

THE TWO IRON AGE WOODEN TRACKWAYS XIV(Bou) AND XV(Bou) IN THE RAISED BOG OF SOUTHEAST DRENTHÉ (THE NETHERLANDS)*

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ABSTRACT: In the raised bog of Southeast Drenthé, a part of the Bourtanger Moor, six prehistoric wooden trackways have been found, of which two can be dated to the Iron Age. The trackways were built on an ombrogenous peat-bog surface with different types of hummock-hollow systems. XV(Bou), the northern plank footpath near Bargerooosterveld, made of oak, is dated to 530 ± 40 BC. It probably crossed the entire raised bog (c. 12 km), and shortly after its construction it was intentionally destroyed. It is supposed that after a bog burst, dated to c. 500 BC, the peat-bog surface was too dangerous to pass across. XIV(Bou), the hurdle trackway near Emmerschans, dated to 170 ± 50 BC, is constructed of wattlework of willow on a substructure of roundwood of different wood species. The hurdles were made in exactly the same way as modern hurdles. The track was probably used for the transport of bog iron-ore, present in the peat at a distance of about 3 km from the bog margin, to Iron Age dwelling places on the higher sandy soils. This area was intensively occupied in the Iron Age, as is also demonstrated by the large Celtic Field complexes.

KEYWORDS: The Netherlands, Southeast Drenthé, Bourtanger Moor, Iron Age, wooden trackways, prehistoric and modern hurdles.

1. INTRODUCTION

1.1. Prehistoric wooden trackways of Southeast Drenthé

This is the third article about the wooden trackways in the raised bog area of Southeast Drenthé, in the region around Emmen. The first article was concerned with the Neolithic trackway of Nieuw-Dordrecht (Casparie, 1982), the second article dealt with the three Middle Bronze Age footpaths (Casparie, 1984). The present article concerns the two Iron Age bog trackways: a footpath and a trackway made of wattlework (fig. 1). In the previously published articles attention was devoted to various aspects of the geology, the vegetation development, the formation of peat, and the history of the occupation of this region. In the present study this previously published information will be referred to; here we shall confine ourselves to providing supplementary information. No discussion will be presented here of the history of occupation in the Iron Age, apart from a few general remarks. This subject is too broad to be dealt with adequately within the scope of this study, that is concerned with the archaeological information provided by the bog finds. With this third article an integral study of the peat-bog trackways of Southeast Drenthé has been completed.

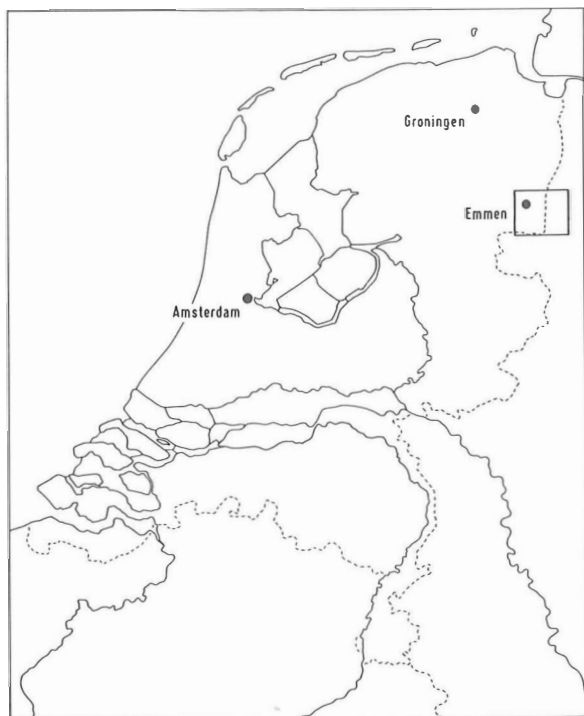
1.2. The aim of the study and the framework of this paper

The two trackways have been discussed in various publications (i.a. Wesselink, 1924; Landweer, 1912; van Zeist, 1955a, 1955b; van Zeist & Casparie, 1966; Casparie, 1972, 1978; Casparie & Smith, 1978), none of which involved an integral approach. This article is intended to be the final report of the various excavations and of the other, palynological and peat-stratigraphical research, with the aim of explaining the presence of the bog trackways and their (possible) functions. Section 2 gives a broad description of the vegetation development from c. 800 BC until AD 100, and of the development of the bog surface in this period. Section 3 is concerned with the actual trackways; the main topics here include the method of construction, the manufacture of the constructional elements, the course of the trackways, and their destination and function. In section 4 an attempt is made to give a comprehensive picture of all the information and the relationship between the various aspects of these two bog trackways and the rest of the research.

* Figs 10-14, 27 and 28 can be found in the fold at the back of this volume.

1.3. The situation of the trackways: a broad overview

The 'northern plank footpath' XV(Bou) near Bargerosterveld (fig. 2), that has been dated to 530 ± 40 BC (GrN-4622), was presumably intended



to be a passageway right across the whole Bourtangter Moor (fig. 1), over a distance of some 12 km. Part of it was excavated as early as in 1910. Those parts of it that were excavated between 1952 and 1967 lie 90 m north of the MBA footpath XVI(Bou) (Casparie, 1984). It was built from the Hondsrug, the higher sandy soils west of the raised bog (fig. 4). Traces of occupation of Iron Age date have been found there (B.A.I. excavations, pers. comm. P.B. Kooi).

The hurdle trackway XIV(Bou) near Emmer-schans (fig. 3), that has been dated to 170 ± 50 BC (GrN-4147), was intended to provide access to something in this part of the Bourtangter Moor, probably bog iron-ore (fig. 4). The trackway is situated ± 750 m north of XV(Bou). It is probably the only prehistoric bog trackway made of hurdles in the Netherlands. The way in which these hurdles were made is very well known, since hurdles produced up until this century were made in exactly the same way as the Iron Age hurdles.

In one of the regions of bog iron-ore a worked oaken plank was found, dated to 575 ± 35 BC (GrN-7899), that is indicative of the exploitation of this ore already in the early Iron Age (Casparie & Smith, 1978) (fig. 5; 3.2.9). Both the construction of the hurdle trackway and this exploitation took place from the Hondsrug.

The (presumed) starting-points of both bog trackways can be situated on the eastern flank of the Hondsrug, the eastern, partly ice-pushed border of the Drents Plateau (fig. 1). This plateau had already

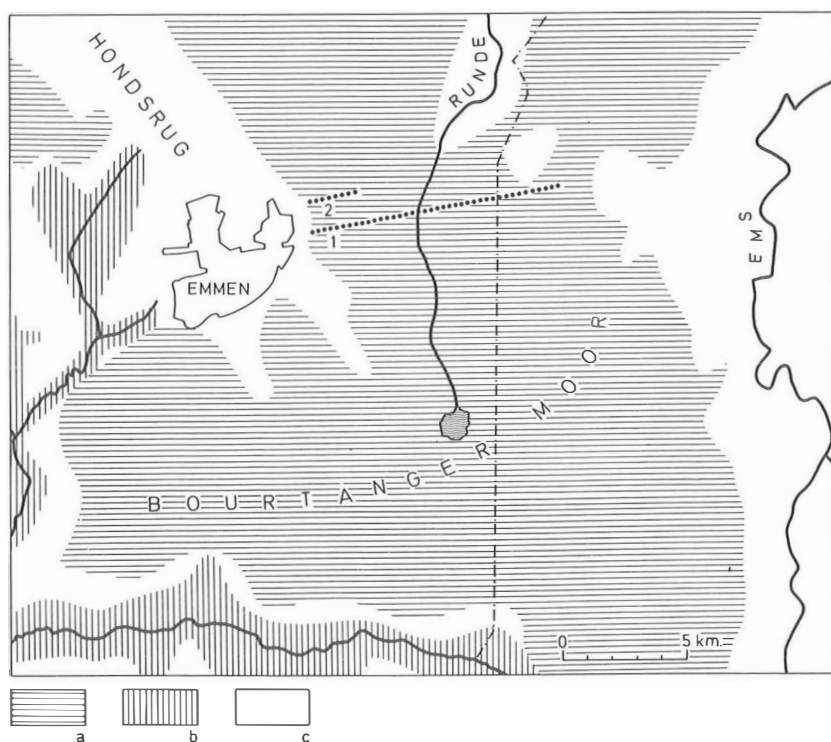


Fig. 1. The original peat-bog situation in Southeast Drenthe, indicating the Iron Age trackways. a. raised bog; b. fen peat; c. higher sandy soil (sand and boulder-clay). 1. The northern plank footpath XV(Bou). 2. The hurdle trackway XIV(Bou).

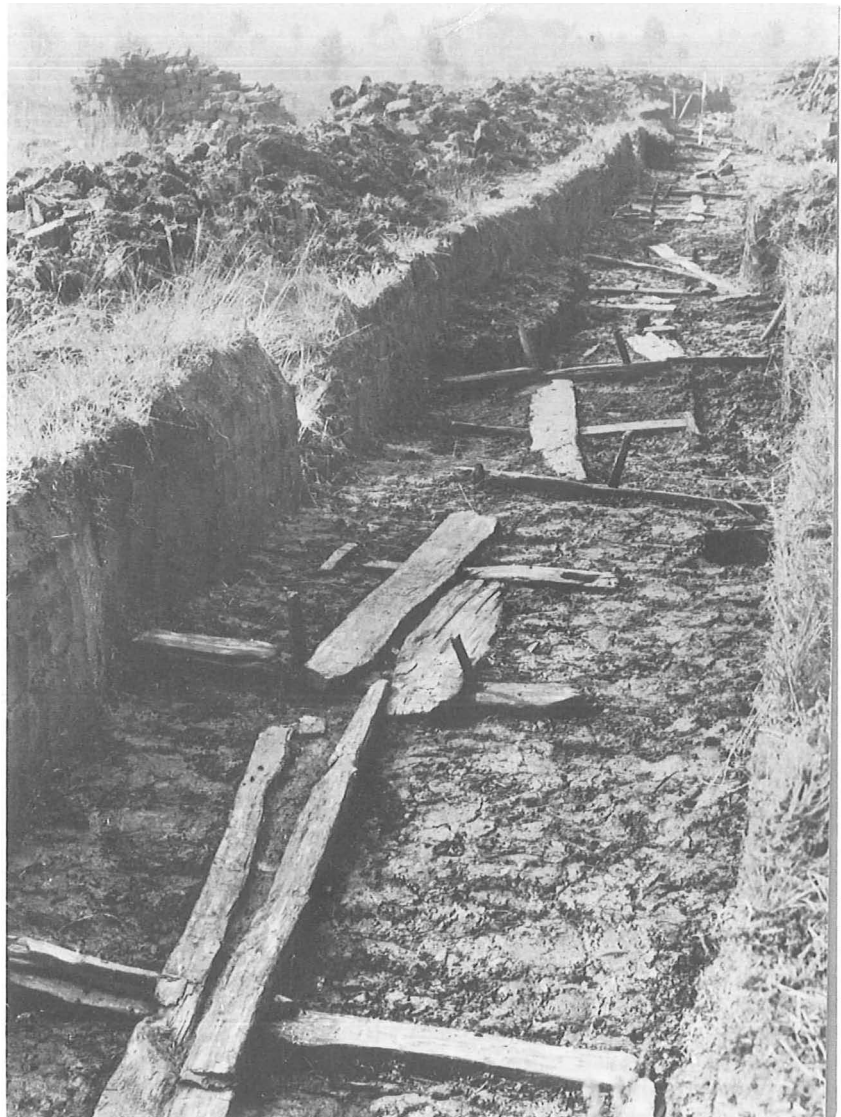


Fig. 2. Northern plank footpath XV(Bou), trench 3, from 96 m towards the west, June 1963. Photo C.F.D. (= Central Photo Service, State University Groningen).

been occupied by agrarian cultures since c. 3000 BC (Casparie, 1982; 1984).

Groenman-van Waateringe & Smith (1984) describe a leather shoe found in this bog region, which they date to the LBA. The findspot can be indicated rather precisely (fig. 5); this does not correspond exactly to the spot pin-pointed by the authors. Their publication includes a photograph that shows that right next to the spot where the shoe was found part of a bog trackway or footpath is present, although the shoe was found 60 cm deeper in the peat. In spite of the extensive enquiries in this region it was not possible to obtain any definite information about this trackway (pers. comm. Mrs. Smith). In any case the pathway is not part of the northern plank footpath XV(Bou). Nor can it possibly have been a trackway built from the

Hondsrug; if that had been the case then we would certainly have found the trackway in the course of the fieldwork of our peat-bog investigations (Casparie, 1972). In view of the height of the pathway in the peat profile it is very well possible that it dates from between 500 BC and the beginning of the Christian Era. It is not inconceivable that it was a particular construction that belonged to the hurdle trackway XIV(Bou); this will be discussed in more detail in 3.2.9.

An extensive investigation based on interviews with the local population, carried out by Mrs. A.F. Smith and Mr. E. Heuving, has shown that another bog trackway is possibly present in this region; this would have run in a direction completely different from that of XIV(Bou) and XV(Bou). On the basis of our knowledge of this bog region, we consider



Fig. 3. Hurdle trackway XIV(Bou), trench I, towards the east, October 1962. Photo C.F.D.

the existence of such a bog trackway as highly improbable. Consequently this hypothetical trackway is disregarded here.

The ^{14}C -datings used here are non-calibrated values, given in years BP (before present = AD 1950). The datings used regularly in this article are derived from these ^{14}C -datings, and are expressed in years BC, as has been usual in archaeological publications. Now it is preferable to express the non-calibrated datings only in years BP, as was agreed in the last radiocarbon congresses, and to use for calibrated datings cal BC and cal AD. As a consequence of the irregularities in the Radiocarbon calibration curve between 2900 and 1900 BP (radiocarbon age), and using the 1 sigma deviation, the ^{14}C -datings in this paper can be corrected to:

XV(Bou): 800-550 cal BC or 430-400 cal BC

XIV(Bou): 200-50 cal BC

plank (3.2.9): 800-760 cal BC or 680-550 cal BC

The bogburst of c. 500 BC (2.3) is not a radiocarbon date, but the interpretation of 'shortly after 540 ± 60 BC' (Casparie, 1972); this means shortly after 810-

560 cal BC or 440-410 cal BC (pers. comm. J.N. Lanting). For the comparison with the radiocarbon dates in the preceding papers on the wooden trackways of Southeast Drenthe, we use uncalibrated ^{14}C -dates in this paper, expressed as BC.

1.4. Acknowledgements

Also this article is mainly the result of the peat-bog research and the excavations carried out by the author together with G. Delger and K. Klaassens and Dr. W.H. Zimmermann (Wilhelmshaven). In addition the following staff members and former staff members of the Biologisch-Archaeologisch Instituut (B.A.I.) cooperated: Mrs. L. van Duinen, Drs. O.H. Harsema, Y. Jongema, Dr. P.B. Kooi, A. Meijer, Drs. J.N. Lanting, Mrs. I. van Otterloo, H. Praamstra ; H.R. Roelink, Prof. J.D. van der Waals, Prof. H.T. Waterbolk, Prof. W. van Zeist, H. Zwier. Assistance was also provided by Mrs. A.F. Smith of Exloo, and E. Heuving of Klazienaveen (in tracing reports of finds made) and Prof. J.C. Vogel (^{14}C -datings). Ir. W.D.J. Tuinzing (Ben-

nekom/Wageningen) provided extensive information about willow-bed cultivation and hurdle-making.

The excavations of the footpath XV(Bou) and much of the peat-bog research took place on terrain belonging to the 'Klazienaveen' firm in Klazienaveen, managing director Ir. K. Meinders and supervisor of the firm G. Hekman. The Koninklijke Nederlandse Heidemaatschappij and Mr. L. van Dijk, State Forestry Service (S.B.B.) in Emmen, provided technical assistance. The Districts Arbeidsbureau (i.e. the local Employment Exchange) at Emmen was responsible for supplying a few labourers on several occasions to help with the fieldwork. With Dr. H. Hayen, of the Staatliches Museum für Naturkunde und Vorgeschichte in Oldenburg, many aspects of the bog trackway research were discussed.

The large amount of drawing was undertaken by G. Delger; H.R. Roelink also did some of the drawing work. Mrs. G. Entjes-Nieborg, B.A.I., typed out the manuscript. Mrs. S.M. van Gelder-Ottway translated the text into English. The author is very grateful to all of these persons for their cooperation.

1.5. Abbreviations

EBA	Early Bronze Age
MBA	Middle Bronze Age
LBA	Late Bronze Age
IA	Iron Age
(Bou)	Bourtanger Moor (= bog); used in the classification of prehistoric (wooden) trackways, according to Hayen (1958).

