possibly from the manufacture of a disc-wheel, as mentioned previously.

As far as the choice of wood and origin of the wood are concerned, the subareas A-E show that the first trees to be used were birches, the first phase of forest regeneration on abandoned arable, that was generally not very far away from the margin of the bog. The subareas F-I indicate the felling of forest that was much less degraded and/or open, presumably on better soil, not very close to the edge of the bog. In subarea J wood is present, that to some extent grew closer to the edge of the bog, and to some extent corresponds with that of subareas G and H. Wood refuse is only used as an exception.

Apart from this exception, trackway-surface elements of very thick, very old trees are lacking. The original forest may already have been almost completely felled, so the wood found here, with the exception of *Alnus* and to some extent *Betula*, comes from the secondary forest.

4.4.3. *Catalogue: the trackway-surface wood of trench 7*

4.4.3.1. *General remarks concerning the wood*

The identification results are given in table 1; for the wood catalogue see fig. 27. The way in which this has been put together is explained in 4.4.2.

The selected thicknesses: From the excavation drawing (fig. 16) it can be deduced that most of the logs have a trunk thickness between 10 and 25 cm, and that especially diameters between 15 and 20 cm predominate, corresponding exactly to the situation in trench 2. Some of the wood was cleft, mainly the thicker logs, though this was not systematically recorded. Here too the bark was still present in many cases. No counts of annual rings were made, but broadly speaking the wood does not differ from that of trench 2.

The processing of the wood: Here too, just as we were able to ascertain for trench 2, fresh wood was used, that was immediately processed. Joints to connect the wood were lacking, while this was nevertheless necessary for a functional trackway surface, in view of the limited carrying capacity of the peat-bog surface (Casparie, 1972). At the extremities of these logs the traces of felling were still clearly visible; it was not ascertained whether the trees had been felled with 'pencil points'. We may assume that the wood was processed in the same way as is indicated for trench 2.

The quality of the wood: This was in principle equivalent to what we were able to ascertain for trench 2. However, also a few distinctly misshapen, bent trunks were used, particularly of *Alnus*. The state of preservation of the wood found here was better than that of the wood of trench 2. Nevertheless it was not possible to ascertain any more details of the wood processing.

4.4.3.2. *The choice and use of the wood*

Alnus with c. 83% (table 1) is the most important type of wood for this part of the trackway; in addition *Quercus* and *Betula* were used, though to a much lesser extent. Here too the durability of the wood evidently played no (important) role in the choice of wood.

From the wood catalogue of trench 7 (fig. 27) it is evident that *Quercus* and *Betula* are present mainly in the western part of the trench (log nos. 1–75; 1–18 m); in the remaining part *Alnus* occurs almost exclusively. We explain this by assuming that here we have the point at which the available forest on the higher soils – that was already severely degraded – was exhausted. Now all that was left as a supply of wood for the trackway was the bog-fringing forest, in which *Alnus* was the most important tree. However, as we can see from the wood composition of trench 2 (table 2), this forest was in use almost since the beginning of the construction of the trackway.

No further data were collected concerning the age of the timber. The occurrence of cleft wood – also *Alnus* – points to the presence of rather thick trees in the bog-fringing forest, and to an efficient use of wood, as we have also ascertained for trench 2.

4.4.3.3. *Origin of the wood*

In the same way as the characteristic features of trench 2 have been presented here too the following remarks can be made, following the construction of the trackway from west to east (fig. 27).

K. Already degraded forest, close to the bog-fringing forest, possibly even from the higher part of the *Alnus*-rich bog-fringing forest, in which *Quercus* and *Betula* also occur. In this case we are not concerned with the expansion of birch on abandoned fields.

L. Transition from the oak-rich forest on cover-sand to the bog-fringing forest, though not yet trees actually growing on the peat-bog surface.

M. Bog-fringing forest, consisting mainly of *Alnus*, with a few oaks and birches here and there, certainly growing on peat-bog soil but presumably not on the very wet bog surface.

N. Bog-fringing forest, consisting almost exclusively of *Alnus*, with little *Betula*, and where *Quercus* no longer occurs. Almost certainly on very damp to wet peat-bog soil.

As far as the choice of wood and its origin are concerned, subareas K and L indicate that the forest on the higher sandy soils became used up; forest on boulder-clay was not used here. Whether the forest was severely degraded at the spots where K and L were felled is difficult to say. It cannot be excluded that the soil here was unsuitable for agriculture (too wet).

Subareas M and N indicate the exploitation of the bog-fringing forest, and then not exclusively that part where the trees are still rooted in the mineral soil, but also the forest growing on the peat-bog, where the soil was very damp. This bog-fringing forest had not been cleared previously; the first deforestation took place for the purposes of building the trackway. Neither very thick, very old trees nor wood-working refuse was used for building this part of the trackway.

4.4.4. *Catalogue: the trackway-surface wood of trench 8*

4.4.4.1. *General remarks concerning the wood*

The identification results are given in table 1; for the wood catalogue see fig. 27. The way in which this has been put together is explained in 4.4.2.

The selected thicknesses: Here too, as for trench 7, it can be deduced from the excavation drawing (fig. 16), that most of the logs have trunk thicknesses of 10–25 cm, but that thicknesses of 15–20 cm predominate. Some of the wood was cleft; it was not exactly noted which logs were involved. Evidently there were still thick trees available for building the trackway.

In general the picture that has been outlined for trenches 2 and 7 is also applicable to trench 8.

The processing of the wood: We assume that for building this part of the trackway too fresh wood was used, that was processed straight away. This cannot be concluded on the basis of the wood composition, but the presence of bark on many logs and the absence of joints connecting the wood are indicative of this.

The quality of the wood: This was not different to what has been ascertained for trenches 2 and 7. No unusual phenomena were observed, such as the abundant use of misshapen trunks.

4.4.4.2. *The choice and use of the wood*
Alnus was found almost exclusively (table 1). We assume that this is not a matter of a selection made from different types of wood, but that the bog-fringing forest was the only forest still available for the trackway. The pollen diagrams (figs. 4–6) do not support this assumption however. In view of the presence of cleft wood, the material was indeed used efficiently. Alders that grow close together have only few branches and a small canopy. They are therefore easy to cut down and process further.

4.4.4.3. *Origin of the wood*
In the same way as the characteristic features of trench 2 have been presented, here too the following remarks can be made (fig. 27).

O. Bog-fringing forest, consisting almost exclusively of *Alnus* but only very little *Betula*, on very damp to wet peat-bog soil.

It is clear that here exclusively the bog-fringing forest was exploited for building this part of the trackway. This forest with a width of 50–100 m, had not been exploited prior to the construction of the trackway.

4.5. The use made of the wood: the surface-levelling wood

The presence of this was initially ascertained, as stated previously, only in trench 2; from reconsideration of trenches 7 and 8 it is clear that this finishing-off activity was practised over the entire (known) length of the trackway. The discussion here is limited to the surface-levelling wood of trench 2, see in this connection table 2 with the identification results and the wood catalogue (fig. 27) that fit in together with those of the trackway-surface wood of trench 2.