2. VEGETATION DEVELOPMENT AND PEAT STRATIGRAPHY

2.1. Pollen analysis

2.1.1. Introduction

This section gives an outline description of the development of forest between 800 BC and AD 500, as a sequel to the corresponding discussion for the period 3000-1700 BC (Casparie, 1982) and the period 1700-800 BC (Casparie, 1984). Up until 1300 BC a number of *landnams* can be distinguished, that we regard above all as instances of extra emphasis on the reclamation activities and not so much as isolated instances of interference with the vegetation. As a result of the continuing reclamation that went on from c. 3000 BC, deforestation was so advanced by c. 1300 BC that *landnams* can no longer be clearly distinguished in the pollen diagrams. Evidently from this time on a large part of

the higher sandy soils in Southeast Drenthe was permanently in use.

The points of departure for the discussion below have been stated in the previous studies on the prehistoric bog trackways (Casparie, 1982; 1984); besides the pollen diagrams mentioned in those studies also the pollen diagram for Bargerooterveld III is made use of (fig. 6), that was prepared by Y. Jongema. The pollen samples on which this diagram is based were taken in 1967 during the excavation of the MBA footpath XVII(Bou); for the situation see figure 5. This figure also indicates the locations of sampling sites used for the pollen diagrams Emmen I and Bargerooterveld II, which are referred to here. These pollen diagrams appear in the article on the MBA footpaths (Casparie, 1984: figs 3 and 4); they were prepared by van Zeist (van Zeist, 1959; Waterbolk & van Zeist, 1961).

In the pollen diagrams the *Quercetum mixtum sensu lato* (van Zeist, 1959) is consistently taken as the basis for estimations; broadly speaking this consists of the components of the natural forest on the higher ground. In the Bargerooterveld III diagram (fig. 6), besides these trees only a few herbs are illustrated, as well as *Alnus*, *Betula* and *Corylus*. The discussion of the development of forest is mainly restricted to the trees. For the situation of the types of forest we have distinguished, see Casparie (1982: fig. 7; 1984: fig. 5); these were severely degraded already in Iron Age times.

On the left side of the pollen diagram (fig. 6) the time scale is divided into zones designated by the capital letters E-J, that indicate the phases of forest reclamation or changes in the pollen picture that have been discerned. E-G have been discussed previously (Casparie, 1984); these concern the Bronze Age. The time spans indicated are approximations of recorded reclamation activities rather than exact datings. By using *Quercetum mixtum s.l.* (van Zeist, 1959) as the basis for estimations the pollen diagram does not give a clear picture of the degree of deforestation, all the more so since only the trees and just a few herbs are illustrated. It is certain, in any case, that the deforestation was considerable already in the MBA.

2.1.2. The forest history of Southeast Drenthe, c. 800 BC-AD 500 (fig. 6)

H (c. 800-500 BC)

The considerable increase in values for *Fagus*, present in all pollen diagrams for this region, indicates a marked expansion of beech. This almost certainly took place in various places where previously forest had been cut down, but possibly also in abandoned fields. The lower values for *Quercus* are probably partly the result of the way of estimating the pollen percentages, but are also partly due to the fact that oak too was felled



Fig. 4. The peat-bog region of Southeast Drenthe, showing the course of the trackways. 1. sand; 2. boulder-clay (almost) up to the surface; 3. raised bog; 4. bog iron-ore areas (see page centres A, B, C, D); 5. rectangles of figures 9 and 27. The excavation trench 7 of XV(Bou) is also indicated.

regularly. Besides *Fagus* also *Carpinus* will have been able to become established in suitable places.

Although the pollen diagrams Emmen I and Bargerroosterveld II (Casparie, 1984: figs 3 and 4) indicate that the intensity of occupation may have been less than in the preceding period G (lower values for e.g. *Plantago lanceolata*), this population decline would only have been slight. The presence

of urnfields in this region (fig. 5) is indicative of continuing occupation. Also there is no suggestion of any such population decline in the pollen diagram Bargerroosterveld III (fig. 6). In this diagram the *Fagus* maximum is followed by a considerable lower value, that can be dated to 450-500 BC. This general picture is evident in other diagrams for this region (e.g. Casparie, 1972: Emmen 17). This may

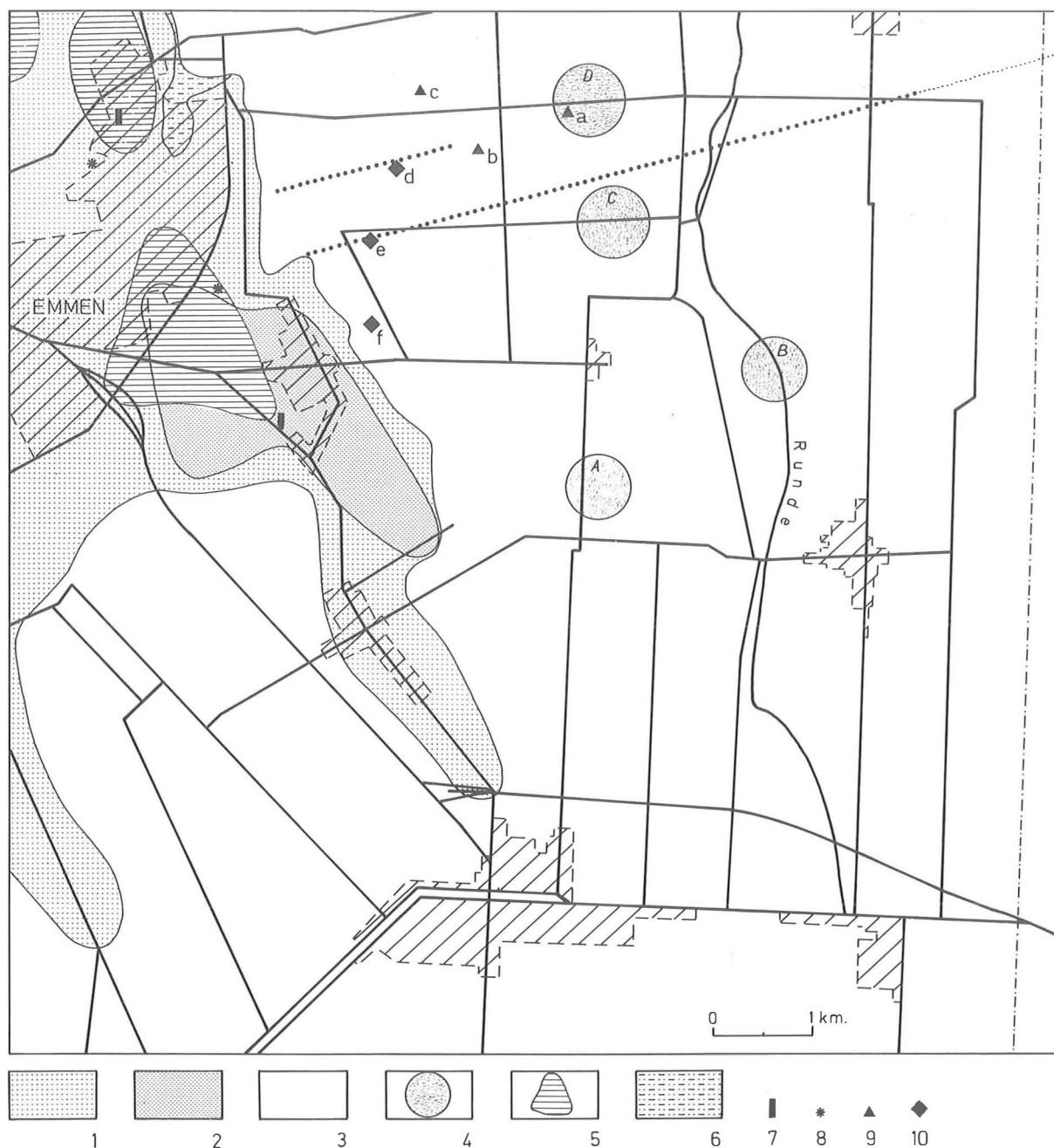


Fig. 5. Some archaeological information relating to Southeast Drenthe and the sampling spots for the pollen diagrams. 1. sand; 2. boulder-clay; 3. raised bog; 4. bog iron-ore areas (seepage centres A, B, C, D); 5. Celtic Fields (after Brongers, 1976); 6. the wet side-valley, the (supposed) area of the willow bed culture; 7. groups of cremation mounds (pers. comm. P.B. Kooi); 8. lumps of iron slag (Modderkolk, 1970); 9. bog finds: a. oaken plank at the bottom of iron-rich seepage peat (Casparie & Smith, 1978), b. plank in poorly humified *Sphagnum* peat (Groenman-van Waateringe & Smith, 1984), c. remains of a peat body (not discussed in this paper); 10. sampling spots for pollen diagrams: d. Emmen I (Casparie, 1984: fig. 3); e. Bargerroosterveld III (fig. 6); f. Bargerroosterveld II (Casparie, 1984: fig. 4). In this study only the diagram Bargerroosterveld III is illustrated (fig. 6).

indicate the selective felling of beech, that would have favoured the expansion of e.g. oak. The proportion of *Tilia* in the forests has become very small in the meantime. The values for *Fraxinus* and *Ulmus* have not changed to any great extent; there is no evidence to suggest that there was any decrease in extent of particularly those types of forest in which these trees dominate.

I (500 BC-0)

The beech remains an important tree, the hornbeam has still not yet expanded to any great extent, and the elm and the ash appear to maintain themselves. The expansion of *Betula* and *Corylus*, together with the increase in *Plantago lanceolata* in Bargerooterveld III (fig. 6), in 300-200 BC, we associate with the laying out of Celtic Fields in this region (fig. 5). This involved not only the re-use of (old) arable land, but almost certainly also more felling of the remnants of forest still in existence.

The high values for *Alnus* are indicative of a rather extensive bog-fringing forest. It is remarkable that the intensive use of *Salix* for trackway XIV(Bou) (3.2.5, 3.2.7) is not demonstrable in the many pollen diagrams that we have consulted.

J (0-A.D. 500)

In this period *Carpinus* expands, but the hornbeam does not become as common as the beech. *Fraxinus* and *Ulmus* have lower values, which is almost certainly indicative of continuing forest clearance. In the 2nd and 3rd century AD *Plantago lanceolata* has relatively high values. In this period *Betula* and *Corylus* expand once again. The land use in this region is intensive. The occurrence of *Plantago major* in a continuous curve (fig. 6, spectra 18-20) may be indicative of some change in agricultural practice.

2.2. The peat-bog: stratigraphy

The bog trackways XIV(Bou) and XV(Bou) were found in the same ombrogenous peat-bog region as the MBA footpaths XVII(Bou) and XVIII(Bou). The peat stratigraphy of this region has been discussed by us previously in detail (Casparie, 1984: 2.2); for this reason a brief, supplementary discussion will suffice here. The peat stratigraphy near the Iron Age bog trackways is illustrated in figure 7. For the peat profile of XIV(Bou), part of the vertical peat-face C was taken (Casparie, 1972), where the bog trackway intersects with it (3.2.2, trench 3); for XV(Bou) part of the vertical peat-face E was taken, where the pathway intersects with it (3.1.2, trench 4). The peat concerned has shrunk considerably as a result of the artificial drainage since the 16th century AD. The original thickness of the peat deposits could be reconstructed approximately. Generally speaking, the peat was 5-8 m

thick below these Iron Age trackways. The thickness of the ombrogenous peat, on top of which the trackways were laid out, varied from 3-5 m. Below this fen peat is present or ferruginous seepage peat (not in the peat sections illustrated, fig. 7), overlying Late Glacial *Braunmoorstorf* (Hypnaceae peat) or fluvatile sand.

Both trackways lay in systems of hummocks and hollows, although this cannot be deduced from the peat sections (fig. 7). This is the result of the method used for measuring and drawing the vertical peat-faces, which involved distinguishing three categories of ombrogenous peat: highly, moderately and poorly humified *Sphagnum* peat; due to the exaggeration of the vertical scale in the illustrations of the vertical peat-faces it was not possible to indicate hummocks and hollows or hummock-hollow systems. XIV(Bou) is here situated right next to a hummock (Casparie, 1972: Emmen 12, fig. 44); XV(Bou) lay here in poorly humified hollow-peat.

From the description given by Wesselink (1924) it can be deduced that at the easternmost spot where XV(Bou) was found, on top of the ferruginous seepage peat a layer of fen peat was present, that could correspond to the *Menyanthes-Betula* peat deposit that we have distinguished in this locality (Casparie, 1972); however, the information available is too scanty to permit any meaningful conclusions to be drawn on this matter.

2.3. The peat-bog surface 600-100 BC

The surface of the peat-bog in Southeast Drenthe in c. 1200 BC has been described in detail in our study on the MBA footpaths (Casparie, 1984: 2.2.3). For later periods too the spatial distribution of the types of peat-bog distinguished – especially hummock-hollow systems – can be clearly outlined: in this case for the period 600-100 BC. Here we have chosen the time of c. 500 BC, because then an extensive bog burst occurred in this region; this hardly changed the spatial pattern of bog types, but it nevertheless had a great influence on the hydrology of the bog and consequently also the possibilities of access for people on foot. Figure 8 shows the spatial pattern of bog types; it is almost identical to that of c. 1200 BC. For this pattern and for the description of bog types see Casparie, 1984: 2.2.3 and figure 7. The discussion below is intended as a sequel to the information given in that article. The hummock-hollow systems have already been discussed previously (Casparie, 1972).

Domed complexes. Between 1200 and 500 BC the peat-bog surface grew ± 60 cm upwards. The formation of highly humified peat in hummocks was largely superseded by moderately humified *Sphagnum imbricatum* peat, which involved a slight decrease in the proportion of *Calluna* and *Eriopho-*

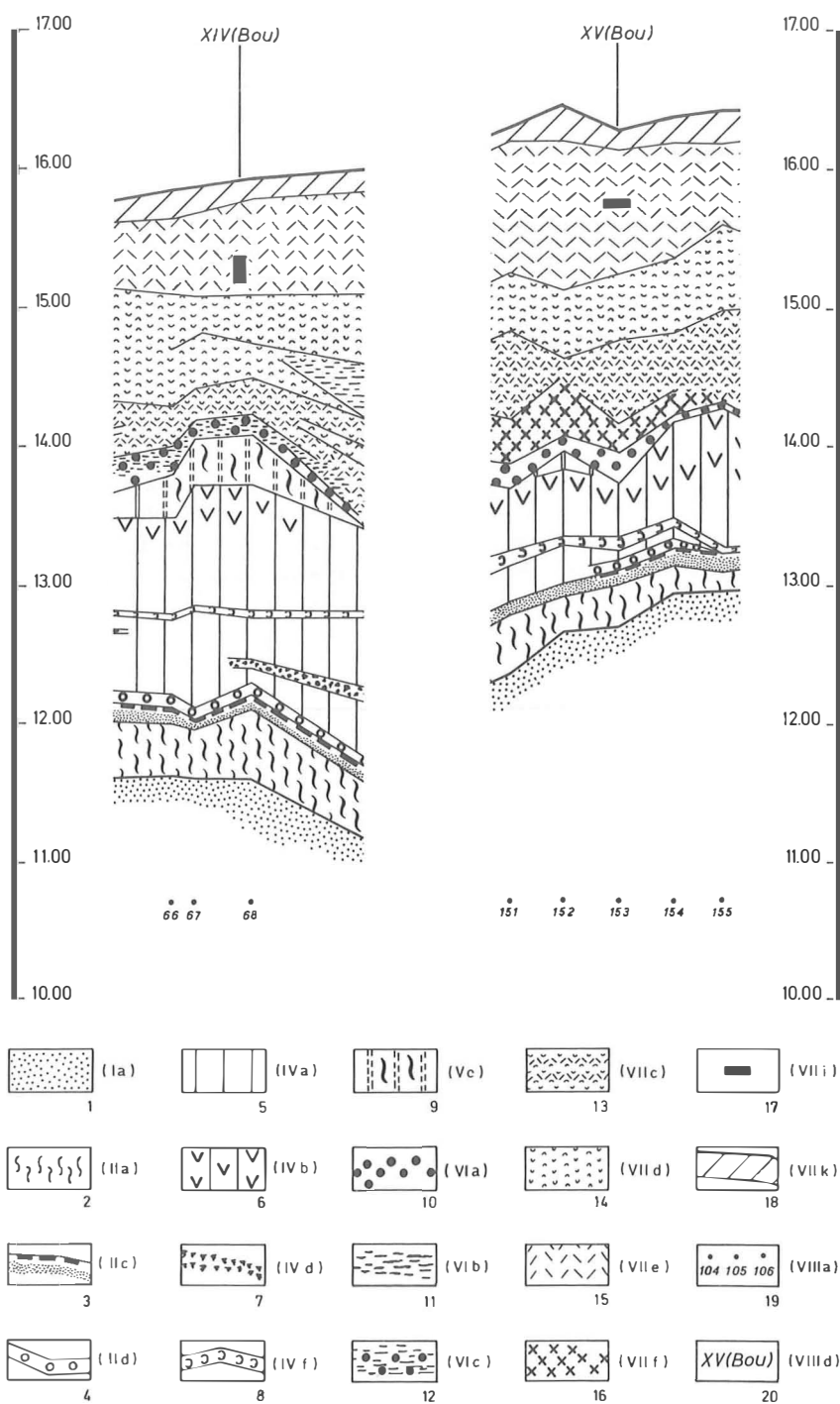


Fig. 7. Peat sections close to the hurdle trackway XIV(Bou) in trench 3, at 3 m (left) and footpath XV(Bou) in trench 4, at 10 m (right), derived from the vertical peat-faces C and E, respectively (Casparie, 1972). Key (the numbers given between brackets refer to Casparie, 1972): 1. sand; 2. Braunmoorstorf; 3. loess layer; 4. layer of *Betula* twigs; 5. fen peat; 6. fen-wood (carr) peat; 7. charcoal layer; 8. early Atlantic charcoal layer; 9. ferruginous fen peat with siderite; 10. pine stump layer; 11. *Scheuchzeria* peat; 12. *Pinus-Scheuchzeria* peat; 13. highly humified *Sphagnum* peat; 14. intermediate deposits; 15. fresh *Sphagnum* peat; 16. *Calluna-Sphagnum* peat; 17. level of the trackway; 18. secondarily weathered layer, disturbed peat; 19. points examined ('pits'); 20. code for wooden trackway numbering.

rum vaginatum. *Sphagnum rubellum* decreased significantly. In the hollows there grew especially poorly humified *Sphagnum papillosum* peat and to a much lesser extent *S. cuspidatum*. About 100 BC the peat-forming level was ± 1 m above that of 1200 BC.

Contact zones. Between 1200 and 500 BC the peat-bog surface grew 40-50 cm upwards; slightly less

than in the domed complexes. This applies notably to the hummocks, where the formation of highly humified *rubellum* peat continued to a considerable extent. In the hollows *cuspidatum* peat formed, predominantly in open water. Hummock-hollow systems in contact zones include Emmen 17, Emmen 22+23 and Emmen 32.

The Bargoosterveld III profile (fig. 6) was



Fig. 8. Outline sketch of the peat-bog surface c. 500 BC, indicating the hummock-hollow complexes distinguished, as described in Casparie (1972). 1. type Emmen 9; 2. type Emmen 17; 3. type Emmen 22+23; 4. type Emmen 32; 5. raised bog lake Emmen 19; the arrow indicates the direction of the erosion of 500 BC; 6. bog-marginal forest. For the meaning of the symbols on the Hondsrug (sand, boulder-clay), see fig. 4: nos. 1 and 2. A, B, C and D: bog iron-ore areas.

sampled through a hollow of the type Emmen 17; also the hollows of type Emmen 32 are characterized by fairly thick layers of *cuspidatum* peat, in which the effects of slight erosion are detectable.

The water content of the contact zones steadily increased, mainly because of increasing precipitation (Dupont, 1986). The water level would have

been hardly lower than the hummocks. The hollows were virtually impassable. As a result of the bog burst this situation changed significantly around 500 BC (see below).

The raised-bog lake and the shore zones. This region had become, broadly speaking, one vast body of

water, in which extensive patches of floating *Sphagnum cuspidatum* and *Scheuchzeria* vegetations were present. The depth of water in the raised-bog lake Emmen 19 was possibly almost 1 m. In the hollows of type Emmen 22, that had a slightly higher bottom, the depth of water was probably about 60 cm. The peat that had formed was mostly poorly humified. The moderately to highly humified hummocks, type Emmen 23, hardly projected above the water.

The siderite areas. In c. 1200 BC these still projected slightly above the ombrogenous bog surface; around 500 BC this was probably no longer the case. Concerning the siderite area D (fig. 8), it is certain that bog iron-ore was exploited here already before 500 BC (Casparie & Smith, 1978). The siderite area C seals off, as it were, the west-east contact zone to the west of this area; it may have impeded the discharge of water from this contact zone. In any case the raised-bog lake Emmen 19 had no run-off; the water level rose continually until 500 BC.

The bog burst of 500 BC. The sudden drainage of the raised-bog lake Emmen 19 and its shore area Emmen 22+23 has been described by me in detail (Casparie, 1972). The erosion gulleys that formed as a result were more than 1 m deep, possibly up to almost 2 m. We assume that as a result of the increasing water pressure of the raised-bog lake, with an increasing water surplus on the bog surface, the weakest bank of the lake collapsed. The winning of bog iron-ore in the siderite area C may have been partly responsible for this catastrophic discharge. There are, however, no concrete indications of this.

The raised-bog river, the Runde. This raised-bog rivulet developed in the south-north situated contact zones (Casparie, 1972). In view of the large size of the area with erosion phenomena (several square kilometres), the water discharge in 500 BC must have been enormous. We consider it very likely that it was precisely because of this bog burst that the actual valley of the Runde became cut out in the peat; if this happened then any bog trackways that may have been present here would have been washed away.

Bog marginal area. In this belt of forest around the treeless raised bog *Alnus* and *Pinus* were the most important trees, while *Betula* and (in the drier parts) *Quercus* also occurred. The choice of wood for XIV(Bou) and for XV(Bou) indicates that this bog-fringing forest was exploited hardly or not at all for the building of the trackways.

The development of the abundance of water in the bog. If we compare the method of construction of

the MBA plank footpath XVII(Bou) with that of the IA plank footpath XV(Bou), it is evident that the bog region became considerably more difficult to get across between 1200 and 500 BC. This was undoubtedly the result of the increasing abundance of water that caused a decrease in the carrying capacity of the bog surface.

The footpath XVII(Bou) has for each longitudinal plank (± 2.75 m long) one transverse timber, that gives the path sufficient stability. Footpath XV(Bou) has for each longitudinal plank two (fig. 10) or even three transversals (fig. 14): one with holes for the pegs and either one or two intermediate transversals, see also 3.1.4. This last-mentioned situation, that has been found only by Wesselink (1924), was present very close to the Runde (fig. 5), that at that time almost certainly functioned as a contact zone. Possibly the bog surface was so weak here that the longitudinals needed the support of transversals every 90-95 cm. The method of construction of the hurdle trackway XIV(Bou) could indicate that the bog became more consolidated after 500 BC (fig. 28).

After the bog burst of 500 BC. The sudden discharge of water from the raised-bog lake Emmen 19 and other raised-bog lakes was accompanied by the loss of many minerals from the bog. The bog in its entirety became considerably more oligotrophic. The desiccation patches were only of limited extent and were certainly not very intensive. The result of these changes in the bog surface was a marked increase in the growth of fresh and poorly humified *Sphagnum* peat: *S. papillosum* in the erosion gulleys, in which water stagnated again and especially *S. imbricatum* grew on the uneroded bog surface. It is not fully clear how the contact-zone areas now became passable; it is certain, however, that the domed complexes in their entirety contained less water as a result of the drainage by the bog burst. Consequently the somewhat more consolidated peat-bog surface have become more easily passable. This lasted in any case until a few centuries after the beginning of the Christian Era.

3. THE BOG TRACKWAYS - METHOD OF CONSTRUCTION AND THE CONSTRUCTION ELEMENTS

3.1. The northern plank footpath XV(Bou)

3.1.1. Overview of the field research

The footpath was possibly known to exist already at the beginning of the 19th century (Westendorp, 1819). The reference to 'a wooden path in the Emmererfscheidenveen' is too vague to permit us to identify this as the footpath XV(Bou). In the 20th

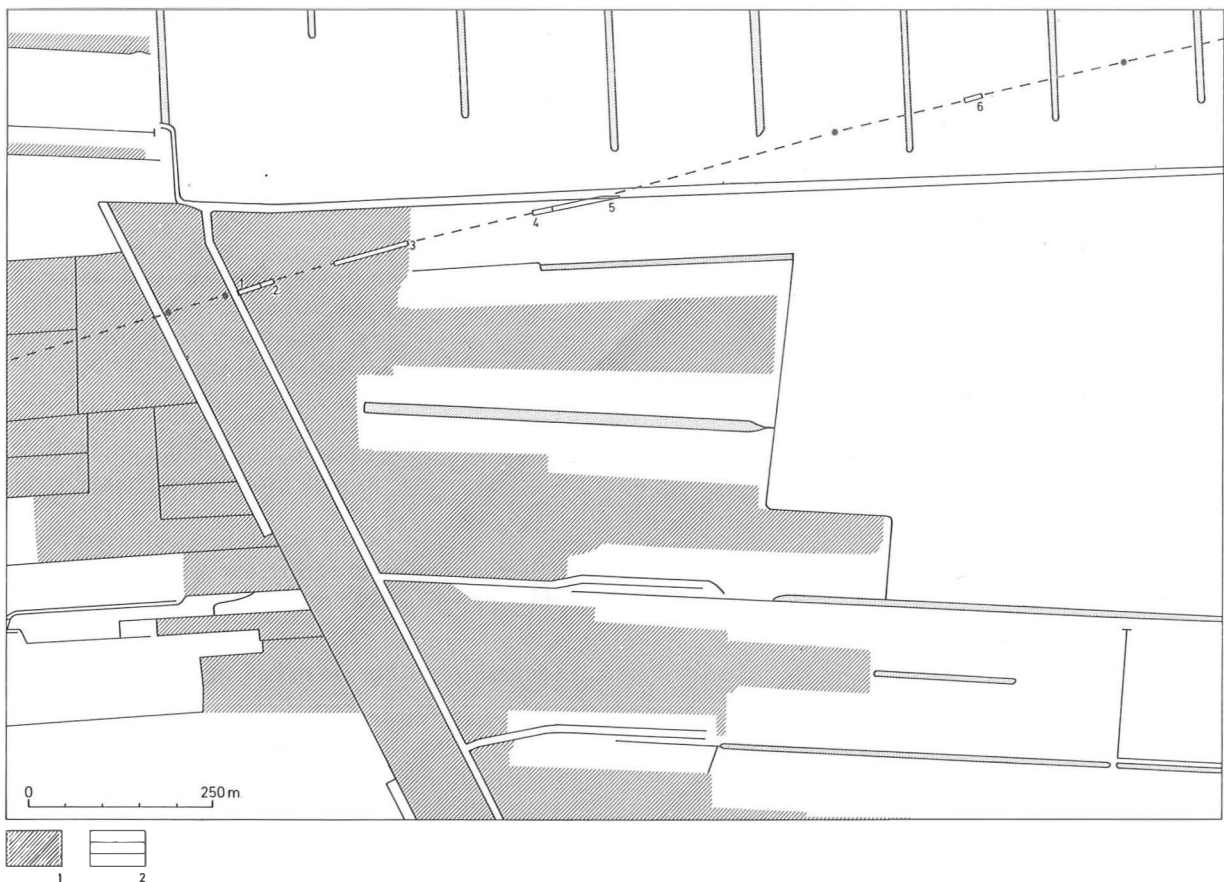


Fig. 9. Northern plank footpath XV(Bou). Location of the excavation trenches 1-6 and the observations points, indicated by an asterisk. The definite, unexcavated part of the course is indicated by a broken line; the path continued further to the west and to the east. For the precise location of this map and of trench 7, see fig. 4. Key: 1. peat remains; 2. water.

century there have been many reports of this pathway; only those that have been followed up by closer investigation (excavation) are discussed here.

The first excavation took place in 1910 (Wesselink, 1924); in the course of this excavation the remarkable method of construction could be ascertained (fig. 14). The situation of the excavation trenches and the course of the path are shown in figure 9. The other parts of the pathway that have been excavated are shown in figures 10-13. The construction had been disturbed in large stretches of the pathway.

The exposure of those parts of the footpath that we excavated took place as follows. The topmost peat was dug away using a shovel or mechanical digger, until the path had almost been reached. Then the remaining peat was removed with a trowel or by hand, and the elements of the path were cleaned up with a paint scraper and brush. After the elements had been measured and drawn, samples were taken, where necessary; the wood was then removed and the underlying peat dug away down to

a depth of c. 30 cm. Throughout the entire procedure photographs were taken of parts of the path.

In trenches 2, 4 and 5 the topmost peat layer had already been removed by machine, by the Maatschappij Klazienaveen, owner of this peat area concerned. As a result of this mechanical digging the wood of the pathway was damaged in many places.

During the previous excavations (1910, 1952) a working method was used that did not differ in principle from the method described above.

1910, trench 7. Wesselink exposed the path in two places, situated ± 65 m apart. On the basis of Wesselink's data it is possible to establish the location of these two trenches quite well (fig. 4). The eastern trench was photographed and the part of the trackway exposed in it was drawn schematically (fig. 14). Each trench was about 10 m long.

Aim: to establish the construction method, documentation, information about the peat stratigraphy. Wesselink assembled a lot of information, that

will be made use of in the discussion below.
Wesselink, 1924.

1952, trench 6. Excavation carried out May 7th-12th 1952 by H. Praamstra and W. van Zeist, following reports that the path had been found in the course of peat-digging activities. At that time it was not yet known that the MBA footpath XVII-(Bou) was present in the vicinity. Length of trench 28.00 m (fig. 13). While the excavation was in progress the course of the trackway was established, by means of reconnaissance, over a considerable distance (3.1.5).

Aim: to establish the construction method and the course of the trackway; sampling for palynological research. The construction method could not be established with certainty.

Dating: see 3.1.3.

No finds were made.

Van Zeist, 1955a; 1955b.

1961, trench 4. Excavation carried out September 24th-28th 1961 by H.R. Roelink and W.A. Casparie. In the course of peat research in this region (Casparie, 1972) it became evident that the path had already been destroyed over a considerable length as a result of peat-digging. The part of the path that had not disappeared totally was subsequently excavated. Many longitudinals had already been severely damaged. Length of trench 24.30 m (fig. 12).

Aim: documentation; the construction method could not be established.

No finds were made.

Casparie, 1972.

1963, trenches 2, 3 and 5. Excavations in the months May-July by G. Delger, K. Klaassens, W.H. Zimmermann and W.A. Casparie, during the campaign of the peat research from May-October 1963. The area of peat-land which contained these parts of the footpath as well as portions of the footpaths XIV(Bou) and XVII(Bou) was dug away in the course of 1963. Lengths of the trenches: trench 2: 18.50 m, trench 3: 102.70 m, trench 5: 80.60 m (figs 10-12). Between the trenches 2 and 3 (87 m) the footpath had been severely disturbed.

Aim: to gain insight into hummock-hollow systems of the fossil bog surface, the construction method, traces of use, dating.

Finds: in trench 3 at 83 m a wooden mallet was found, which had undoubtedly been used for driving the pegs into the bog surface (fig. 26).

Dating: a ¹⁴C-dating was carried out for a plank of trench 3 at 93-94 m, see 3.1.3.

Casparie, 1972.

1967, trench 1. Excavation carried out June 5th-9th 1967 by K. Klaassens, H.R. Roelink and W.A.

Casparie. Length of trench 33.10 m (fig. 10). This trench is adjacent to trench 2.

Aim: to gain insight into hummock-hollow systems of the fossil bog surface and to collect more detailed information on the construction method and the use of the path.

Dating: see 3.1.3.

Casparie, 1972.

1978, a few reconnaissances. Reconnaissances made on November 6th and 7th and on December 20th 1984 by G. Delger, K. Klaassens, L. van Dijk (S.B.B.) and W.A. Casparie in the course of field-work of S.B.B.

Aim: to assess the state of preservation of the wood and the peat for the purpose of enabling the S.B.B. to take measures to look after this archaeological monument.

Dating: samples of the wood were collected for a dendrochronological dating, see 3.1.3.

The reconnaissances are not discussed separately.

3.1.2. *The situation per trench*

The method of construction of the path was found to be consistently unclear throughout all of the field research. Some of the disturbances that were come across had definitely been caused intentionally. These disturbances are of prehistoric age (3.1.6). Without the investigation by Wesselink (1924), it would probably have been impossible for us to fully understand the method of construction.

The path showed a rather pronounced relief, as is usual with prehistoric bog trackways. The variation in height, measured at the transverse timbers, amounted to at most 80 cm per trench. We may attribute about 30 cm of this to the relief of the hummock-hollow surface of the bog. This relief was originally more moderate; it is pronounced due to the shrinkage of the peat as a result of the systematic drainage of the bog since the 16th century AD. Owing to this shrinkage, in the middle of the peat-bog region particularly, approximately from trench 3 on, the level of the footpath has come to lie a few metres lower.