In as far as round-wood was used, all the locally available wood was in principle suitable; there is therefore no question of any selection of wood. With the slab-wood the situation is different, although no convincing picture can be gained on account of the limited numbers of such pieces of wood. Nevertheless the information indicates that square beams were made out of oak and alder

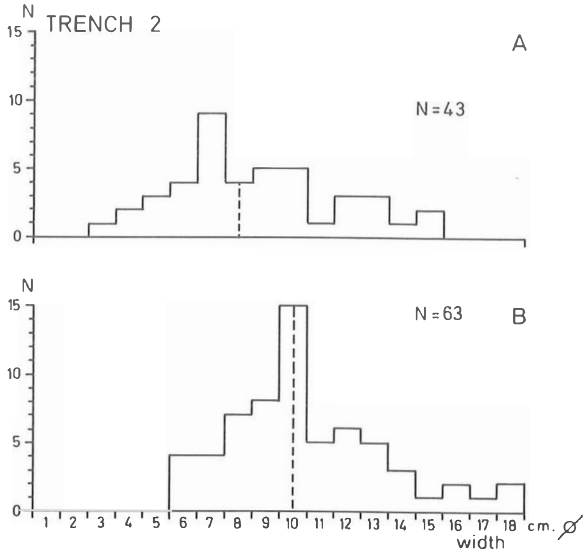


Fig. 29. Nieuw-Dordrecht 1981 (trench 2), a few characteristics of the levelling wood. A. diameters of the branches used as levelling wood, in cm (average 8 cm); B. width of a number of slabs (average 10 cm).

trunks with diameters of more than 25 cm; probably as much as c. 35 cm. This wood was not present in the trackway, which suggests that other felling activities took place in this region apart from those concerned with providing wood for building the trackway.

In fig. 29 the range of thickness of the surface-levelling wood is shown, as far as this could be well determined. The average thickness of the branches is 8 cm. From several slabs with a width of 10–14 cm it has been established that the trees from which they came had a diameter of 25 cm or more.

Also these slabs were used in a fresh condition, indicating that the felling activities took place at the same time as the construction of the trackway. Settlement traces of the PFB culture, *e.g.* in the form of ground-plans of houses, are not known for Nieuw-Dordrecht. In view of the restricted occurrence of birch slabs, *Betula* was possibly not used very much for construction purposes.

This distinct change in the choice of wood for the trackway-surface logs of trench 2, log nos. 239/240 (transition from F-G) (fig. 27), does not coincide with any conspicuous change in the surface-levelling wood. In the subareas H and I exclusively *Quercus* slabs are present however. Possibly there is nevertheless some connection with the predominant selection of *Quercus* for the trackway-surface timbers in subareas G and H, in the sense that the slab-wood refuse comes from the same forest complexes where the timbers of G and H were felled, but that the slab-wood became available somewhat later for the building of the trackway. A sort of 'delayed reaction', because the wood concerned had to undergo at least one stage more of processing. In that case the trees for the square posts, that were not used for the trackway, were felled in the same forest complexes as the trackway-surface logs of G and H. The associated PFB-settlement, if such indeed existed, could then have been situated very close to the wooden trackway.

5. INTEGRATION AND DISCUSSION

5.1. Destination, function and length of the trackway

5.1.1. *The possible destination*

The destination of the trackway, that is to say a distinct end-point to which the trackway leads, was not found, as already stated in 2.4. We assume, however, that this construction of the trackway was a planned activity, with the aim of reaching a certain destination. To what extent can all the data that have been collected give us some idea of the intended destination of the trackway? And which destinations can we exclude?

In the first place, we cannot exclude the possibility that here an uncompleted trackway is concerned, thus, without any 'demonstrable' destination. The fact that a trackway wide enough for wheeled traffic was built instead of for example a footpath that was easier to make could be an argument for an uncompleted construction. All the more so because the trackway was not intended to give access across only the especially wet lagg zone of c. 100 m width. Another argument in favour of an uncompleted trackway is the absence of any repairs to or (later) modifications of the construction system, that was definitely not an adequate one for this peat-bog.

If we assume that the trackway had a more or less straight course, then the probable destination area is the vicinity of the cover-sand ridge, the Runde and bog iron-ore areas A and B (figs. 7 and 10). If we also assume that the trackway represents a completed piece of work, of which we have not found the last part and end-point, then we can say with certainty that the other side of the peat-bog, that lay c. 13 km further east, could not have been the destination. As stated previously, no traces of the trackway have ever been found in the peat to the east of the cover-sand ridge (Postwegrug). Nor have any traces of it been found in the peat that overlies the cover-sand ridge (figs. 7 and 10). The sand-ridge itself, as we have already seen, was certainly not the destination of the trackway, as this had been overgrown by peat already 1000 years earlier (2.4.1.). The peat-bog was very wet at this spot (2.2.1.), so this area too could not have determined the direction of the trackway as a somewhat drier, more attractive intermediate section of the route. Also on account of the absence of ridges further east or southeast into the peat-bog, it is clear that the Postwegrug cannot have been intended as part of a larger, through-going route. We cannot imagine that the trackway was intended as a passage-way through the bog to get to the Runde. We have already demonstrated (2.4.3.) that there was nothing to be found there. From the distribution of bog finds (fig. 10) one gets the impression that the peat-bog itself had material or spots that could have served as a destination. The iron-ore spots A and B (fig. 10) are the first things that should be considered as a possible destination (2.4.2.). The peat-bog finds 14–17 can be correlated, in terms of situation, with the presence of bog iron-ore: the seepage centre B. Unfortunately, in most cases the presence of this role ore is not mentioned in the description (2.3.3.). No. 17, and also nos. 12 and 15 do nevertheless indicate that people were familiar with bog iron-ore in the Neolithic and EBA. The trackway could then have been intended to reach iron-ore area A.

Landweer (1912) mentions the occurrence of wood remains, possibly peat-bog trackways, close to area A. The location can be fairly well indicated (fig. 10). in the case of a, XIX (Bou), we are concerned with a wooden construction that is reminiscent in many ways of a trackway like that of Nieuw-Dordrecht, but then somewhat wider and with supporting timbers lying longitudinally under the trackway-surface wood, as found only in our trenches 1, 2 and 3. The depth given by

Landweer does not exclude a Neolithic or EBA dating, but there is by no means any certainty about this. Landweer ascertained a north-south orientation. This does not only clearly deviate from the trackway of Nieuw-Dordrecht, trenches 1–9, but as an extension of this trackway it would be more or less a bend in a backward direction; this seems not very probable to us. Therefore we do not consider Landweer's observation to be part of the trackway of Nieuw-Dordrecht. It is possibly a platform, that in our opinion must be seen exclusively in relation to the bog iron-ore. Such a destination cannot be excluded for a trackway, but there is no justifiable reason for regarding the Neolithic trackway of Nieuw-Dordrecht as a supply route or way of access to Landweer's platform a. As for the iron-ore area A, however, we can regard this as a possible point of attraction that led people to penetrate the bog already in the Neolithic or the EBA. Concerning the construction indicated near b, XX (Bou) (fig. 10) Landweer merely mentions that it has a different direction.

On the basis of the bog finds it is very well possible that also the iron-ore area B (fig. 10) was exploited or entered at the time when the trackway was in use. Nevertheless we do not see this spot as destination of the trackway, as the greater part of the route must then have existed without a wooden trackway-surface. In the area of peat between the iron-ore locations A and B, to the north of the overgrown Postwegrug, no traces of the trackway have been found.

The presence of ritual places or structures in this peat-bog region cannot be excluded. The location of the disc-wheel of Smeulveen, bog find no. 5 (2.3.3.; fig 10), is a strong indication of the existence of such sites; the ritual structure that can be dated to the MBA, near Bargeroosterveld, c. 2.5 km NNW of the Nieuw-Dordrecht trackway (Waterbolk & Van Zeist, 1961), bears witness to the reverence in which bogs were held. In neither case is there any connection between the ritual phenomenon and a wooden trackway through the bog. Moreover this also applies to most of the other bog finds that can be interpreted with certainty as being of ritual significance.