Local subsidence, for example of extremely desiccated old vertical peat-faces, resulted in a yet more pronounced relief, e.g. trench 1, the western 3 m. The heights that were measured do not add anything to our understanding of the footpath; consequently they are not mentioned on the excavation drawings.

In the following descriptions of the trenches the mean thickness of the peat above the footpath is mentioned per trench; variations in thickness per trench are not given.

Trench 1, fig. 10. One of the major objectives with this excavation was to acquire new data on the



Fig. 15. Northern plank footpath XV(Bou), trench 1, towards the west. Most of the longitudinal planks are missing. In the foreground a repaired transverse timber; to the right of it a plank driven into the peat. In the background, close to the farmhouse, is situated the starting-point of the path. June 1963. Photo C.F.D.

method of construction. The path lay ± 40 cm below the peat surface. The western end of the trench had subsided over a length of c. 2 m.

It is remarkable that longitudinal planks are almost absent from this trench (fig. 15); over a length of 33 m in this trench only 2 planks were found, both of which had been driven vertically into the peat. The state of preservation of the wood that was found was good. The hummock-hollow system, on which the path was laid out, could be clearly discerned.

Trench 2, fig. 10. The path lay about 40 cm below the peat surface, that showed traces of digging activities in many places. As a result the wood of the

path had been damaged to such an extent that accurate observations could no longer be made. Here, too, most of the longitudinal planks were missing; no vertical planks (i.e. planks driven vertically into the peat) were found, either. The hummock-hollow pattern was difficult to see.

Trench 3, fig. 11. Here the path lay 80-100 cm below the peat surface. In the excavation trench a number of modern drainage ditches are visible. The damage caused by these to the path was relatively slight. No additional (recent) disturbances were present.

In the western half of the trench most of the longitudinals were missing, nor had they been driven into the peat. The eastern part of the trench

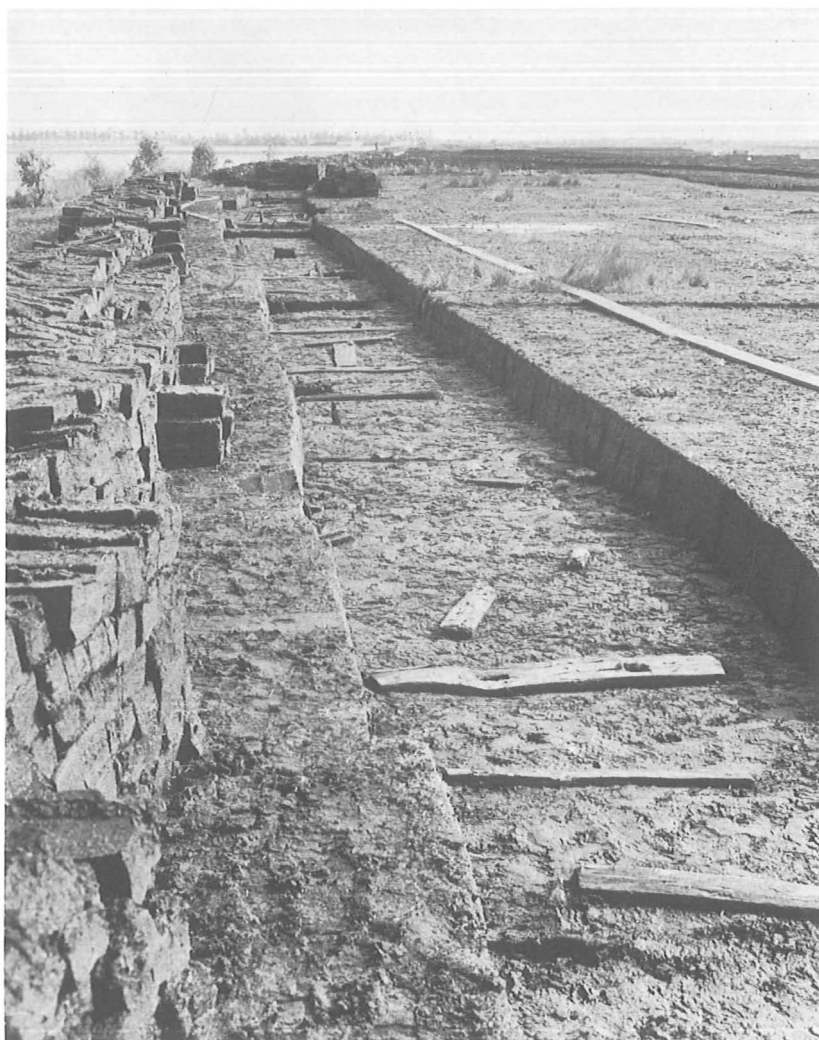


Fig. 16. Northern plank footpath XV(Bou), trench 5, from 4.80 m towards the east. Most of the longitudinal planks are missing. July 1963. Photo C.F.D.

contained relatively many longitudinals; most of them were still present in situ (fig. 2). The state of preservation of the wood was fairly good. The hummock-hollow pattern could be clearly discerned.

Trench 4, fig. 12. The presence of the footpath was evident from wood remains found on the vertical peat-face (Casparie, 1972: fig. 24, peat-face E, pit 153). The exact situation and the peat stratigraphy at this spot are given in this way.

When the excavation was carried out the overlying peat had already disappeared; the serious damage was caused by the recent peat-digging activities. Therefore it can only be established that fewer longitudinals were present than one would expect to find on the basis of the number of transversals. No vertical planks were found. The hummock-hollow pattern was not investigated.

Trench 5, fig. 12. The path lay c. 60 cm below the peat surface. The excavation took place during the peat-digging operations; this resulted in some extra damage to the path.

Here too the most of the longitudinals are missing (fig. 16); in fact relatively many vertical longitudinal planks (fig. 17) or transversals were found. Between 64 and 67 m bits of wood refuse were found (figs 12, 18). The method of construction was impossible to determine. The hummock-hollow pattern was clearly visible. Here the path lay right next to a contact zone (2.3).

Trench 6, fig. 13. The path lay 60 cm below the peat surface. On the field drawing the possible presence of a disturbance is indicated in two places. Just what kind of disturbances these are is not known, since no further details are available. Predominantly vertical planks were found. Therefore the method



Fig. 17. Northern plank footpath XV(Bou), trench 5, from 38-53 m towards the west, with a few longitudinal planks driven into the peat. July 1963. Photo C.F.D.

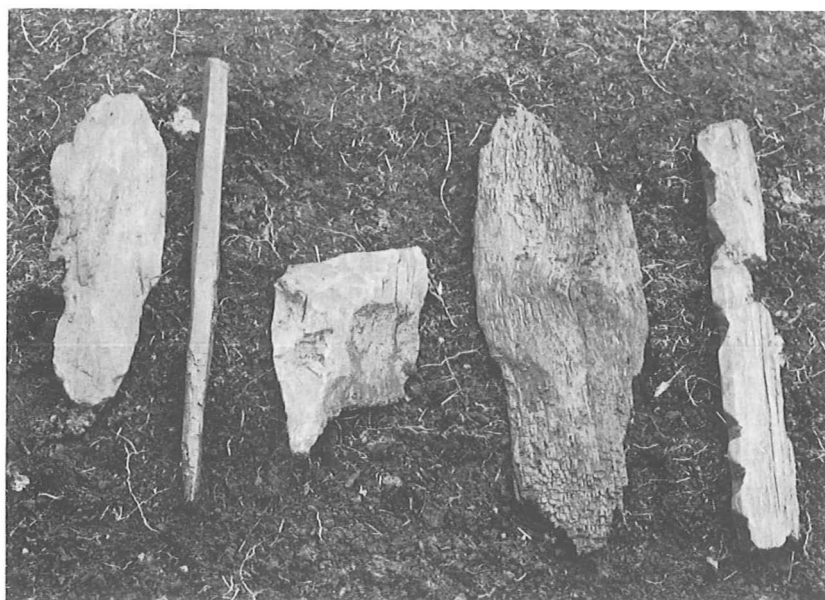


Fig. 18. Northern plank footpath XV(Bou), trench 5, secondarily used wood, found between 64 and 67 m, partly charred. The piece on the right shows numerous traces of cutting. Photo C.F.D.

of construction could not be established.

Having re-examined the field drawing, we think it possible that this excavation revealed also part of the MBA footpath XVII(Bou), about 7 m south of the course of the path excavated here, XV(Bou). This would then be the easternmost point at which the MBA footpath has been encountered (Casparie, 1984).

Trench 7, fig. 14. According to Wesselink (1924), here the path lay about 1 m below the peat surface.

The method of construction is clearly discernible here; the stretch of path found here clearly shows the construction method (fig. 19). The state of preservation of the wood is poor according to Wesselink; a photograph published by him is clearly indicative of this.

3.1.3. *Dating*

The path, as it was found in 1952 (fig. 13), was dated by means of pollen analysis (van Zeist, 1955a: pp.

48-49, fig. 16). The age that was then established, 3rd-1st century BC, has turned out to be too young. From trench 3 of the 1963 excavation a longitudinal plank between 93 and 94 m (fig. 11) was selected for a ^{14}C -dating of the youngest annual rings; the dating obtained was GrN-4622: 530 ± 40 BC (not calibrated).

This Iron Age dating is supported by the research on the peat stratigraphy. In many places the path is situated fairly high in a thick *Sphagnum cuspidatum* deposit, the end of which can be associated with the bog burst that can be dated to c. 500 BC (Casparie, 1972). Dupont (1986) has dated this bog burst more precisely to 500 BC (calibrated). The footpath XV(Bou) is therefore somewhat older than this date.

A few transverse timbers, found during the preliminary surveys of 1984 (3.1.1) have been investigated dendrochronologically by Dr. B. Schmidt, Labor für Dendrochronologie, University of Köln. The wood concerned is sapwood, that cannot be correlated with any one of the standard chronologies (pers. comm. B. Schmidt).

3.1.4. The method of construction

Here we are concerned with a footpath two planks wide, with transverse timbers used for extra stability. The reconstruction drawing (fig. 19) is based essentially on the data of Wesselink (1924); during the later excavations observations were made repeatedly to see whether the wood remains found fitted in with this construction method. This actually turned out to be the case; only minor deviations from this construction method have been detected.

From information collected by Mrs. A.F. Smith (Exloo) in the region concerned it can be deduced that east of trench 6 (fig. 9) the path probably had a different method of construction, which has not been established in any excavation and that in the immediate vicinity of the rivulet the Runde (fig. 5) a special substructure was present. This has not been established by further research, either. These two

points of information will be considered in more detail at the end of this section.

On the basis of Wesselink's data and our own excavations we arrive at the following picture (fig. 19):

The longitudinal planks, that were laid out side by side, are supported at their overlapping ends by a transverse timber with a square hole, present on either side of the overlying planks. Over this a corresponding transverse timber also with two holes was laid out. The plank ends and these 'double transversals' were consistently fixed in the bog surface by means of two pegs. These pegs, that were driven through the square holes, either had a thickened head or were driven somewhat obliquely through the holes into the peat. In this way the ends of the longitudinals were firmly fixed. In addition transverse timbers without holes were used. These served to support the longitudinals between the 'double transversals'. In trenches 1-5, between these double transversals there was always one transverse timber present without holes (figs 10, 11, 12). In trench 6 the situation was not clear; for trench 7 Wesselink mentions that two such transversals are always present between two double transversals (fig. 14). Also small pieces of wood have been used to give extra support here and there. The usable width of the path was 44-50 cm. The plank width measurements correspond to this (3.1.5). The distance between the double transversals varied, with a few exceptions, between 2.67 and 3.36 m, though particularly between 2.85 and 3.20 m. The mean distance was 2.95 m. In prehistoric times the method of construction was probably adapted slightly here and there; the path was cleared away for the most part, not very long after it had been built, see 3.1.7.

Messrs. L. Kuilder and H. Lasker, both now of Emmen, were familiar with the path in the area 200-700 m east of trench 6, in the 1930's, when they lived there. This area was then in the process of being exploited by means of peat digging; they saw the wood remains on a number of occasions. The

XV (Bou)

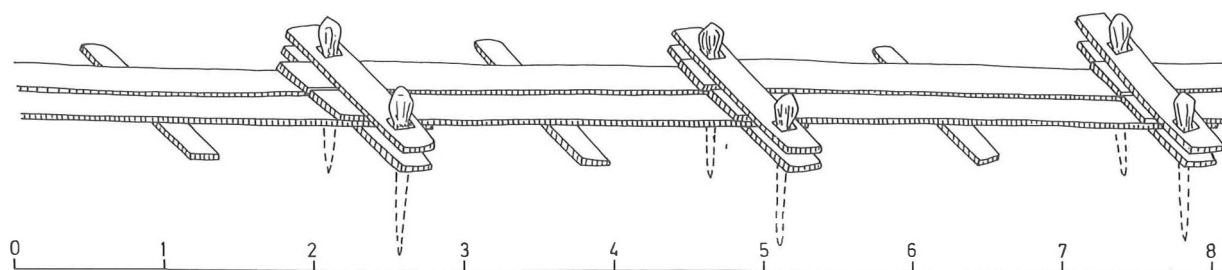


Fig. 19. Method of construction of the northern plank footpath. Drawing G. Delger.

path concerned consisted of planks laid out transversely, each measuring about 1.25 m. At both ends holes had been cut out, through which pegs were fitted, that were driven into the bog. The planks were of oak wood, measuring 25-30 cm in width and 3-5 cm in thickness. Possibly a substructure was present consisting of round wood laid out longitudinally; only one of the eye-witnesses was able to remember this.

From the information they provided it is evident that the bog here was exceptionally wet; this may have been the shore zone of the raised bog lake Emmen 19 (2.3). Mrs. Ottens-Ottens of Emmercompascuum informed Mrs. Smith that in the 1930's she had seen vertically fixed posts in the bog near the Runde, the pointed ends of which were sticking into the mineral subsoil. These posts stood about 1.5 m apart, and their top ends were connected by a horizontal log. The level of this horizontal part of the construction closely corresponds to the level at which the path XV(Bou) was found in the peat. The direction of the repeated system is thought to correspond to that of footpath XV(Bou). Its precise location could not be ascertained.

We must certainly assume (3.1.8) that near the Runde the path must have had a substantial foundation, e.g. on the basis of the posts driven into the sandy subsoil. For this reason it is not impossible that the information given here above concerns the footpath XV(Bou).

3.1.5. The construction elements

The longitudinals and the transversals are all made of cleft wood, namely *Quercus*. After the wood had

been cleft the planks and the transverse timbers were cut into shape, where necessary, with the aid of an axe (fig. 20).

The planks were mainly made out of heartwood; some of them had been cleft from the very middle of the tree, as a result of which a longitudinal split had arisen (fig. 21). Only a few planks have remained preserved in their entirety. They varied in length from 3.13-3.82 m. On average they would have measured 3.25-3.50 m. This can be deduced from the distances between the 'double transversals'. The width of the planks varied mostly from 18 to 26 cm, occasionally from 28-32 cm. The thickness of the planks showed considerable variation. Some planks were 1-3 cm thick, some 2-5 cm thick, while others measured 7-9 cm in thickness.

The planks had not been neatly finished off. It is true that irregularities, produced when the wood was cleft, had been cut away with the aid of an axe, but the ends of the planks, for instance, showed little uniformity. In a number of cases notches had been cut in the planks to make them fit between the pegs (fig. 22).

The transverse timbers were also mostly of *Quercus*, as a general rule sapwood, sometimes semicircular cleft tree-trunks of small diameter. In a few cases *Alnus* was used. The transverse timbers with squared holes (fig. 22) were mostly between 100 and 150 cm in length; sometimes they were considerably longer, up to about 2.50 m. The width was generally between 14 and 22 cm, in many cases 15-16 cm. The thickness varied from 1-8 cm. Thicknesses of 1-4 and 5-8 cm occurred regularly. In many cases these transverse timbers consisted of slabwood, the outermost planks of the tree trunk, often with the bark still present. With these slabs



Fig. 20. Northern plank footpath XV(Bou). A few planks driven vertically into the peat, found in trench 5 between 77 and 80 m. Length and width: foremost plank 3.05 x 0.29 m; middle plank 3.45 x 0.24 m; rearmost plank: 3.15 x 0.21 m. The planks showed no traces of use; the cleft planks had been trimmed into shape with the aid of an axe or adze. Width of cutting edge of the axe: at least 7 cm. Photo C.F.D.