In the peat-bog region of Southeast Drenthe no single indication has been found of any ritual structure or place that could have served as destination of the trackway. On the basis of our data it is only possible to exclude a number of potential destinations; no justifiable statement can be made about the possible or probable end-point of this trackway.

5.1.2. *The possible function*

Especially since the end-point of the trackway is not known, there seems to be little sense in making any statements about its possible function. Nevertheless, with regard to its function a few points can be made.

If the trackway was intended to provide access to another area, if possible by making use of more passable parts of the peat-bog surface, then the construction of a wide trackway–suitable for wheeled traffic–can be seen as an obvious approach. For this wood facilitate the use of a wide range of possible ways of transport. In the above we have already argued (5.1.1.) that this connecting function is by no means likely. In that case we would be concerned with an uncompleted trackway.

Supposing that one of the iron-ore areas, and then in particular area A (fig. 10), was the destination of the trackway, then it may be assumed that the trackway was intended to serve mainly for the transport of iron-ore. The construction of such a wide trackway would then be remarkable. For the transport of bog iron-ore a footpath would have been sufficiently wide, as is clearly illustrated by the two Bronze Age footpaths north of the Nieuw-Dordrecht trackway (Casparie, 1978). If in Neolithic times people in Southeast Drenthe were already familiar with the technique of iron production–and for this there is no direct evidence–then the material could only have been processed in very small quantities at most. For the time being we doubt whether the technology was then already available for producing a temperature of c. 600° C under reducing conditions. Such a temperature is necessary for the production of iron from this kind of ore.

We may assume that the material was familiar to the builders of the wooden trackway of Nieuw-Dordrecht and/or their contemporaries living in the neighbourhood. This is indicated for example by the bog finds 12, 15 and 17, (2.3.3.; fig. 10). However, the occurrence of this ore cannot simply explain the construction of a trackway wide enough for wheeled trafffic, precisely from the point at which our trackway begins.

The bog iron-ore is present in the peat as a yellowish-white, greasy substance in reduced form; if it is exposed to the air, then it oxidizes in about three weeks to a conspicuously intensely coloured orange-red material, that turns into a powder when dried. Colouring agents are known to have been used long before the Neolithic. For this reason we cannot completely exclude the possibility that this bog iron-ore was indeed dug up, but then for the purpose of producing colouring matter. However, there is no direct evidence pointing in this direction.

The possibility that the trackway had a ritual function certainly cannot be disregarded. Van der Waals (1964: pp. 47-50) indicates for example the presence of two wooden hafts, bog finds nos. 3 (fig. 12) and 4 (fig. 14), just under the trackway-surface (2.3.3.). In this opinion these objects can only have been deposited intentionally. We consider it possible, however, that they could have been mislaid when the trackway was being built, partly because also fragments of hafts have been found. Apart from this point we are able to follow Van der Waals' argumentation completely: peat-bog often had a ritual function already in the Neolithic. This is emphasized by the many TRB hoard finds that have been made in raised bogs (Bakker, 1979).

In our investigations we have not found any concrete indications of a ritual function of the trackway, nevertheless the curious mode of construction-a wide trackway for wheeled traffic, that certainly did not lead to any other inhabited area-can be viewed as a possible indication of a non-functional, ritual purpose of the trackway (5.3.1. and 5.3.2.).

5.1.3. *The possible length*

The length that we are able to establish with certainty is c. 800 m (trenches 1-9) (3.1.; figs. 10 and 15). The trackway was somewhat longer. To the east of trench 9, in the course of peat-digging activities over some ten years wood that was part of the trackway was found, as it turned out from our enquiries. This makes it probable that the trackway must have been a good 1000 m long or slightly longer. This was confirmed to a certain extent following later enquiries, in the years 1981 and 1982 (pers. comm., Mrs. A.F. Smith).

If we assume that the function of the trackway was to facilitate the transport of iron-ore from spot A to the Hondsrug, then the trackway would have been c. 1500 m long (Landweer's spot a). The trackway would then have followed a distinct bend, that would have been a good deal sharper than the gentle bends known to us at present. For the purpose of calculation of the amounts of wood used (5.2.2.) we assume two possible lengths: 1000 m (minimal) and 1500 m (possibly maximal).

5.2. The use of the forest for building the trackway

5.2.1. *The wood species available*

The pollen diagram of Nieuw-Dordrecht (fig. 6) taken from Van Zeist (1959) informs us which woods were present in this region. Most of these species were not used for building the trackway. Many of the types indicated by Van Zeist do not have (suitable) stems or trunks and moreover do not occur abundantly: *Myrica, Humulus, Frangula, Rhamnus, Rubus, Lonicera, Hedera, Viscum. Pinus* grew only here and there on the peat-bog. *Salix, Populus, Ilex, Acer, Sorbus* and *Taxus* occurred only sparsely in the degraded forest. The last two species were actually made use of, *i.a.* for hafts, as is shown by the finds of these in trenches 8 and 1, respectively (figs. 12 and 13). *Ulmus* and *Fraxinus* may well have been present initially in the forest on sand, but the repeated interference since c. 3000 B.C. presumably resulted in the disappearance of these species here. They occurred abundantly on the boulder-clay ridge, c. 1.5 km and further to the northwest of the starting-point of the trackway (fig. 7). The absence of these wood species in the trackway could mean that wood for building the trackway was transported over a distance of less than 1.5 km. To what extent *Ulmus* also occurred in the *Tilia*-rich forest is difficult to say, but this forest was not intensively exploited for the trackway. *Fagus* and in particular *Carpinus* were at most very rarely present in the neighbourhood of Nieuw-Dordrecht c. 2100 B.C.

Noteworthy is the absence of *Corylus* in the trackway, although hazelnut shells were found in large numbers in various places between the trackway-surface logs, and this tree–possibly to some extent in the form of shrubs–was abundantly present in this region. Admittedly the quality of the wood is not good, but it is no worse than *e.g. Betula*. *Corylus* can expand well precisely in degraded forest, although it needs somewhat richer soil. Possibly the abandoned fields on sand were nevertheless too poor. But on the somewhat richer soils, that were also present here as is shown by the occurrence of groups of *Quercus* in trench 2, subareas G, H and J (fig. 27). *Corylus* was certainly present. However, this may only have been in the form of shrubs, that would have been useless for building the trackway. There is no single indication of any other reason for not cutting down *Corylus* for this trackway.

5.2.2. *Some remarks concerning the quantity of felled forest*

There is too little information available for us to be able to calculate with any degree of accuracy the size of the area of forest that was exploited for building the trackway. Nevertheless a rough idea can be given of the extent of the area of forest from which wood for the trackway was taken, albeit with much reserve. Our estimations are based on the following information.

In the first place mainly forest on sand was felled (much *Betula* and *Quercus*); the forest on boulder-clay was exploited much less intensively (relatively little *Tilia*). The sandy part of the ridge of Nieuw-Dordrecht covers c. 250 ha; the boulder-clay part with *Tilia*-rich forest is c. 100 ha in extent (figs. 3 and 7). The bog-fringing forest around the ridge mainly an *Alnus* carr, is some 50–100 m (average 75 m) wide. The total length of this belt of forest around the ridge is about 8 km.

From trench 7 it is apparent, as far as the choice of wood is concerned, that after about 700 m the builders of the trackway used exclusively wood from the alder carr (4.4.3.). This justifies the assumption that, to put it simply, no wood from the higher sandy soils, in fact the ridge of Nieuw-Dordrecht, was available for the trackway. In other words: the forest belt that had once been available here was now exhausted. This does not mean that there was no wood present here any longer.

From trench 2 it appears that when the trackway was being built, the first trees to be felled were all stands of birches on abandoned fields, including the field boundaries with *Quercus*, after which oak of the regenerating forest was used (4.4.2.). It can be assumed that the builders, in order to avoid long transport routes, acquired the wood as close as possible to the starting-point of the trackway, and that the forest was exploited as intensively as possible, which led to actual deforestation.

The amount of wood used for the trackway can be estimated, on the basis of log measurements of 15–20 cm diameter and 3 m length, at 0.35–0.48 m^3 of wood per metre of trackway. This is including the bark as our estimate is based on the maximum diameter, right at the bottom of the log. The values thus correspond to those of the standard-volume estimates (subtracting 12% for the bark). If we take an average value of 0.4 m^3 per metre of trackway, then for 700 m of trackway 280 m^3 is necessary. Assuming a (maximal?) trackway length of 1 km the amount of wood used is 400 m^3, and for a trackway length of 1.5 km this is 600 m^3.

The timber yield of planted forests on good soil can be as much as 400 m^3 per ha; for planted forest on soils comparable with those of Nieuw-Dordrecht, the timber yield would be c. 300 m^3 per ha of forest. The timber production of a natural forest is much less; it is very much dependent on the degree of interference, as caused by *e.g.* the felling of certain generations of trees. On the basis of experience in present-day forestry we can give a rough figure of 100–150 m^3 of timber per ha of forest (pers. comm., L. van Dijk). The yield of logs with diameters of 15–20 cm–*i.e.* the thicknesses most often selected for building the trackway–amounts to at most 50 m^3 per ha of forest; probably even about 40 m^3 per ha. Assuming a figure of 50 m^3 per ha of forest, a length of 700 m of trackway will require 5–6 ha of forest. For 1 km of trackway this figure is c. 8 ha of forest. It will be clear that with a greater influence of prehistoric man on the forest the area of forest required for such a trackway must have been greater.

From 700 m on *Alnus*, from the bog-fringing forest, is used almost exclusively. A stretch of 300 m of trackway from this forest that is on average 75 m wide, represents a strip of carr belt c. 320 m long, calculating in the same way.

Out of a total of 250 ha of sandy soil this amount of timber used takes up only a small amount of space. The transport route for timber across sand is then at most 200 m; almost negligible in relation to the transport along that part of the trackway already built. One could also suggest that this indicates extreme deforestation, more than 95%. This cannot be correct.

The amount of timber used can also be estimated on the basis of the canopy projection. A stretch of trackway 700 m long of wood from the sandy ridge means, for an average log thickness of 20 cm, with 5 logs being used per metre of trackway, a total of 3500 logs, coming from–an estimated–3000 trees. The canopy surface-area of trees can vary considerably, depending on the species and on whether or not a tree is free-standing or part of a dense forest. The canopy surface-area of trees with a trunk diameter of 20 cm can vary, broadly speaking, from 15 to 25 m^2. If we take a figure of 15 m^2 (dense forest situation) then the total canopy surface-area of 3000 trees can be estimated at 4.5 ha; taking a figure of 25 m^2, this is 7.5 ha. Only a proportion of the timber is suitable for the required purpose: the supply of logs c. 3 m long and 15–20 cm in diameter. This is dependent on very many factors, including the age of the forest, the amount of forest regeneration on previously felled spots and disaster such as fire. Also felling activities were carried out for other purposes, to an extent not known to us. To make some kind of estimate, we assume that 50% of the wood was too heavy; this corresponds to a canopy projection-area of 40%. 30% had suitable diameters (20% canopy projection) and 20% of the wood was too thin (10% canopy projection); then on 30% of the surface no trees are present. Of trees with suitable diameters only a few species are used: *Quercus*, *Tilia*, *Betula* and *Alnus*. If we suppose that this was three-quarters of the suitable timber available, then 15% of the forest surface provided suitable logs. The area of forest required for the first 700 m of trackway is then 30 ha (dense forest situation) to 50 ha. Calculating from the starting-point of the trackway 30 ha of more or less continuously dense forest is represented by a semicircular area with a radius of about 450 m. The longest supply route over sand of wood is in this case 450 m. For an area of 50 ha the corresponding radius is 550 m.

Out of a total surface area of 250 ha of the sandy part of the ridge of Nieuw-Dordrecht an area of 30 ha and even of 50 ha of forest is a relatively small proportion. We wonder whether the excessively long supply route or the absence of more forest on the ridge of Nieuw-Dordrecht could be the reason why the builders switched over, after 700 m of trackway, to the bog-fringing forest for the supply of wood. For the transport route over sand, however, an extra distance must be added, thus eventually the c. 700 m of the already constructed trackway, which means a total transport route c. 1200 m long. If after 700 m of trackway had been built, in our estimation corresponding to 30–50 ha of forest, the forest on the sand ridge had completely disappeared, then this would mean a very high degree of deforestation, aready before the trackway was built, of 75–87%. This does not seem realistic to us.

From the pollen-analytical information (2.1.1.) we know that the region had already been deprived of a considerable proportion of its original forest, partly for the provision of arable land, by means of a series of clearance activities, *i.a.* c. 2200 B.C. After these wide-scale clearances there again occurred extensive expansion of birch, *i.e.* part of the forest regenerated, whereby in addition to *Betula* also *Quercus* was able to expand. This forest would have been much more open, for the area was still in use by prehistoric man; we have no data concerning the degree of forest expansion, but if we assume that one-third of the region was again covered with forest, then 30–50 ha of forest represents an area of 90–150 ha for the timber supply; about one-third to more than half of the total sandy part of the ridge of Nieuw-Dordrecht. The maximal supply route across sand is in this case c. 800 m, or possibly 1000 m, so the total transport route for the wood is then 1.5–1.7 km.

A supply route 800 m long across sand means almost the entire width of the sand ride to the south of the boulder-clay plate. On the basis of the above-mentioned estimates and data a stretch of 700 m of trackway would nevertheless have signified a considerable deforestation of the area.

The probable length of the trackway is c. 1000 m. This means that for the following 300 m of trackway the bog-fringing forest was used, for which 1500 trees with a trunk diameter of 20 cm were required. If we here too assume a canopy surface-area of 15 m^2 for such trees, then 300 m of trackway represents a total canopy surface-area of 2.25 ha. If we assume that also for the bog-fringing forest 15% of the surface provides usable wood, then for this stretch of trackway almost 16 ha of bog-fringing forest is required. If the average width of this belt of forest is 75 m then this surface area represents a length of bog-fringing forest of about 2 km along the sand ridge.

The supply route for this timber along the margin of the peat-bog is then slightly longer than 1 km. In addition there is the distance of more than 700 m, up to 1000 m, over that part of the trackway already built. The total length of the transport route for the wood then amounts to maximally c. 2 km.

We have good reason to assume that the supply route over the boulder-clay ridge, from a northwesterly direction, was shorter than 1.5 km: the wood from the *Ulmus*- and *Fraxinus*-rich forests present there does not appear to have been used for building the trackway. However, we cannot rely on this fact as a gauge for the maximum distance over which the wood was transported, since the non-use of these tree species indicates rather that the forest on boulder-clay was exploited hardly or not at all: also the more closely situated *Tilia*-rich forest was not used on a large scale.