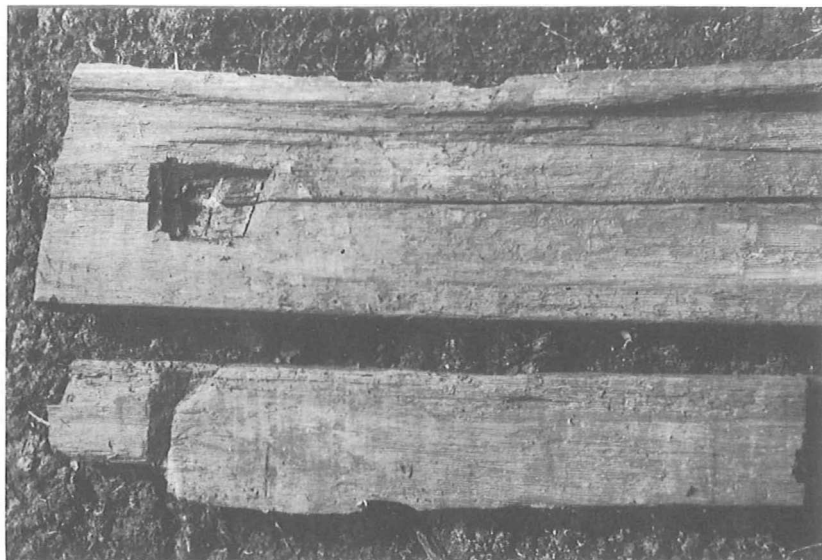


Fig. 21. Northern plank footpath XV(Bou). Cutting traces on the transverse timbers found in trench 5. Above: an unfinished hole; below: an incompletely shortened plank.



Fig. 22. Northern plank footpath XV(Bou), trench 3, between 39 and 43 m. Notch in a longitudinal plank to facilitate the fixture of the peg through the underlaying transverse timber. Photo C.F.D.

the flat side of the lower transverse timber usually rested on the peat; the round side between the cut-out holes was then sometimes trimmed flat to make these transversals support the planks more effectively. No essential differences in size, finishing off, etc. could be discerned between the lower and upper transverse timbers. The holes that had been cut out mostly measured 7 x 7 cm (fig. 21). Those transverse timbers that had not been provided with holes had roughly the same characteristics as the perforated transverse timbers; they were, however, more diverse in form. The length varied mainly from 1.07 to

1.80 m; a transverse timber of 3.96 m (fig. 12, trench 5) undoubtedly originates from a longitudinal plank that must have split accidentally. The width was usually 14-20 cm; the thickness varied from 1-8 cm. Some were triangular or semicircular in cross-section.

The smaller pieces of wood, that were used incidentally for providing extra support, could only be recognized as such when they were still in their original position, as in trench 3, at 95 and 96.50 m. These pieces of wood were usually only 50 cm long, 5-10 cm wide and 1-5 cm thick.

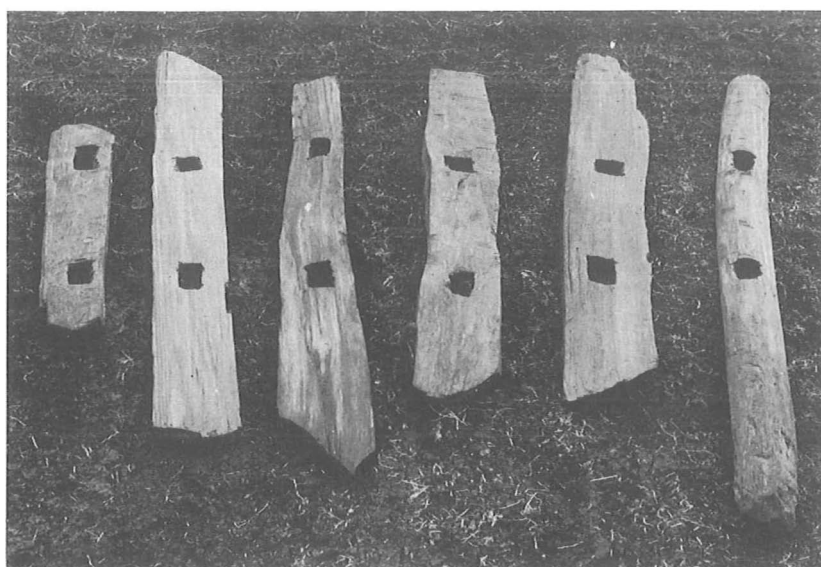


Fig. 23. Northern plank footpath XV(Bou). A few transverse timbers from trench 5. Photo C.F.D.



Fig. 24. Northern plank footpath XV(Bou). Pegs from trench 5. Their length varies from 1.10 to 1.70 m. With many of the pegs the thickened head – on the right – is still visible.

Some of the pegs were made of roundwood, especially *Alnus*, with diameters of 5-7 cm. These were found in trench 1 in particular. Most of the pegs were made of *Quercus*, however, especially sapwood. They were cut into their four-sided to seven-sided shape by means of striking blows longitudinally with an axe (fig. 24). The length of the pegs was mainly 85-115 cm; the average length was just over 100 cm. In trench 1 the average length was ± 75 cm. The pegs that had been cut into shape with an axe either had a thickened head (± 9 cm in diameter) or they gradually tapered towards the point. Thus the pegs could be used effectively for fixing the longitudinals between the transversals. The heads of the pegs probably stuck out 15-30 cm above the footpath.

Freshly cut wood was always used for these

construction elements; any secondary wood that may be present does not include construction elements.

3.1.6. *The rest of the wood*

A fairly large number of undefinable pieces of wood were found, that undoubtedly originate for the most part from the construction elements discussed above (3.1.5). These pieces broke off the construction elements at the time when the pathway was purposely destroyed (3.1.7). A few pieces may have broken off as a result of use of the pathway, before it was destroyed. There is little sense in devoting any special attention to these fragments. In addition, as mentioned already above (3.1.5), a few pieces of wood were found here and there that were used to



Fig. 25. Northern plank footpath XV(Bou), trench 3, from 72 m towards the east. In the foreground a slightly damaged double transversal, still holding in place one longitudinal plank. Two *Alnus* branches, one on each side of the path, possibly deposited after the destruction of the path. July 1963.

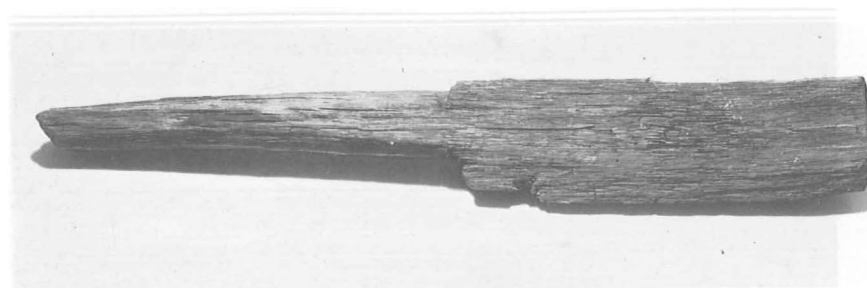


Fig. 26. Northern plank footpath XV(Bou). Wooden mallet, *Quercus*, found in trench 3 at 83 m. Length of the mallet: 103 cm. Photo C.F.D.

provide extra support (e.g. trench 3, fig. 11, between 62 and 64 m), or that served to fix a peg in position. These pieces of wood can hardly be distinguished from the above-mentioned fragments of construction elements; in view of their irregular occurrence it is clear that they did not consistently form part of the basic structure. They are mainly of *Quercus*; also *Alnus* was found in a few cases. The builders of the pathway would have taken these pieces of wood from the higher sandy soils. These pieces of wood were probably refuse left over after trees had been felled and cut up (3.1.9).

In trench 3 (fig. 11), at 36.40 m, three *Alnus* sticks were found that had been driven vertically into the peat, about 80 cm away from the path. It is not known how far they stuck out above the peat-bog surface, but in view of the limited depth of the stick remains, relative to the level of the path, and in view of the length of the other *Alnus* branches lying in this trench, this was probably 60-90 cm. In trench 3 between 69.0 and 70.10 m an *Alnus* branch lies close to the path. Between 74.0 and 76.10 m, in trench 3,

two *Alnus* branches are present, one on each side of the path (fig. 25). The one on the south side lies on top of the broken transverse timber. This can be seen as a weak indication that the branches were deposited here after the destruction of the path. One gets the impression that these branches were used to mark out a route. Small pieces of *Alnus* branches were found in different places in this trench. The wooden mallet of *Quercus* that was found in trench 3 between 82.80 and 83 m (fig. 26) has a more or less round handle and a striking part that is triangular in cross section. Length of the striking part: 50.5 cm; the three sides are 13.0, 13.0 and 11.5 cm wide, respectively. Only on one striking surface the wood has mouldered somewhat as a result of use. The handle is 52.5 cm long; the diameter varies from between 7.0 and 8.5 cm in the thick part, to 5.0-7.0 cm at the thin end.

Also in trench 5 (fig. 12) branches have been found in a few places, for example between 44 and 46 m. Between 64 and 67 m a few pieces of wood were found (fig. 18) that cannot be regarded as

construction elements of the pathway, but that nevertheless belong to the path. The three plank fragments of *Quercus* (64.20-64.60 m, 65.80-66.10 m and 66.10-66.40 m) are partly charred. The process of carbonization did not occur on the spot. It is almost certain that this was secondarily used wood; the function of this wood is not at all clear. The same applies to the pieces of a beam with notches (fig. 18), that measures 77.0 cm in length, and in cross-section 9.5 and 5.5 cm. The notches were made using an axe. These pieces of wood were all found lying horizontally.

3.1.7. *The destruction of the path*

Over large stretches of the pathway the longitudinal and the upper transverse timbers are missing. Many pegs have been pulled out. We interpret this as evidence of the intentional destruction of the path by means of removing the longitudinal planks, as is clearly evident in trench 3, or driving the planks vertically into the bog, as was evident in trenches 5 and 6 in particular. Only the eastern part of trench 3, between 92 and 102 m, appears not to have been destroyed in this way.

The planks that have disappeared completely were probably taken away to the settlement on the Hondrug. Unusable planks and the wood from more distant parts of the path were simply driven into the bog. As a result it became impossible to use this wood again.

In view of the good quality of the wood that was driven into the bog (fig. 17), we may assume that the intentional destruction took place relatively soon after the path had been laid out. These vertical planks showed no signs of weathering on the surface.

We see two possible reasons for this destruction. First of all, it may have happened that the need was no longer felt to communicate with inhabitants on the other side of the bog (3.1.8), or that the destination in the bog no longer required a means of access, so the path could be dispensed with. The other possible reason is that the bog became too dangerous to enter, so that destruction of the pathway was necessary to prevent access to the dangerous spots. The latter we consider the more likely and more appealing explanation. The path lay alongside a very wet contact zone; after c. 1200 BC, when a large lake formed here, the bog region concerned became steadily wetter (Casparie, 1972) and thus more difficult to pass across (2.3). The bog burst of 500 BC, that put an end to this lake, caused so much erosion precisely in this stretch of the route of the path that in the bed of the Runde (fig. 5, 3.1.8), for example, it must have been extremely difficult to pass. The erosion gulleys that formed in the bog were probably almost two metres deep; the width of the eroded area certainly measured a few

hundreds of metres. Whether the destruction of the path can be dated to before or precisely after the bog burst remains unknown.

3.1.8. *Direction, starting point, destination, length and function*

From the situation of the excavation trenches and observation points (fig. 9) the direction of the pathway is clearly evident. This is approximately WSW-ENE, like that of the other prehistoric wooden trackways in this region. In the stretch of pathway that is definitely known to have existed, measuring c. 4.5 km in length, there are no appreciable bends. We may therefore assume that the path was laid out as a direct connection, undoubtedly from the Hondrug (3.1.9, fig. 4). The starting-point must therefore lie ± 150 m west of the westernmost spot where the path has been observed, on the east side of the side-valley of the Hunzelaagte (a low-lying area on the Hondrug), notably at the northern end of this sandhill. This starting-point is about 90 m north of the starting-point of the MBA footpath XVI(Bou) (Casparie, 1984).

On the above-mentioned sandhill no Iron Age occupation has been discerned. To the west of the side-valley the Hondrug was intensively occupied in the Iron Age, as is evident from the presence of Celtic Fields (Brongers, 1976), from abundant traces of iron-smelting activities (Modderkolk, 1970), from urnfields and groups of cremation mounds (fig. 5; Casparie & Smith, 1978; pers. comm. P.B. Kooi). It is fairly certain that the side-valley, that was a wet, marshy lowland area in Iron Age times, also had some kind of man-made bridging connection. This area was reclaimed so long ago that nothing is known of any such construction (see also 3.2.7).

The extensive interviews made in this region by Mrs. A.F. Smith (Exloo) since 1977, later in cooperation with E. Heuving (Klazienaveen), have made it clear that the path was almost certainly encountered also a few kilometres east of Wesselink's trench No. 7 (fig. 4). Its course could even still be indicated in various places (personal communication Smith and Heuving). The path probably extended as far as the eastern margin of the Bourtanger Moor (pers. comm. H. Hayen). This probable course of the path is shown in fig. 1.

Wesselink's investigation (1924) indicates that the path was certainly intended to provide access to something east of the bog rivulet the Runde. This is also suggested by the information, that is otherwise somewhat vague, about a different, notably more robust building method used in the very wet bog-zone close to the Runde (3.1.4). We think it very well possible that this path was intended as a means of communication with the inhabitants on the east

side of the Bourtanger Moor. If this was so, then the path would have measured almost 12 km in length, this being the width of the raised bog area between the Hondsrug and the dune area next to the River Ems (fig. 1).

As this pathway had a walking surface 45-50 cm wide it would have provided a comfortable passage over the domed complexes (2.3); the contact zones and the bog surface near the Runde would have been too wet to allow this construction method as a suitable bridging connection (fig. 18), as is also suggested by the scarce information about the construction method used there (3.1.4).

3.1.9. *The use made of the wood*

From the wood found (planks, transverse timbers, pegs) it can be deduced that oak trees were used measuring ± 40 cm, that were 80-140 years old. The sapwood was used for making transverse timbers, as is evident from the many pieces of slabwood, and for making pegs. The heartwood was used for making the planks, which measured 22-30 cm in width.

The oaks undoubtedly came from the higher sandy areas, notably from the Hondsrug. We may assume that the trees used for this pathway were cut down in forests situated fairly close to the settlement. On the Hondsrug the felled trees were cut up into the construction elements: planks, transverse timbers, pegs. Seeing that here and there wood chips were found, it is evident that the construction elements were trimmed to the required size on the actual building site of the path, in the bog. In any case, excessively wide planks were made narrower so as to facilitate placing them between the pegs of the transversals (fig. 22). We have not been able to show with certainty that the square holes in the transversals were cut out during the process of building the path in the bog, but the presence of a few incomplete holes in the transverse timbers are indicative of this.

It has been estimated by Hayen (1979) that for the 3 m wide Iron Age trackway VI(Pr) in the 'Grosse Moor' (Great Bog) near Diepholz (F.R.G.), which was made of transversely laid planks, an area of 42 ha of forest must have been felled in order to build 1000 m of trackway. If we apply his estimation method to the use of wood for our footpath XV(Bou), that required about a quarter as much as wood per unit length, then we find that a footpath 12 km long requires about 120 ha of forest. This is a considerable large area. The construction of this path must have made extremely great demands on the wood supply of this region, that had certainly been deforested to a large extent as a result of the intensive occupation present here for c. 2500 years already. This is an additional indication that the path was built to serve an important purpose, and

that its construction could have taken place after very careful consideration and planning.

Particularly in trench 1 pegs of *Alnus* were found (3.1.5). Here and there branches of *Alnus* and *Betula* were come across. It is not certain whether the bog-fringing forest, where both of these trees occur, was used to provide this wood.

3.2. The hurdle trackway XIV(Bou)

3.2.1. *Overview of the field research*

Wesselink (1924) observed this trackway in 1910; subsequently he was able to establish its course. He describes the trackway as consisting of a surface-layer of logs and branches (bundles of rods), supported by a substructure of roundwood (3.2.4). Since the beginning of the 20th century the trackway has been regularly cut through in the course of ditch-digging activities, carried out in connection with the cultivation of buckwheat in this peat area.

During our field research, notably when the vertical peat-face C was being investigated (Casparie, 1972), we came across the trackway. The first excavation took place in September 1962; the trackway surface-layer turned out to consist of hurdles. In October 1962 a second excavation followed (fig. 3). In the summer of 1963 the last remaining part of the road was excavated. The situation of the excavation trenches and the observation points, and the course of the trackway are shown in figure 27. The excavation drawings are given in fig. 28. The method of excavation is the same as that used for XV(Bou) (3.1.1).

1962, trench 3. Excavation of September 7th-12th 1962 carried out by G. Delger and W.A. Casparie. It became evident during the peat research that the trackway in the vertical peat-face C was destined to be cleared away in that month definitely as a result of peat-digging. For this reason this stretch of the trackway was exposed. Length of trench: 3.60 m (fig. 29).

Aim: to establish the method of construction, to take samples for dating purposes, documentation. No finds were made.

Casparie, 1972: figs 22 and 44.

1962, trench 1. Excavation of October 3rd-5th 1962 carried out by A. Meijer, G. Delger and W.A. Casparie. The part of this trackway that was found in vertical peat-face B was destined to be cleared away in the years 1962 and 1963. Here a longer stretch of the trackway was exposed, partly because the first excavation did not permit us to establish the construction method with certainty. Length of trench: 10.70 m.

Aim: documentation, to determine the method of construction, to gain insight into the hummock-



Fig. 29. Hurdle trackway XIV(Bou), trench 3, towards the west. September 1962. Photo H. Kroon.

hollow system of the fossil bog surface. No finds were made. Casparie, 1972: fig. 15.

1963, trench 2. Excavation in the months May-July 1963 carried out by G. Delger, K. Klaassens, W.H. Zimmermann and W.A. Casparie, during the campaign of the peat-bog investigation of May-October 1963, shortly before peat-digging at the spot concerned. Length of trench: 38 m.

Aim: documentation, to gain insight into the hummock-hollow systems of the fossil bog surface.

On and next to the trackway-surface various pieces of wood were found, that presumably have something to do with the trackway, either at the time when it was being built or perhaps later, when it was in use. On these pieces of wood no traces of working or other special features are visible. For this reason these bits of wood are not discussed any further.

Casparie, 1972: fig. 40.

3.2.2. The situation per trench

Parts of the trackway lay so close to the peat surface that in many places roots had penetrated the trackway-structure, notably those of *Molinia caerulea*. Naturally, the presence of roots in the remains of the wooden trackway hampered the excavation, in particular the cleaning of the trackway-surface. This was the case in trench 1. In trench 2 the peat surface had been affected by the recent vegetation to such an extent that the trackway surface had largely decayed into a reddish-brown granular mass, in which many details of the trackway construction could no longer be discerned. This

situation was also encountered in two patches of peat, present at c. 180 m and 380 m east of trench 3, respectively. At these places excavation was pointless; they are indicated in figure 27 as observation points.

In trench 3 the state of preservation of the wood of the trackway was excellent; here no serious penetration of roots had occurred into the trackway level.

The road showed a distinct relief, that can be attributed entirely to the hummock-hollow system (Casparie, 1972: figs 40 and 44), although the shrinkage of the peat has certainly made the relief more extreme. The original difference in height between hummocks and hollows would certainly have been some 10-20 cm; locally this difference would have been greater on account of the very weak peat in the hollows (3.2.4). The differences in thickness of the peat above the trackway are indicated only roughly in the descriptions given below. The recent peat-bog surface has originated as a result of its being burnt prior to buckwheat cultivation, which has been practised notably in the vicinity of trenches 1 and 2.

Trench 1, fig. 28. Here the trackway lay 30-80 cm below the peat surface. The wood of the trackway-surface had not been affected by recent penetration of roots to such an extent that observation was difficult. The trackway here was largely undisturbed; the missing hurdle (fig. 3) must have disappeared already before the trackway became overgrown by peat. A distinct pattern of hummocks and hollows was present, that is not shown in the excavation drawing.

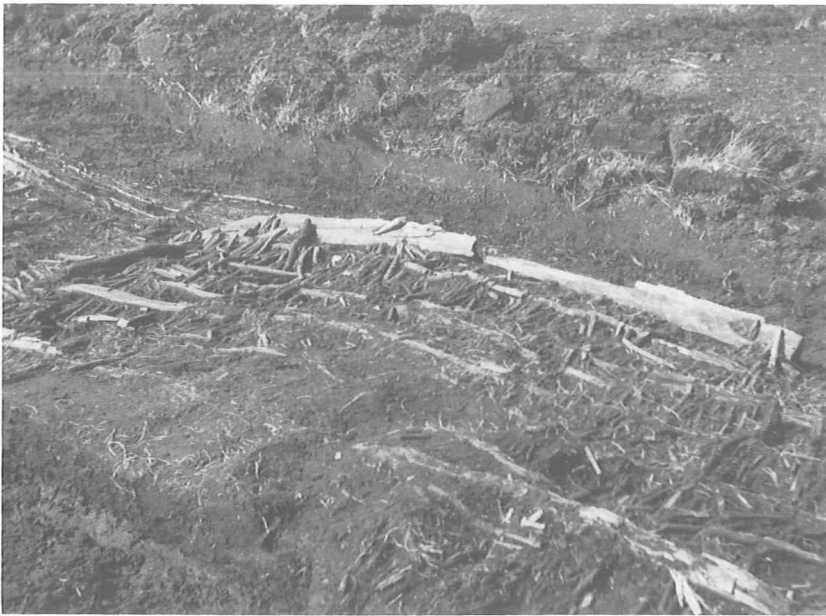


Fig. 30. Hurdle trackway XIV(Bou), trench 2, between 21 and 24 m, towards the north. On the northern side of the trackway surface the (broken) *Alnus* plank. The trackway-surface of *Salix* wattlework, situated here on a hummock, has almost completely decayed due to the destructive action of *Molinia caerulea* roots of the recent vegetation. July 1963.



Fig. 31. Hurdle trackway XIV(Bou), trench 2, between 21 and 22 m. Part of the plank shown in fig. 30 with short pegs of *Fraxinus* wood. July 1963.

Trench 2, fig. 28. Here the trackway lay 10-80 cm below the peat surface. In the western part of the trench (0-21 m) the trackway could be observed only incompletely. Nevertheless, it could be established that the trackway had certainly been present here. In the other part of the trench the shape of the construction elements could still be determined satisfactorily. This trench in its totality certainly does not give a complete picture of the trackway. The trackway lay on a distinct hummock-hollow surface, that has been illustrated by us previously (Casparie, 1972: figs 39 and 40).

On the former bog surface, between 25 and 30 m, a peat-bog stream had been present, in which

extensive *Sphagnum cuspidatum* vegetations were present. Here the trackway construction had been adapted.

Here too part of the trackway probably disappeared already very long ago; between 25 and 31 m the trackway surface has a width of only one hurdle, while the substructure here is wider.

Trench 3, fig. 28. Here the trackway lay 60-70 cm below the peat surface; it had already been found and drawn during our field investigation (Casparie, 1972: fig. 22, peat-face C, pit 68, and fig. 44, section Emmen 12). The precise location and the peat stratigraphy at this spot are also given in the field



Fig. 32. Hurdle trackway XIV(Bou), trench 2, between 26 and 31 m, towards the north. Trackway-surface hurdle with double stakes, that has subsided between the timbers of the substructure. Below this hurdle lies the foundation of *Salix* bunches. July 1963.

investigation report. The trackway here lay in a hummock-hollow system.

3.2.3. Dating

The trackway has been dated by means of pollen analysis (van Zeist, 1955a: p. 48, fig. 15). The age that was thus established, after AD 200, has turned out to be too young. From trench 3, that was excavated in September 1962, a few rods (*Salix*) of a hurdle have provided a ^{14}C -dating: GrN-4147: 170 ± 50 BC (uncalibrated). The rods were 2-4 years old. This Iron Age dating is supported by the stratigraphical peat research (Casparie, 1972). In many places the trackway lies in the poorly humified *Sphagnum papillosum* hollow-peat and over moderately humified hummocks, where *S. imbricatum* is an important peat-forming species.

This dating indicates that this is the latest prehistoric peat-bog trackway in Southeast Drenthe about which information is available. Any peat-bog trackways that were built at an even later date would have disappeared as a result of the burning of the peat surface prior to the cultivation of buckwheat.

3.2.4. The method of construction

On a rather irregular horizontal framework of roundwood, hurdles, i.e. mats of wattlework, were laid out (fig. 3). Here and there this method of construction was supplemented in some way, undoubtedly in connection with particular conditions of the bog surface.

The substructure consists of logs, i.e. young tree-trunks cut to the required length, laid out longitudinally and logs laid out transversely; these two sets of logs are not joined together in any way. There is little or no regularity in the distance between these elements of the wooden substructure. In the longitudinal direction 4-8 logs lie alongside one another. This distance between the transversely placed logs varies from ± 1.20 m to a few metres. It may be assumed that the logs forming the substructure shifted somewhat with respect to one another during the time when the trackway was in use, though possibly also afterwards. This was particularly clearly evident with a few very weak parts of the peat-bog surface (fig. 28, trench 2, 15-21 m).

The hurdles had been laid out either in a longitudinal direction (in which case two hurdles lay alongside each other) or transversely. It was not possible to discern any regularity in this alternating pattern. It is possible that local circumstances (e.g. hummock with pronounced relief) determined the direction in which the hurdles were laid out. The way in which hurdles are made is discussed in 3.2.6.

The hurdles, which form the trackway surface, had been laid down neatly next to one another. They are not connected to one another, nor are they fixed with pegs to one another, to the substructure or to the peat.

On the trackway-surface there is no covering layer present, e.g. in the form of heather sods.

The method of construction evident in trench 2 has been adapted in two places (fig. 28). Between 21 and 24 m, a plank was found on one side of the



Fig. 33. Hurdle trackway XIV(Bou), trench 2, from 27 m towards the east. The foundation of *Salix* bunches, cut through here in two places, below the hurdles with double stakes, after the removal of the trackway-surface hurdles. July 1963.

trackway, on the short side of two transversely laid out hurdles. Near the ends of this plank holes had been cut out in a simple way (fig. 30), through which short pegs were fixed (fig. 31). This plank probably served to prevent the trackway surface from wobbling on the very pronounced hummock that is present here. In trench 2, between 25 and 31 m, below the hurdles with double stakes present here (3.2.6) and the substructure, filling material consisting of bunches of rods was present, in the bed of the previously mentioned bog stream (3.2.2, sub-heading trench 2) (figs 32, 33). Evidently the carrying capacity of the peat here was insufficient to allow the hurdles to be supported only by the substructure of logs. These willow rods will be discussed in more detail in 3.2.6.

The hurdles varied in length from 2.60 to 2.80 m; their width varied from 1.10 to 1.40 m. The length:width ratio is roughly 2:1. On either side the trackway-surface projected 20-40 cm beyond the substructure. The trackway-surface probably lay 15-25 cm above the peat surface; the width of the trackway was ± 2.70 m. This construction would permit a comfortable passage over the bog, though the trackway surface would be rather springy, as it were.

The previously mentioned (3.2.2) absence of parts of the trackway surface in trench 1 (between 5 and 8.50 m) and trench 2 (between 25 and 31 m) we do not regard as an adaptation of the construction method. In the first place we assume that a hurdle (for some unknown reason) was removed; in the second place it is possible that two hurdles became washed away, after they had subsided into the bog stream.

It is not certain whether the construction was strong enough to take wheeled traffic. No vehicle tracks have been found. Two damaged patches in the trackway surface, in the form of oval holes (trench 2, 2.50 m and 3.70 m, respectively), indicate that it was trodden by animals.

3.2.5. The construction elements

For the longitudinally placed substructure elements logs were used consisting of 5-m lengths of tree-trunks of different species of wood. *Alnus* predominates; in addition *Betula*, *Fraxinus* and *Pinus* occur. The logs used were 8-18 cm thick at the base end. The trees were 10-20 years old; as a general rule straight tree-trunks were used. The transversely placed logs of the substructure are more irregular in shape. The length varies from 1 to 3 m; the diameter of the base end is 8-15 cm. The species of wood that have been found are *Alnus* and *Betula*. Also these trees were 10-20 years old. The trees that were used for the substructure would undoubtedly have been present in and near the settlement and along the bog margin.

In trench 2, between 25 and 30 m (fig. 33), an extra foundation of bunches of rods has been found, as mentioned above (3.2.2). The bog stream present here is filled up with *Salix* rods, of the same type as those used for making the hurdles; this is described in more detail in 3.2.6. The branches used were 3-4 cm thick, and mostly 3-4 years old, with lengths varying from 2 m to almost 5 m.

The hurdles were made out of rods of *Salix* measuring 2.5-4 cm in diameter; these rods were 3-4 years old, and measured up to almost 5 m in length.

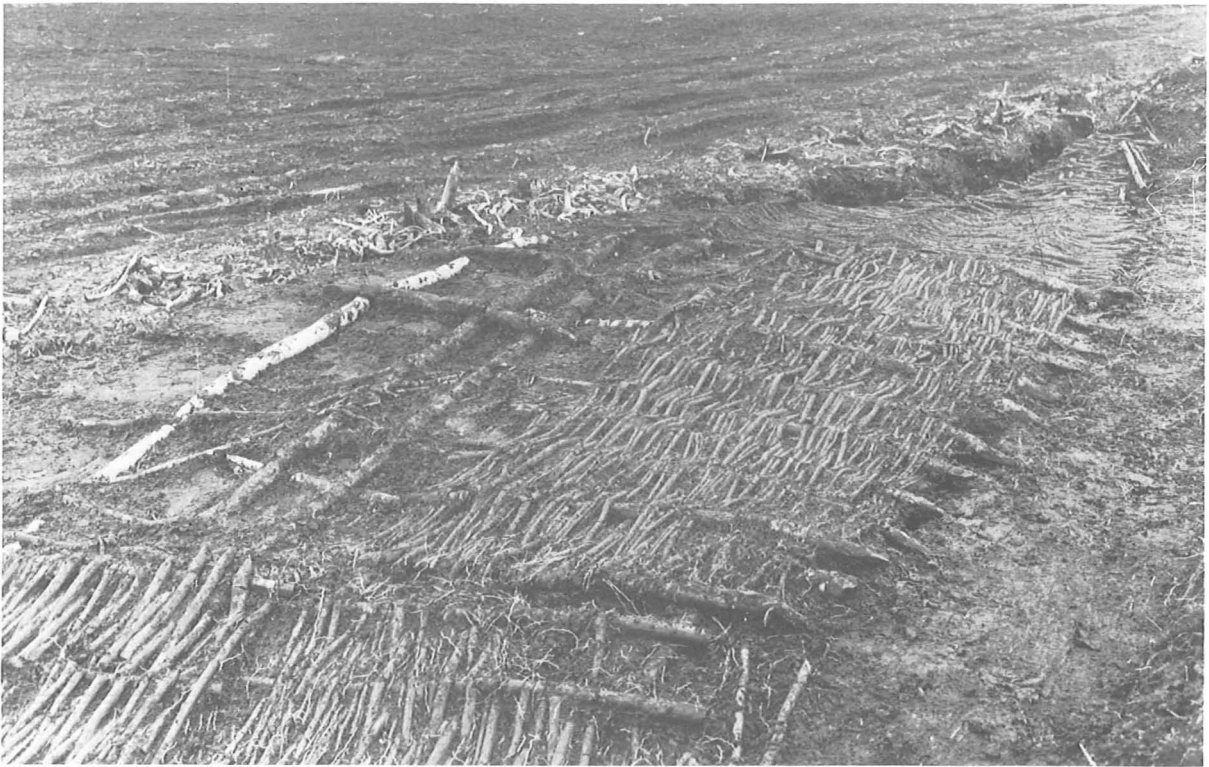


Fig. 34. Hurdle trackway XIV(Bou), trench 1, general view towards the west, October 1962. Photo C.F.D.



Fig. 35. Hurdle trackway XIV(Bou). The ends of the *Alnus* plank from trench 2, between 21 and 24 m, with the holes cut through them.

The rods had not been peeled; for the making of the hurdles see 3.2.6.