To summarize, we consider it very likely that there was a supply route that measured a total length of maximally 2 km. In our opionion this is evidence for the use of wagons or other means of transport in building the trackway.

5.2.3. *The possible length of time taken to build the trackway*

For 1 km of wooden trackway an estimated number of about 4500 trees were felled (see previous paragraph). If we assume that a wood-cutter using stone axes can fell 8 trees per day, corresponding to a stretch of trackway 1.4 m long (tree-trunks thinner than 20 cm were also felled), then the entire trackway represents ± 700 days of felling.

If we assume that the cutting away of the side-branches, the cleaving of the thicker trunks and the transportation of the wood from the felling spot to the construction site costs just as much time as the felling of the trees, *i.e.* also 700 working days, then the total amount of time invested in building 1 km of this trackway can be estimated at 1400 man-days. It would therefore be possible to accomplish such as task by 10 men, broadly speaking, in one winter season, after the harvesting of the crops in the autumn and before the sowing of crops in the following spring.

Our conclusion that no separate phases can be distinguished in the construction of the trackway, *i.e.* that this was an activity that took place all at one time, is in agreement with the above.

5.2.4. *The possible length of time during which the trackway was in use*

From the fact that also the not very durable *Betula* wood and the soft *Tilia* wood have been preserved, it can be deduced that the trackway lay on the surface for only a relatively short period–evidently less than 10 years.

During this period the upward-growing peat was able to protect the wood from the weathering effects of sun and oxygen in such a way that decomposition due to bacteria, moulds, insects, *etc.* came to a standstill. Generally the wood was only superficially penetrated by mycelia of fungi. The fossilization process in the acid, anaerobic peat environment had the result that most of the wood finally became fairly soft due to chemical and physical changes, but its microscopic structure was not affected.

On account of the weight of the wood the very soft, water-saturated peat-bog surface became pushed down slightly. In addition the pressure exerted on the trackway-surface by traffic (wagons, animals, people) may have been not insignificant.On account of the very high water level of the peat-bog, it became especially wet at the spot, a situation that was undoubtedly not the intention of the trackway-builders. As a result, the formation of peat was able to take place here under optimal conditions, so the process of the trackway becoming overgrown by ombrogenous peat was accelerated. This is a phenomenon that we have been able to observe for a number of prehistoric peat-bog trackways.

On the trackway also at the highest excavated part of trench 2, no trees became established. This can also be interpreted as an indication that the trackway lay on the surface for only a short time.

Only at one spot, right next to log 409 of trench 2, was a small stump of *Alnus* found, for which it is certain that germination took place after the trackway was built. This alder reached an age of only a few years, 4, 5 or 6 (the exact age could no longer be ascertained). It can be assumed that this sapling was smothered by the upward-growing peat. This too is an indication that the trackway lay on the peat-bog surface for only a short time. Finally it should be mentioned that the wood showed no recognizable traces of use. Nor were there any signs of wear present, such as cart-tracks. This too indicates that the trackway, if indeed it was used at all, was in use for only a short period of time at most.

The conclusion that can be drawn from the state of preservation of the wood, that the trackway was available for only a limited number of years–less than 10–is supported also by other data.

5.3. Additional remarks

5.3.1. *Organizational aspects*

The picture that is presented by the foregoing information of the Neolithic activities that resulted in this trackway is of course by no means complete. No traces have been found of the inhabitation that was undoubtedly present in the immediate vicinity. The tools and the means of transport that may have been used have not been found, except for a few items. In our opinion the broken wagon-wheel, the *Sorbus*-wood haft and the *Taxus*-wood axe haft (Van Zeist, 1956) belong to the trackway; we are less certain about the flint hoard of Nieuw-Dordrecht (Harsema, 1981; 2.3.3.). During the excavations no remains came to light of the undoubtedly large quantities of wood-cutting refuse. This is probably attributable to the fact that the actual starting-point of the trackway has not been excavated.

On the basis of both the dating for the trackway and the presence of the disc-wheel (Van der Waals, 1964) we can attribute the trackway to the people of the PFB culture, although the TRB and the BB also occur in this region; also either of these cultures could have been involved with the building of the trackway (2.1.1. and 3.5.), but this seems unlikely to us. For the TRB the dating for the trackway, together with that for the many disc-wheels (Van der Waals, 1964), is indeed very late. For the BB, on the other hand, the dating is somewhat on the early side.

From the data available some idea can be gained of the organization of the building of the trackway. As previously mentioned, the timber was not prepared at the building site–the trackway under construction; all wood-cutting activities were carried out at the site of felling in the forest or possibly at the starting-point of the trackway, still on the sand. As the trees were felled as close as possible to the trackway, we are concerned to some extent with one and the same area. Also the alders from the bog-fringing forest were not prepared at the building-site. Whether these trees were divested of branches *etc.* immediately at the felling spot, to be subsequently transported over the sand-ridge to the beginning of the trackway, we do not know; we must interpret the concept of 'wood-cutting site' primarily as the spot right next to the felled tree, also if the tree stood on the peat-bog.

The absence of broken or lost implements or tools in trench 2, such as axes, hafts and wedges, fits in exactly with the conclusion that the felled trees were worked elsewhere into logs.

Trees were felled not only for the trackway but also for another purpose (3.4.3.); we have suggested that this was for the construction of farm-buildings or dwelling-houses of a settlement situated nearby. In addition, we may assume that also *e.g.* firewood was produced. The efficient use of wood, that is evident from the trackway construction, means that also wood of smaller dimensions was used, especially branches, for different purposes.

It seems obvious to assume that the prepared logs were transported on wagons, at least as far as transportation over sand is concerned. However, on the wooden trackway-surface we have not found any sandy cart-tracks whatsoever, while traces of wear were also absent from the trackway-surface. We must not completely disregard the possibility that sand that got on to the logs has become washed away, but it does not seem very likely to us. Here it should also be mentioned that we have not found any broken, discarded parts of wagons, while with such intensive transport that must have been involved with shifting thousands of logs, the breaking of axles and wheels must have been unavoidable. This aspect of the construction is difficult to understand.

We have the strong impression that much of the wood used must have come from the regenerating forest that started to develop after the wide-scale clearance of this region that can be dated to c. 2200 B.C. (2.1.1.). Nevertheless a considerable part of the sand ridge must have remained unforested, otherwise it is difficult to explain that after ± 700 m of trackway (4.4.3.) this wood was no longer available. The possible subsidiary purpose of the tree-felling for the trackway could have been to reacquire arable land. As previously mentioned, we see the trackway as part of the activities of the people of the PFB culture who were already present here, and who also inhabited this region subsequently. In our opinion we are concerned here only with different traditions of the three Neolithic cultures (TRB, PFB, BB) and not with different population groups (2.1.1.).

Most of the timber used was 30–70 years old; the variation in age and thus the variation in trunk thickness was relatively small in comparison with an original, natural forest. It is very well possible that the usable wood was thus more than the figure of 15% of the forest surface-area assumed by us (5.2.2.). In that case the deforestation of the sand-ridge of Nieuw-Dordrecht would have been much greater than we have assumed to be possible.

The occurrence of 'pencil-point' felled (*Betula*) logs in addition to the other, blunter method of wood-cutting (4.4.2.) and the direct transport of the logs to the trackway indicate that the trackway is the work of a number of people. This conclusion can definitely be drawn, however, on the basis of the wide scale on which the work was evidently carried out (5.2.3.).