The length of the hurdles varied from 2.60 to 2.80 m, their width from 1.10 to 1.40 m, as is already mentioned (3.2.4). The thickness of these hurdles varied from 5 to 8 cm. When the excavations were in

progress it turned out that it was not possible to draw the hurdles in detail. We have had to restrict our attention to the stakes, that form the warp of the wattlework, and the surrounding of the hurdles. The way in which the woven network holds together is clearly visible in figures 29 and 34. A few

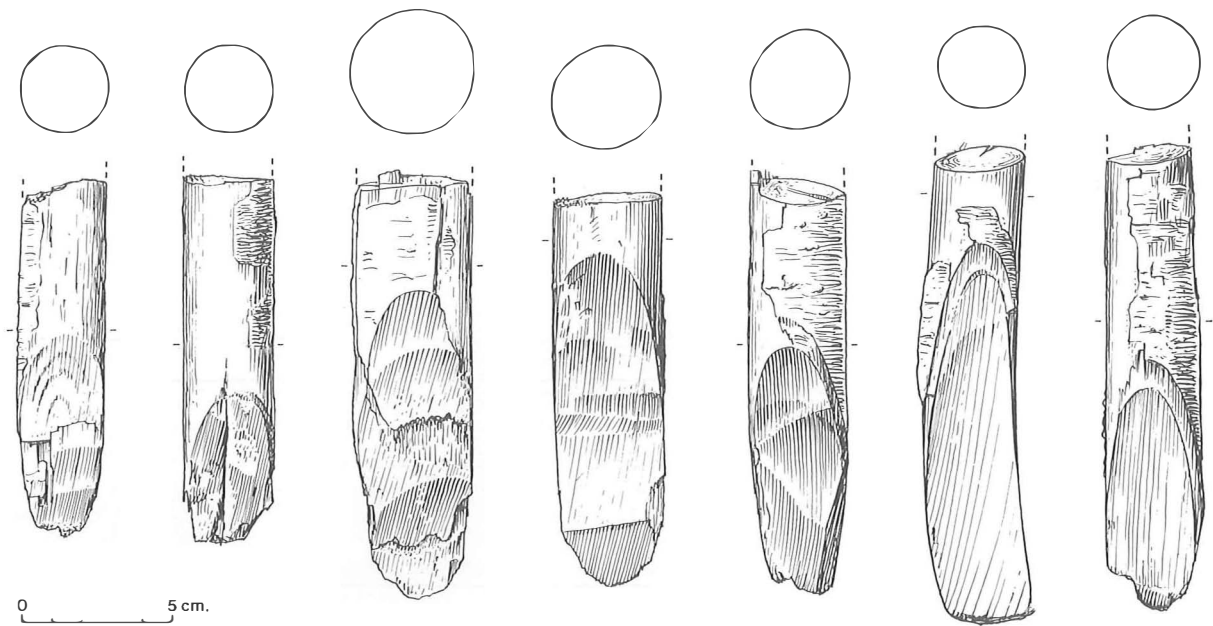


Fig. 36. Hurdle trackway XIV(Bou). Basal ends of the *Salix* rods from the foundation of trench 2, between 26 and 31 m. It can clearly be seen that the branches were cut downwards from the willow stools. Drawing H.R. Roelink.

hurdles had double stakes serving as the warp; these more substantial hurdles were used as a trackway surface-layer over the bog stream (trench 2, 25-30 m), among other things.

The (broken) plank in trench 2, between 21 and 24 m (fig. 30) on the northern side of the trackway had been cut tangentially out of an *Alnus* trunk. It is 2.80 m long, 22 cm wide, and 3-7 cm thick. Close to each end a hole has been made (fig. 35) by means of simply striking a few cutting blows from each side. Sticking through these holes were 4 or 5 short pegs of *Fraxinus*; these pegs were spindle-shaped, 12-15 cm long and 2-3 cm in diameter. They were in an advanced state of decay. Although during the excavation it could not be demonstrated that the plank had been fixed to the adjacent hurdles by means of these pegs, it seems likely, nevertheless, that the plank served to provide support to keep the two hurdle ends effectively in place on the very uneven hummock present here. The plank itself had not been fixed in the peat.

3.2.6. Hurdle-making

The hurdles that were used for this trackway are identical to present-day hurdles of *Salix* wood as regards the kind of wood used, the weaving technique and overall dimensions. Therefore they must have been made in the same way. Ir. W.D.J. Tuinzing of Bennekom, an expert on the cultivation of willow beds and the processing of willow rods,

provided us with extensive information on hurdle-making. Although we shall refrain from giving a full account of the many aspects of this technique, a detailed description of the way in which the Iron Age hurdles were made is appropriate here. For this purpose we have gratefully made use of Tuinzing's information (in: Westendorp et al., 1985). By studying the rods that were used for the foundation in trench 2, 30-35 m (fig. 33), we are able to obtain a clearer picture of the hurdle-makers of 170 BC, since the same starting material was used for this foundation and for the hurdles.

For making the hurdles four-year-old willow rods (i.e. branches of *Salix*) were mainly used. The diameter at the bottom end varied from 2.5 cm to almost 4 cm. The hurdle consists of an interwoven network with a warp and a weft. The average thickness of the weft elements was almost 3 cm, that of the warp elements about 3.5 cm; the rods used for the foundation measured over 3.5 cm in thickness. From the cut surfaces of the branches it can be seen that these were cut off from above (fig. 36); the branches were held under tension, so that they curved slightly to one side. Then, with one to three blows of an axe or billhook, applied at an angle of 15-25°, each branch was cut through to such an extent that the last part of the cut surface broke off due to the tension. This technique is indicative of the cultivation of willow coppice with low willow stools, that were cleared of their shoots in a four-years' rotation (3.2.7). The wood was not stripped.

Fig. 37. Hurdle trackway XIV(Bou), trench 1, between 4.50 and 8.0 m, towards the south. In the foreground the pointed basal ends of the stakes, that were stuck into the ground when the hurdles were being made. October 1962. Photo C.F.D.

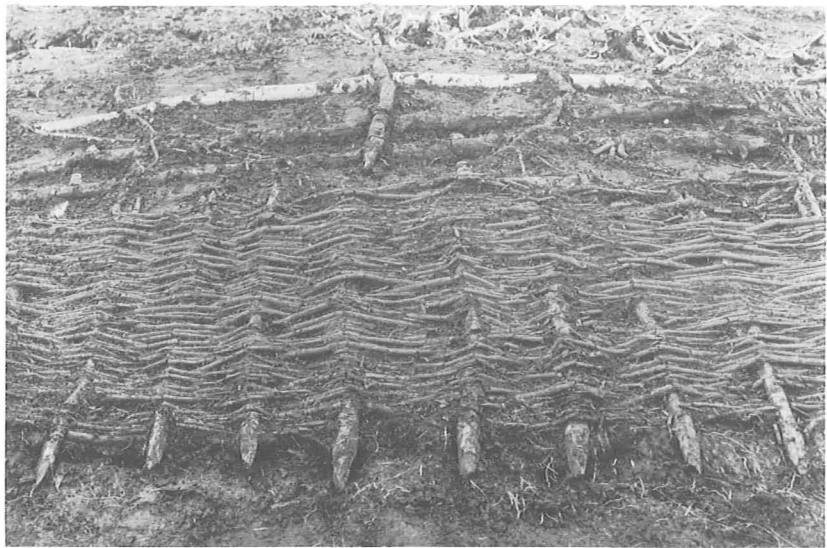


Fig. 38. A modern hurdle of *Salix* rods being made by A. van Weverwijk of Culemborg, near the River Lek in the riverine region of the Central Netherlands. Photo taken on April 14th, 1949 by Ir. W.D.J. Tuinzing. In the foreground the tool kit of the hurdle-maker: wood-cutting knife, a kind of wooden hammer and billhook.



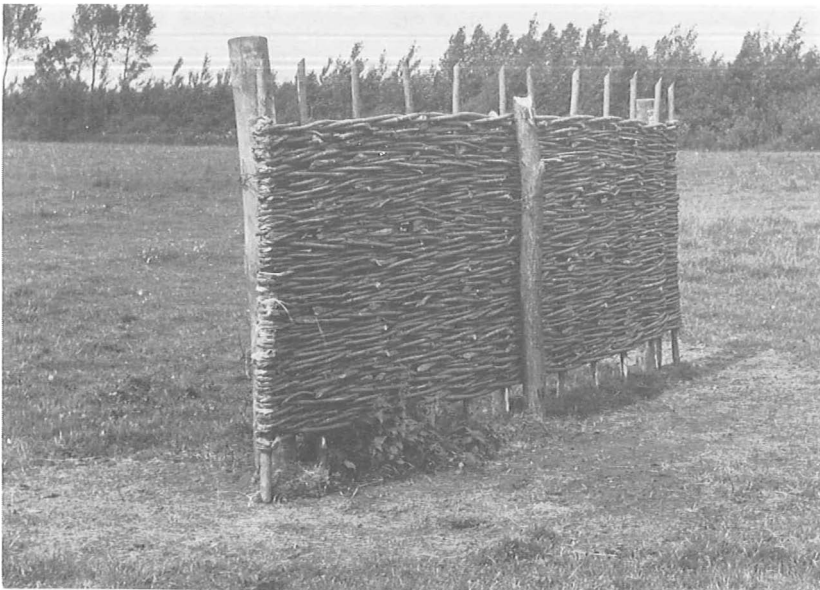


Fig. 39. Modern hurdle as a wind-screen for livestock, near Culemborg. Photo taken on July 20th, 1962 by Ir. W.D.J. Tuinzing. Length of the hurdle: 3.55 m; height from the ground to the top of the stakes: c. 1.60 m.

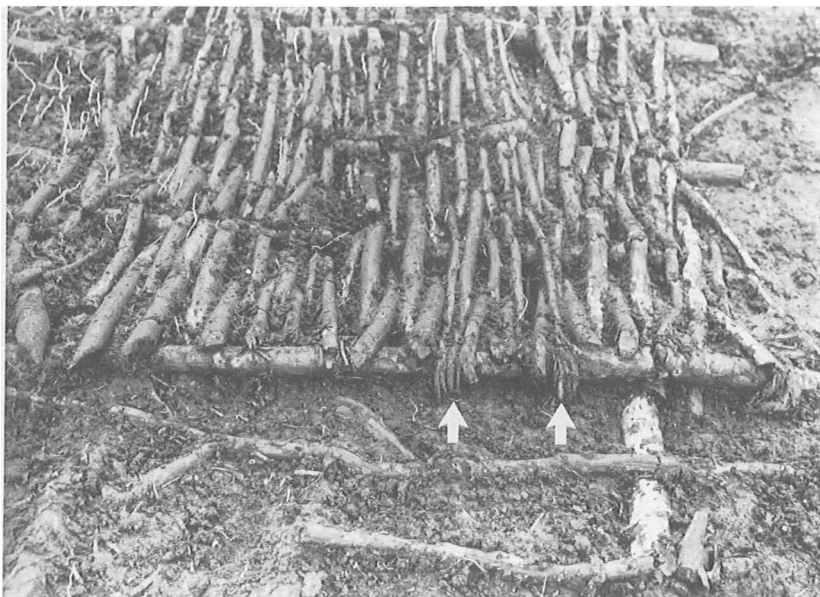


Fig. 40. Hurdle trackway XIV(Bou), trench 1, 8-9 m, towards the east. End of a hurdle with weft rods, bent back 180°, visible (arrows). By twisting these rods around their longitudinal axes the wood fibres can be separated from one another, so that the rods can be turned 180° without breaking. As a result of this the wood decays more rapidly. October 1962. Photo C.F.D.

The rods were cut off in the autumn or winter, as is clear from the consistently well developed last annual ring of the wood. The side branches had been cut away; it could not be ascertained how this had been done.

For the extra foundation of trench 2, 25-30 m, bundles of 30-40 such branches were used. No traces have been found of any binding material that may have held the bundles together.

For each hurdle first of all 12 branches measuring 3-4 cm were selected. These were sharpened at the bottom end, while the top end was trimmed so as to

produce stakes 1.40-1.60 m long. These were stuck or driven vertically into the ground at intervals of 22-25 cm, to a depth of 10-20 cm. The pointed base ends had usually been sharpened in such a way that they were faceted, usually with 3 or 4 sides (fig. 37).

The actual weaving of the horizontal rods through the vertical stakes is done as shown in fig. 38. To make a flat hurdle (fig. 39) out of springy willow rods requires rather a lot of skill. At the stakes at the end of the hurdle the weft element is twisted around its longitudinal axis, so that the wood fibres become separated, though they can still

slip over one another. The weft element can now be bent back 180°, without it breaking. The wood does indeed become damaged as a result of this, and therefore is more susceptible to rotting (fig. 40).

Hurdles that are exposed to some kind of heavy pressure, for example being used as a trackway-surface, are made to be more solid. If thicker rods are selected as stakes then there is a danger of the weft elements breaking; this can be avoided by using warp elements of two stakes together. Another method is to use thicker weft elements, namely with a diameter of 3.5–4 cm at the bottom end. Both these ways of reinforcing were applied to the prehistoric hurdles.

Many hurdles measure c. 2.80 x 1.40 m; this could be called a standard size. When the interweaving of the network has been completed, the projected ends of the weft elements are removed with the aid of a chopping knife or billhook, after which the hurdle can be loosened from the ground. It is then ready for use.

Hurdle-making is an activity that is carried out mainly in the second half of April and the first half of May, because then the wood is more pliable on account of the higher temperature compared with the winter situation.

Hurdles were used in the past for various purposes: not only as surface coverings of trackways and bridges, but also for fences, walls, ceilings, doors or gates and as windscreens. This was probably also the case already in Iron Age times.

3.2.7. *The use of the wood and the location of the willow coppices*

For the trackway, that was over 3000 m long (3.2.8), about 2000 hurdles were used. How much manpower was necessary for making the trackway?

Hurdle-making is rather labour-intensive. A good hurdler can make 4 hurdles a day. The most suitable period for hurdle-making – between mid-April and mid-May – lasts at most 30 days. Assuming that the hurdles were made in one season at the rate of production of 4 per man per day, for 2000 hurdles the number of people needed would be 17.

The cutting and trimming of the rods is not very time-consuming; in one day one person can prepare enough wood for about eight hurdles (55–65 rods per hurdle). The most usual period for doing this (between the beginning of November and the end of February) lasts c. 120 days. Seventeen people would have been able to cut enough wood for the hurdle trackway in about two weeks.

The amount of time invested in transporting the wood to the place where it was made into hurdles (probably the settlement), and in taking the hurdles to where the trackway was being built, is more difficult to estimate. Both bundles of rods and the

hurdles were probably transported by wagon. We assume that the willow coppices, the settlement and the starting-point of the trackway were situated relatively close together. For this reason the transport required would not have been the limiting factor; the best time for building the trackway would have been between April and mid-September, a period of about 150 days. A group of 17 people could easily transport 2000 hurdles over a distance of at most 3–3.5 km in 35 days.

In addition to these activities, the work that was put into making the substructure has to be taken into account (see below) to obtain a good idea of the total amount of time that was invested in building this trackway.

The area of willow coppice that was exploited for making the hurdles of this trackway can be roughly estimated, on the basis of a few assumptions. The information is based to a large extent on present-day willow-bed cultivation. At the present time this is practised exclusively on the very heavy though extremely fertile clay soils of the riverine region of the Central Netherlands. The yield of wood obtained there will be higher than what we may assume for the willow coppices of Southeast Drenthe in 170 BC (see below), partly because of the use of specially selected varieties of *Salix* nowadays. The value estimated here for the area of willow coppice therefore has to be regarded as a minimum value.

The wood is cut in a four-years' rotation; we assume that a quarter of the coppice area always had four-year-old wood growing on it. That is to say, we assume that of the total area of coppice every year a quarter was cut. A productive willow stool, that is stripped of all its branches every for years, has – very approximately – 40 shoots, of which 20 will be straight, of the right length and thickness. Thus for each hurdle (55–65 shoots) three willow stools will be needed, on average. Therefore the 2000 hurdles of the trackway required 6000 stools. If we assume that the willow stools stand 3 m apart on average (in practice this distance varies from 1 to 6 m), then each stool occupies 7.5 m². Thus for this trackway an area of 4.5 ha of willow coppice would have been used. The total area of willow coppice, under conditions of constant exploitation, would then have been (at least) 18 ha, of which a quarter was harvested each year.

Hurdles are of very limited durability; usually they last for only a few years. It is therefore certain, in view of the great skill of the hurdlers, that willow coppice was harvested every year to obtain sufficient raw material for this and other wattlework. It is conceivable that for the purpose of such a large-scale activity as the building of this trackway willow rods were cut exclusively for these hurdles, while all the other wattlemaking activities had to be postponed for a year. In that case the willow

coppices of these trackway builders need not have been larger than c. 18 ha.

As we have argued above, we may assume that the willow coppice was present in the neighbourhood of the trackway. The location of this coppice can be pin-pointed: an area less than 30 ha in size, namely the side-valley of the Hunze depression, c. 1 km northwest of the starting-point of the trackway (fig. 5). The bog itself and its marginal area could not have been used as coppice, as they are not suitable for the growth of *Salix*. The extensive field complexes, the Celtic Fields (Brongers, 1976), that take up a considerable part of the higher soils near the trackway (fig. 5), could not have been used for *Salix* cultivation, either. This also applies to the highest parts of this region; the settlement where the trackway builders lived was almost certainly here (4.6).

The side-valley, with its subsoil of partly ice-pushed boulder-clay, became steadily wetter as a result of the upward growing bog surface in the Hunze depression, all the more so because there it has a very limited amount of slope. The bottom of the side-valley projected barely 2 m above the peat-forming level in the Hunze depression, while the length of the valley was 800 m.