5.3.2. *The aim of the builders of the trackway*

There are no concrete indications available concerning the function of the trackway, perhaps partly because its end-point is not known to us. The answer to the question, why there was (suddenly) a need for a wide wooden trackway some distance into the bog, cannot be given; this has already been discussed in 5.1. and 5.2. Only a few aspects are sufficiently clear, and concerning a number of unsolved problems some marginal, partly clarifying notes can be made, that indicate above all what the destination could not have been.

The trackway was definitely intended for wheeled traffic, for the transportation of large or heavy loads. If there had only been a need for the transport of lighter or smaller loads then a footpath would have been sufficient, that could have been built much more quickly and with much less effort (5.3.3.). We do not believe that the aim of the trackway was to reach the opposite side of the raised bog situated c. 13 km away; evidence for this is of course difficult to provide, but the region providing the wood supply–the ridge of Nieuw-Dordrecht–was so small that we can assume that also the builders realized that for 13 km of trackway more wood is necessary than was present here. Therefore the aim of the trackway could not have been to meet a need for communication.

Over how long a period did the idea develop that a wide trackway had to be built through the bog? Naturally we are quite unable to answer this question but from the fact that no precursors have been found, in the way of stretches of trackway in the neighbourhood, it can be deduced that the trackway was most probably a fairly new requirement or necessity, not based on any ideas, techniques or customs that had already been in existence for a long time.

The trackway was fairly certainly built in a relatively short time, possibly in one season (5.2.3.). In view of the absence of any repairs or constructional modifications the trackway functioned for only a short period at most (5.2.4.). Therefore the need for this trackway appears to have been of short duration.

We can assume that the completed part of the trackway was hardly or not at all usable within the space of a few years, because conditions had become too wet as a result of the downward pressure of the weight of the wood exerted on the peat-bog surface, and due to the trackway-surface becoming overgrown, with *Sphagnum* peat.

In this region no other part-bog trackways are present dating from the late Neolithic or the EBA. After this single attempt at making the bog accessible for wagons by means of a wooden trackway, no further efforts were made to achieve this purpose, also not on the basis of modification of what was still left of the trackwav.

From the distribution of bog finds in this region dating from the Neolithic and EBA (fig. 10; 2.3.3. and 2.3.4.), it is evident that as a general rule no trackway was necessary for entering the raised bog. It is not knwon, of course, in which season the peat-bog was visited, but we think that it would have been mainly in the drier summer period and not in the wet autumn and winter-time; even taking into consideration the fact that there was then less precipitation than in the MBA and later periods. This applies to both entering the peat-bog without any kind of trackway or path and travelling by means of a man-made trackway. Also on the basis of this consideration it is evident that this trackway is the result of one particular need, of only short duration, for going into the peat-bog with wagons.

It is not impossible that while the trackway was being built it became clear that the construction of a wooden trackway in a living, upward-growing raised bog could not be realized, so that the work was stopped prematurely. The idea that we are concerned in a number of cases with so-called uncompleted peat-bog trackways is not new. An argument against this is that especially in regions where many peat-bog trackways are found this would mean a regularly occurring miscalculation, which does not seem very likely (Van Zeist & Casparie, 1966). In the surroundings of the Nieuw-Dordrecht trackway the nearest wooden trackways going into the raised bog are two footpaths, c. 900 years younger. The long time-interval therefore does not plea against the assumption that while the trackway was being built the decision may have been arrived at to stop the work prematurely.

The necessity for this trackway could also have been arisen as a result of the peat-bog becoming wetter precisely at this time, so that the passability of the surface, that was already limited, became reduced even further. We associate increasing wetness of the peat-bog surface with thc changes in the peat-forming environment that took place since c. 2000 B.C. (Casparie, 1972). However, there are no indications that the bog had become considerably wetter c. 2100 B.C. It is certain that the peat-bog region concerned was particularly wet already long before the trackway was built. The excavation of trench 7 in 1964 made it clear that the holes here contained permanently open water (fig. 25); a wetter situation than that resulting from the increase in precipitation c. 2000 B.C. developed to a wide extent elsewhere in this raised bog region. That the passability of the peat-bog surface became distinctly more limited c. 2100 B.C.–if conditions of increasing wetness already prevailed–seems unlikely to us.

That the builders of the trackway miscalculated the possibility of making the peat-bog thus accessible, because they were not familiar with the peat-bog, is not very likely. In any case there is evidence of previous occupation already for some centuries–at least since c. 3000 B.C.–in this region. We find it hard to imagine that the inhabitants of this region were unaware of the upward growth of the peat-bog surface between 3000 and 2100 B.C.

What can be established is that for the greatest part of the trackway (trenches 4–8) the builders used a method of construction–only a trackway surface, without any perpendicularly placed substructural components–that must be qualified as insufficiently solid for this peat-bog (figs. 16, trench 7; and 25). For a stable trackway in this very wet peat, substructure and trackway-surface components should really be attached to one another *e.g.* by using wooden pins to make fast the trackway-surface in the peat, as can be seen in the case of several younger peat-bog trackways. We must assume, albeit with some hesitation, that the builders were nevertheless insufficiently capable of designing the right kind of wooden constructions to make the peat accessible for wagons. This again could indicate that the builders of the trackway were unfamiliar with the growth of raised bog.

Analyzing the possible destinations, it can be excluded that the trackway ran to a sand ridge, the Postwegrug (2.2.1. and 2.4.1.). Nor was the intention to reach the bog stream, the Runde (fig. 10). The question remains what attractive thing there could have been in the peat-bog to find or to do, that prompted the idea of getting there via a trackway. We have already suggested the possibility–however unlikely it may seem–that it was attempted to reach the iron-ore regions (fig. 10) by means of wagons (2.4.2., 5.1.1. and 5.1.2.). We may assume that the presence of this material was known to the trackway-builders. However, we doubt whether they knew that this was the raw material for the production of iron. But even if they did know this, it still cannot be explained why cart-loads would have been necessary. In the MBA iron production did take place in this region (Casparie, 1978), but this involved a process whereby only small quantities of ore could be treated (pers. comm., J.J. Butler and J.A. Charles). For the supply of such small quantities no wide trackway for wheeled traffic would have been necessary, but only a footpath; *e.g.* the Southern plank footpath, that is, however, c. 900 years younger than the wooden trackway of Nieuw-Dordrecht.

The possibility that iron-ore was used in a dried state as a colouring agent is an attractive idea that would still permit us to give the trackway some functional significance, but it is not based on any single direct observation. Thus the possibility remains that the trackway may have had a ritual, sacred function.

5.3.3. *Comparison with wooden peat-bog trackways elsewhere*

Comparison of the Neolithic situation near the ridge of Nieuw-Dordrecht with that in the Somerset Levels (Coles *et al.*, 1975; 1976; 1977), leads to a number of interesting points, but does not help us any further in solving the problem of the destination and function of the wooden trackway of Nieuw-Dordrecht. In both cases we are concerned with sedentary Neolithic occupation (in the Somerset Levels demonstrable already since c. 3200 B.C.) close by peat-bog, that was penetrated by the inhabitants.

There are also distinct differences in terms of the environmental situation. The peat-bog of the Somerset Levels is c. 6 km wide; within it, c. 2.5 km away from the higher soils (Polden Hills) there are a few very attractive, fairly large islands of sand and rocks (Burtle, Honeygar, Westhay, Meare). Already in the Neolithic these were intensively used, *i.a.* for agriculture. The bog itself was for the most part still in the stage of fen peat formation; it was still predominantly covered by carr vegetation. It was a rich source of food supply, which made it an attractive hunting ground, that moreover provided other raw materials, such as wood and reeds. At times extensive flooding occurred.

The Bourtanger Moor near Nieuw-Dordrecht was a oligotrophic, predominantly ombrogenous raised bog where there was little to be had. Only the bog marginal forest, 50–100 m wide, would have been more attractive on account of its richer environment. Here the peat-bog was considerably wider, about 13 km, without any intermediate islands of sand; in fact, as we have stated previously, it was impossible to cross. There was also less variation in the amount of open water present in the bog surface, in comparison with the peat-bog of the Somerset Levels.

The large number of Neolithic wooden trackways in the Somerset Levels, intended to a considerable extent to connect the higher soils and the above-mentioned islands of sand and rock, indicates the need for regular contact since c. 3200 B.C. For most of the tracks the fu ction is clear; only in one case is it probable that the wooden trackway had a function other than providing a means for crossing the peat-bog: the so-called Garvin's Tracks of c. 2400 B.C., that may have served to provide access to fishing areas or a hunting ground.

Various building methods were used, but here the light constructions with light material predominated: bunches of twigs and wattle mats. A conspicuous feature is the absence of trackways wide enough for wheeled traffic; only narrow trackways were built, at most 1.5 m wide. We may assume that for the purposes of communication there was no need for wheeled traffic.

In a few cases it could clearly be shown that a part of trackway that had been found was a special adaptation to particular local circumstances, such as the very wet lagg zone near the higher soils (Rowland's Hurdle Trackway, c. 2260 B.C.), and a very wet zone in the middle of the peat-bog (Walton Track, c. 2300 B.C.). The majority of these light wooden trackways or footpaths functioned for only a short while, sometimes a few years at most; they were quite rapidly overgrown by peat.

All in all, it is clear that these trackways were mainly intended to maintain contact between Neolithic settlements and their farmlands, and for communication. In those places where the soil could not simply be crossed, a wooden trackway was built, if necessary with appropriate foundation. The very wide-scale research that has been carried out indicates an effective construction method by the builders, who were aware of the problems concerned with building trackways on the bog surface.

The penetration of the Bourtanger Moor since c. 3000 B.C. in Southeast Drenthe–which evidently took place as shown by the bog finds (2.3.4.)–led to the construction of wooden trackways and footpaths to a much lesser extent; there were only five of these in this peat-bog region up until the beginning of the Christian Era. The reason for this is clear. To the east of this inhabited region there were no settlements or farmlands to be reached. There was obviously no need for a simple means of contact, via some kind of light construction, with the inhabitants on the other side of the peat-bog, 13 km away.

The trackway of 2100 B.C. is made of heavy material, mainly logs and cleft wood of considerable weight. It is unlikely that the people of the PFB culture here were not familiar with the use and possibilities for use of bunches of twigs and wattle mats upon the bog surface. We must assume that a light construction with such light material was considered unsuitable for the wheeled traffic intended, and was therefore disregarded.

For that part of the trackway in the bog-fringing forest, that was 75 m wide at this spot, no special construction technique was used; the use of longitudinally placed substructural components continues into the following part of the trackway lying on the raised bog surface (figs. 16 and 17, trenches 1–3). An effective construction method, to prevent wagons from tipping over was lacking over most of the length of the trackway. The builders of the trackway were aware of the problems of a trackway surface with round-wood for wagon traffic, as is evident from the use of surface-levelling wood.

Also this trackway became rapidly over-grown by the peat; no attempts were made to prolong the length of time during which the trackway was functional, either by making modifications or in any other way. As long as we do not know what the destination was of the Nieuw-Dordrecht trackway, it seems, in comparison with the situation in the Somerset Levels, that there was hardly any or no sence in building such a heavy, wide trackway on this peat-bog surface without providing it with very much substructure.

From the northern part of West Germany almost 300 prehistoric and early-historical (wooden) trackways are known (pers. comm., H. Hayen) from many peat-bogs; some of these bogs are large, and some are small or narrow. In the last-mentioned case such trackways often connect the higher areas on either side of the peat-bog, as for example in the Grosse Moor am Dümmer (Hayen, 1980: fig. 1). Such routes through the whole peat-bog are usually trackways suitable for wheeled traffic (Hayen, 1979).

For the Ipweger Moor Hayen (1963a: fig. 1) mentions some thirty wooden trackways and paths, of which only a few can be regarded as connecting trackways between areas of sand; most of them by no means extend right across the whole peat-bog. Here it is remarkable that quite a lot of the footpaths present date from the Early and Middle Bronze Age (Hayen, 1963b). A number of trackways investigated by Hayen are distinctly trackways for wheeled traffic that date from the Iron Age (Hayen, 1963b; 1965; 1978).

In the region studied by Hayen the number of peat-bog trackways that can be dated in the Neolithic is small, in relation to the total number of trackways. From this it could be deduced that in the Neolithic the need for frequently entering the peat-bog and for crossing right over it was not yet as great as in the Somerset Levels, Southwest England. This could be connected with the fact that in the German region relatively few finds have been made up to now in the peat of disc-wheels that can be attributed to the PFB culture (Hayen, 1973).

Hayen (1979) mentions for the Grosse Moor am Dümmer a few fairly wide wooden peat-bog trackways, that have not been studied in any further detail, that on the basis of stratigraphy can be dated to the Neolithic, the trackways XXIV (Pr) and VII (Pr). The latter has a width of 3.5.–4.5 m. It is possible that further research will elucidate whether these trackways, that probably extended right across the whole peat-bog, can be ascribed to the PFB culture and whether they were built with the intention of using them for wheeled traffic. However, no such trackway has yet been demonstrated in the German region. Therefore on the basis of the German material it is not yet possible to get any clearer idea of the aim of the wooden trackway of Nieuw-Dordrecht.

The 'Buinerbrug' (Mulder, 1911; 1912; Van Giffen, 1913) is the only other wooden trackway in the Dutch part of the Bourtanger Moor that is certainly of Neolithic age (Waterbolk, 1954). The information given by Mulder and Van Giffen about the method of construction shows some differences, but in general it is clear that there was a trackway-surface of transversely laid logs, 3.5–4.5 m long; possibly in some places there may have been a substructure of longitudinally laid logs. A covering layer (turves, sods, sand) has not been demonstrated. There is known length of trackway of at least 500 m. The trackway must have been wide enough for wheeled traffic. The western starting-point of this peat-bog trackway was presumably not situated on the Hondsrug, but on the eastern levee or river dunes to the east of a course of the Hunze, the main river draining the Dutch part of the Bourtanger Moor.

Van Giffen (1913) mentions that the trackway is mainly made of *Pinus* tree-trunks, on which it was still possible to see where the many side-branches had been present before they were cut off. This is clearly shown on his excavation drawing. Partly on the basis of this Van Giffen comes to the conclusion that the trackway was actually not used.

Although broadly speaking this trackway corresponds to that of Nieuw-Dordrecht in terms of the method of construction, there is on the one hand too little information available and on the other hand there are distinct differences, so also this trackway does not give us any further information about the possible destination of the wooden trackway of Nieuw-Dordrecht.

To resume, it can be said that the destination and function of this wooden trackway still cannot be satisfactorily deduced from the abundance of information and points of discussion presented in this article.

6. REFERENCES

ACHTEROP, S.H. & J.A. BRONGERS, 1979. Stone cold chisels with handle. (*Schlägel*) in the Netherlands. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek* 29, pp. 255–263.

BAKKER, J.A., 1979. *The TRB west group: studies in the chronology of the makers of hunebeds and Tiefstich pottery* (= *Cingula* 5). Amsterdam.

CASPARIE, W.A., 1969. Bult- und Schlenkenbildung in Hochmoortorf. *Vegetatio* 19, pp. 140–180.

CASPARIE, W.A., 1972. Bog development in Southeastern Drenthe (the Netherlands). *Vegetatio* 25 pp. 1–276.

CASPARIE, W.A., 1978. De absolute ouderdom van Landweer's voetpad in het veen van het Emmercompascuum. *Nieuwe Drentse Volksalmanak* 95, pp. 229–242.

CASPARIE, W.A., 1980. De toestand van de Neolithische veenweg van Nieuw-Dordrecht (Report to State Forestry Service).

CASPARIE, W.A., 1981. De Neolithische veenweg van Nieuw-Dordrecht (Report to State Forestry Service).

CASPARIE, W.A. & W. GROENMAN-VAN WAATERINGE, 1980. Palynological analyses of dutch barrows. *Palaeohistoria* 22, pp. 7–65.

CASPARIE, W.A. & A.F. SMITH, 1978. Het stuk hout van dominee de Graaf: een oude veenvondst uit het Emmererfscheidenveen. *Nieuwe Drentse Volksalmanak* 95, pp. 243–257.

COLES, J.M., B.J. ORME, F.A. HIBBERT & G.J. WAINRIGHT (eds.), 1975; 1976. *Somerset Levels Papers* 1; 2. Hertford.

COLES, J.M., B.J. ORME, F.A. HIBBERT, G.J. WAINRIGHT & C.J. YOUNG (eds.), 1977. *Somerset Levels Papers* 3. Hertford.

ELZINGA, G., 1962. Prehistorische werktuigen van edelhert- en elandgewei uit Drenthe. *Nieuwe Drentse Volksalmanak* 79, pp. 185–219.

GIFFEN, A.E. VAN, 1913. De Buinerbrug en het steenen voetpad aldaar. *Oudheidkundige Mededelingen Rijksmuseum van Oudheden* 7, pp. 51–90.

GLASBERGEN, W., 1957. De gesteelde stenen hamerbijl van Emmercompascuum. *Nieuwe Drentse Volksalmanak* 74, pp. 16–18.

GLASBERGEN, W., 1960. De dolk van Bargeroosterveld. II. Herkomst en datering. *Nieuwe Drentse Volksalmanak* 77, pp. 190–198.

HARSEMA, O.H., 1981. Het neolithische vuursteendepot van Nieuw-Dordrecht, gem. Emmen, en het optreden van lange klingen in de prehistorie. *Nieuwe Drentse Volksalmanak* 98, pp. 113–128.

HAYEN, H., 1957. Zur Bautechnik und Typologie der vorgeschichtlichen, frühgeschichtlichen und mittelalterlichen hölzernen Moorwege und Moorstrasse. *Oldenburger Jahrbuch* 56, Teil 2, pp. 83–170.

HAYEN, H., 1963a. Zwei hölzerne Moorwege aus dem Fundgebiet Ipwegermoor B, Kreis Ammerland (Bohlensteg I und Bohlendamm VII). *Neue Ausgrabungen und Forschungen in Niedersachsen* 1, pp. 113–131.

HAYEN, H., 1963b. Grosse Bohlenwege im Randmoor westlich der Unterweser. *Praehistorische Zeitschrift* 41, pp. 206–209.

HAYEN, H., 1965. Menschenförmige Holzfiguren neben dem Bohlenweg XLII (Ip) im Wittemoor. *Oldenburger Jahrbuch* 64, Teil 2, pp. 1–25.

HAYEN, H., 1972. Vier Scheibenräder aus Glum. *Die Kunde* N.F. 23, pp. 62–68.

HAYEN, H., 1973. Räder und Wagenteile aus nordwestdeutschen Mooren. *Nachrichten aus Niedersachsens Urgeschichte* 42, pp. 129–176.

HAYEN, H., 1978. Ausgrabungen am Bohlenweg VI (Pr). *Jahrbuch für das Oldenburger Münsterland*, pp. 81–94.

HAYEN, H., 1979. *Der Bohlenweg VI (Pr) im Grossen Moor am Dümmer* (=Materialhefte zur Ur- und Frühgeschichte Niedersachsens 15). Hildesheim.

HAYEN, H., 1980. Durch das Moor hinlaufende Blockwege in der Gegend von Lohne. *Lohne (Oldenburg) 980-1980*. Vechta, pp. 47-63.

LANDWEER JZ., G.J., 1912. Nieuw ontdekte houten veenwegen (veenbruggen) in Drente. *Nieuwe Drentse Volksalmanak* 30, pp. 135-141.

MULDER, G.J.A., 1911. Veenbruggen en de nieuw ontdekte Buinerbrug. *Tijdschrift Kon. Ned. Aardr. Genootschap* 28.

MULDER, G.J.A., 1912. De Buinerbrug en het steenen voetpad aldaar, *Oudheidkundige Mededelingen Rijksmuseum van Oudheden* 6, pp. 63-72.

SCHWABEDISSEN, H., 1966 (1967). Ein horizontierter 'Breitkeil' aus Satrup und die mannigfachen Kulturverbindungen des beginnenden Neolithikums in Norden und Nordwesten. *Palaeohistoria* 12, pp. 409-468.

SPOEL-WALVIUS, M.R. VAN DER, 1964. Pollen analytical studies on disc wheels. With a reference to the Radiocarbon dates. *Palaeohistoria* 10, pp. 147-156.

WAALS, J.D. VAN DER, 1964. Prehistoric disc wheels in the Netherlands. *Palaeohistoria* 10, pp. 103-146.

WATERBOLK, H.T., 1954. *De praehistorische mens en zijn milieu*. Diss. Groningen.

WATERBOLK, H.T. & W. VAN ZEIST, 1961. A Bronze Age sanctuary in the raised bog at Bargeroosterveld (Dr.). *Helinium* 1, pp. 5-19.

ZEIST, W. VAN, 1955a. Pollenanalytical investigations in the Northern Netherlands, with special reference to archaeology. *Acta Botanica Neerlandica* 4, pp. 1-81.

ZEIST, W. VAN 1955b. Some Radiocarbon dates from the raised bog near Emmen (Netherlands). *Palaeohistoria* 4, pp. 113-118.

ZEIST, W. VAN, 1956. De veenbrug van Nieuw-Dordrecht. *Nieuwe Drentse Volksalmanak* 74, pp. 314-318.

ZEIST, W. VAN, 1957. Twee neolithische veenvondsten te Nieuw-Dordrecht. *Nieuwe Drentse Volksalmanak* 75, pp. 12-15.

ZEIST, W. VAN, 1959. Studies on the Post-Boreal vegetational history of South-eastern Drenthe (Netherlands). *Acta Botanica Neerlandica* 8, pp. 156-185.

ZEIST, W. VAN, 1967. Archaeology and palynology in the Netherlands. *Review of Palaeobotany and Palynology* 4, pp. 45-65.

ZEIST, W. VAN & W.A. CASPARIE, 1966. Veenwegen uit het verre verleden. *Wegen* 40, pp. 110-125.

Manuscript completed in 1983.

Fig. 5 is to be found in the fold at the back of this volume.