The catchment area for the supply of water to this side-valley is small: at most 150 ha. Consequently the side-valley would have been very susceptible to drying out in periods when no rain fell. This drying-out would have been especially noticeable during the summer months on occasions when the bog surface subsided somewhat, with an accompanying increase in the drop in the side-valley. It is possible that this accounts for the remarkably large number of growth interruptions in the *Salix* wood that was used for this trackway. A large proportion of the stakes that were analyzed showed so-called double or false annual rings, indicative of a cessation in growth occurring nearly every year. The obvious conclusion is that this represents an annual drying-out of the side-valley during the summer period.

In and around such willow woods also *Fraxinus* and *Alnus* were undoubtedly present.

The number of logs that were used for the substructure cannot be determined so readily. On the basis of the excavation drawings (fig. 28), it is possible that the substructure required c. 5000 logs measuring about 6 m in length, that were partly used cut up into shorter logs (as transverse timbers of the substructure). Such logs with a diameter at the bottom end of 8-15 cm have a volume of about 40 litres. The total quantity of wood used for the substructure is thus 200 m³. On the basis of our calculations relating to the timber requirements for the Neolithic trackway of Nieuw-Dordrecht (Casparie, 1982: pp. 155-156), we arrive at a total area of woodland of 3-5 ha. The trees were 10-20 years old when they were felled. If we assume that one man

can fell 16 such trees in a day, and that the further processing of the wood (cutting off side branches and transport) costs just as much as time as the felling, then one person should be able to produce 8 such logs per day. The 5000 logs thus represent more than 600 man-days; for a group of 17 people (the same group size as was assumed for the hurdle-making) this work could have been done in 35 days.

From our rough estimations it is evident that the cutting of the willow rods, the making of the hurdles, the felling of the trees for the substructure and the transport of the construction elements, together with the building of the trackway over a total length of c. 3000 m (3.2.8), altogether meant at least four months work for 17 people.

The area of willow coppice required was at least 18 ha; of this the yield of one year – 4.5 ha – was utilized for this trackway. In the following year the greater part of this coppice area would have been able to provide plenty of wood once again for wattlework required for various other purposes. In view of the point of departure for the calculations, namely that these are minimum values of areas, it is likely that the whole side-valley, extending over an area of less than 30 ha, was used for this willow coppice. The forest that provided the logs for the substructure could have been exploited again for its timber after 10-20 years. It is fairly certain that this was not undisturbed, dense forest; thus the areas size of 3-5 ha should be regarded as a minimum value. In view of the extent of the area of willow forest, and of the size of the area of land under cultivation (c. 250 ha of Celtic Fields, see fig. 5), it is clear that we are concerned here with a landscape that was being used intensively already in this period, where forest was only sparsely present. It is possible that the people living here had to cut down all the trees of the right size that were available in order to build the substructure. This would also explain why the substructure contained species of wood that came from different places.

3.2.8. *Direction, starting-point, destination, length and function*

From the location of the excavation trenches and the observation points (fig. 27) it is clear in which direction the trackway ran; this was SWS-ENE, just like the other prehistoric bog trackways in this region. Some of the observation points were given by Wesselink (1924), others we established ourselves. The westernmost observation point is based on information from the owner of this terrain, W. Welling of Emmerschans, that he acquired in 1963. At this spot (fig. 27), a few decades earlier, a lot of wood had been found in the peat, precisely at the transition from sand to peat. We have interpreted this as the starting-point of the hurdle trackway or at least part of the trackway close to where it began.

The trackway was laid out as a direct connection; it was certainly at least 1500 m long (fig. 5, between excavation trench 1 and the easternmost observation point). It definitely could not have been intended to extend across the whole raised bog (a distance of 11 km); for this purpose its method of construction is unsuitable. We are convinced that it served to provide access to the bog iron-ore (siderite) centre D (fig. 5). If this was indeed the case, then we are concerned with a trackway that was 3000 m long or slightly longer.

The presumed function of the trackway, namely to permit the transport of iron-ore, is suggested not only by the presence of lumps of ironslag in the area of the (presumed) settlement (Modderkolk, 1970) and by the direction of the trackway (towards a bog iron-ore area), but also by a few finds from the peat, notably the piece of wood with a rectangular hole (3.2.9), that was found in the bottom layer of this siderite area D (Casparie & Smith, 1978). The iron-ore (van Heuveln, 1958) formed between 5200 and 3100 BC (Casparie, 1972; 1984). It had probably become overgrown by poorly humified *Sphagnum* peat already at the time when this trackway was built. We do not know whether the spot was still visible from a distance, as it had been in the Middle Bronze Age (Casparie, 1984).

3.2.9. A few wood finds

During the excavations of this trackway no finds were made that give any indications of its function. With many finds from the peat it is not clear whether they are related to activities in the bog, or whether they are objects that were accidentally lost, for example. Two wood finds in the area of the trackway are indicative of exploitation of the bog close to the trackway XIV(Bou) during the Iron Age.

1. In the siderite area D, at the transition from sand to peat, a plank was found (fig. 5:1), that has been dated to 575 ± 35 BC. This find – precisely in the course of trackway XIV(Bou) – indicates that bog iron-ore was dug here in the Early Iron Age (Casparie & Smith, 1978). Close to the plank, in which a rectangular hole had been cut out, various rows of small poles were found (pers. comm. H. Kuilder, Emmen), also at the base of the peat, that are indicative of relative extensive digging activities in the bog.

The plank, *Quercus*, measures 1.14 m in length, 20-21.5 cm in width, 3.5-5.4 cm in thickness; it was prepared entirely by chopping, i.e. it had not been sawn. The chopping traces indicate that an axe was used with a cutting edge of about 6 cm. The

Fig. 41. Oaken plank, found at the bottom of the peat in seepage centre D (fig. 5.). The plank has been dated to 575 ± 35 BC. Length of the plank: 114 cm. Photo C.F.D.

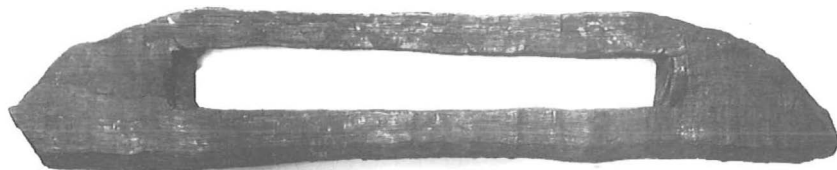


Fig. 42. The peat-digger J. Velema indicates the plank, in the peat near XIV(Bou) (fig. 5). The plank (not dated) may form part of a construction of some sort close to the hurdle trackway. Photo c. 1933 by J.H. Botterweg.



rectangular hole that had been cut out measures 64.5 cm in length, while its width varies from 6.5 to 8 cm (fig. 41).

The level at which the find was made, 2.75–3 m deep in the peat, can be dated to c. 5000 BC (Casparie, 1972). We are therefore concerned here with an object that had been deeply dug in. Its precise function is not known, but in view of the quality of the peat at this spot – rich in iron-ore – we can be almost certain that it had something to do with exploiting bog iron-ore.

2. Groenman-van Waateringe and Smith (1984) describe a leather shoe found in the peat, that can be dated to the Late Bronze Age. Their illustration Plate 1a (fig. 42) shows the finder of the shoe, at the spot where it was found in the peat. The finder is pointing to a plank of a bog trackway. The photo was taken in about 1933 by J.H. Botterweg (Drachten). In figure 5 this spot is indicated as No. 2. The level of the plank can be roughly indicated: between 500 BC and the beginning of the Christian Era. In view of the situation (fig. 5:2) and the level of this piece of wood (undoubtedly a plank, though no measurements are known), it is possible that this wood can be associated with the trackway XIV(Bou). In any case we can be certain that it was connected with some kind of activity that can be dated in the Iron Age.

The location given by us (fig. 5) deviates from that mentioned by Groenman-van Waateringe and Smith (1984). The location they mentioned was put on their map in the wrong place, as the result of a misunderstanding.

4. INTEGRATION AND DISCUSSION

4.1. Introduction

In previous studies on the bog trackways of South-east Drenthe (Casparie, 1982; 1984), we focussed our attention on many aspects in order to explain as well as possible the Neolithic bog trackway of Nieuw-Dordrecht XXI(Bou) and the MBA footpaths XVI(Bou), XVII(Bou) and XVIII(Bou). Many of the points of departure discussed in those studies are also applicable to this discussion of the Iron Age bog trackways, that forms a sequel to the previous studies. Those points of departure are not repeated here.

4.2. The accessibility of the peat-bog area

The development of the surface of the raised bog from the time when the MBA footpaths were built (1200–1100 BC) until the bog burst of 500 BC is mainly a matter of increasing abundance of water and consequently greater problems for anyone wanting to pass across the bog. For the domed complexes it is difficult to assess whether the

bottoms of the hollows could be safely trodden in the summer period without the aid of planks or hurdles; the contact zones and the area of the raised-bog lake were in any case impassable throughout the whole year (2.3). The raised-bog rivulet the Runde was probably a rather insignificant stream until the bog burst; nevertheless the footpath XV(Bou) must have had a very substantial construction in the contact zone of the Runde. The accessibility of the bog iron-ore areas, notably area D (fig. 8), that was evidently being exploited in the Early Iron Age (3.2.9), is not clear. In about 500 BC the siderite areas had already become overgrown by (poorly humified) *Sphagnum* peat.

After the bog burst the peat surface of the domed complexes possibly became slightly more easily passable. A few centuries later this was no longer the case, as can be deduced from the need for an extra foundation of bunches of rods for the trackway XIV(Bou) (3.2.4). After the bog burst the water supply in the contact zones decreased considerably; nevertheless these zones almost certainly remained hardly accessible at all. A lot of water soon accumulated once again, and these zones were marked by deep erosion gulleys. The absence of proper wooden trackways, i.e. trackways substantial enough to take wheeled traffic, can possibly be interpreted as an indication that this peat-bog region still had a very limited carrying capacity and was thus very difficult to pass across. In view of the scarcity of peat-bog finds dating from the Iron Age in this region (pers. comm. W.H. Zimmermann, Wilhelmshaven), it is evident that the bog surface was trodden less in the Iron Age than in the preceding periods.

4.3. The reason for the existence of the wooden trackways

The most important reason for building the footpath XV(Bou) was probably the need for contact with inhabitants of the east side of the Bourtanger Moor (3.1.8). The way in which this need became expressed raises a number of questions. Why was a footpath built and not a trackway for wheeled traffic, that offers more possibilities for transport? It is very probable that the wood supply in the region where the path-builders lived was too small to permit a trackway to be built; for this purpose about 500 ha of forest would have been required (3.1.9), which was no longer present as a result of the intensive occupation (4.6). Evidently this path was not intended for transporting large quantities of material. Therefore such a path cannot be regarded as a trade route; the practical possibilities were too limited. Why was so much energy put into establishing a connecting route, that could only have served a limited purpose and that was not intended to take intensive traffic? It is fairly certain that the hardly passable state of the bog surface in c.

530 BC (4.2) necessitated the building of this path, but it is not known whether this is the successor of a previous route, without any wooden walking surface, across the bog. We may assume that this peat-bog surface had been very wet for a long time already; with this path it therefore seems that a new need for contact arose rather than the gradually increasing inaccessibility of the bog necessitated the improvement of an already existing route. It is also certain that at about that time people did indeed make their way across the bog (3.2.9), notably for the purpose of winning iron-ore.

It is not clear whether the walking surface of this path projected high enough above the bog surface to permit people to walk along the path dry-shod. Although the path was well supplied with transverse timbers and had a more substantial construction in the exceptionally wet parts of the bog (3.1.4), it was probably usable as a comfortable passage only in dry, rainless periods (3.1.8).

Between the time of construction of this path and the bog burst (2.3) there was probably hardly any difference in time; the ^{14}C -datings are also indicative of this (2.3 and 3.1.3). In view of the quality of the wood of the planks that were driven into the peat (3.1.7), it is not impossible that the bog burst surprised the path-builders while they were at work. We may assume that they had not foreseen this bog burst; the effect of this catastrophe on the passability of the raised bog was so drastic that it was decided to demolish this path (3.1.7). Partly because no traces of use are evident and no finds relating to the path were made, it cannot be clearly established for what kind of communication this path XV(Bou) was intended.

The hurdle trackway XIV(Bou), that was almost certainly intended to reach the iron-ore centre D (fig. 5; 3.2.8), is remarkably wide, wide enough to take wagons. The MBA wooden trackways in this region, that were also built for the purpose of winning bog iron-ore, are merely footpaths. This can be adequately explained by the fact that in the MBA this material could be processed only in small quantities (Charles, 1984). The technique of iron processing became considerably improved in the Iron Age, as can be deduced from many finds of pieces of iron slag of *Rennfeueröfen* (i.e. furnaces for iron smelting) (see i.a. Hayen, 1968). Also from the inhabited area close to the hurdle trackway sufficient information is available on iron-working in this period (Modderkolk, 1970). Yet here too a few questions arise. Can the remarkable width of this hurdle trackway be attributed to a greatly increased demand for iron-ore, that had to be won in a very short time? In that case the use of wagons or of a large workforce would be plausible. No clear indications have been found that the path was intended to be made use of in either of these ways.

The (possibly) increased demand for iron-ore would probably also have led to an intensive

exploitation of the bog iron-ore areas A, B and C (fig. 5). Yet here no wooden trackways were made use of; at least no Iron Age trackways relating to these areas have been found. These areas may have been relatively easily accessible. The question then arises as to why people took the trouble to build a labour-intensive trackway to get to the iron-ore area D, a trackway that could only have been used for a very short time (4.4).

4.4. Building methods, organizational aspects and the duration of the period of use

The northern plank footpath XV(Bou) was clearly planned in advance; in view of the consistent method of construction (fig. 19) over a relatively great length it is fairly certain that the construction was carried out according to specific instructions stringently prescribing the application of a particular building method and choice of material (predominantly oak timber). The construction elements were probably made in the settlement, but they had to be trimmed and cut into shape at the building site in the bog to make them fit together well. In terms of the dimensions of the construction elements this footpath hardly differs from the MBA footpath XVII(Bou) (Casparie, 1984) that is more than 600 years older. With the use of metal axes, evidently enough standard techniques and standard measurements had been developed, that remained in use for a very long time.

The path is made of freshly cut oak timber; only in one place, trench 5, 64-67 m (fig. 18), some secondarily used wood has been found. The significance of this and the previous function of the pieces of wood concerned are unknown.

The wood has been worked more roughly than in the MBA footpath XVII(Bou); this may be attributable to the use of iron tools. A wooden mallet (fig. 26) has been found, that must have been one of the tools used for building the path.

It was the intention of the path-builders to lay out a straight pathway; no bends are present at all. In view of the straight course of the path over a considerable length it is clear that the direction of the path was predetermined in the terrain.

The path had great stability; on account of its surface width of c. 0.5 m it was very comfortable, but it is questionable whether it would have allowed people to walk here dry-shod in the very wet area of bog (immediately before the bog burst). The use of extra transverse timber (3.1.4) compared with the MBA footpath XVII(Bou) would have meant only a slight improvement. The fixing of the transverse timbers by means of pegs into the peat and the way in which the longitudinal planks are firmly held in place between the transversals in footpath XV(Bou) are indicative of a throughout knowledge of the bog and experience with the problems of carrying capacity. Also the more substantial means of

construction in the excessively wet parts of the bog (3.1.4) is indicative of this.

The hurdle trackway XIV(Bou) has a very simple means of construction (fig. 3; 3.2.5); the substructure consists of ordinary, general-purpose timbers and the trackway-surface elements are standard items of use (3.2.5, 3.2.6). Therefore it is impossible to say whether this path was also built according to specific instructions prescribing the materials to be used. In view of the straight course of the path it is probable that the route was determined in the terrain beforehand (fig. 5). The making of the willow hurdles (3.2.6, 3.2.7) is a routine task restricted to a particular season; this hurdle-making required great technological skill, and was almost certainly a traditional craft of long standing (4.8).

Like recent willow beds, the willow coppice that was exploited for this trackway (3.2.7) undoubtedly provided willow rods for various other purposes too, such as finer basketry, for making bushels and hampers. The basketry was almost certainly done in the settlement.

The trackway XIV(Bou) had fairly great stability when trodden underfoot, partly on account of the resilient nature of the surface material. The laying out of wattles on a framework of roundwood gives a maximal surface-increasing effect of the hurdles on the bog surface. Such a means of construction (fig. 4), that exerts a minimum pressure on the bog surface, is insufficient, however, in very wet contact zones, as is clear from the (supplementary) use of withy-bed bundles as foundation material in a bog-stream channel (3.2.4). The absence of connections between the trackway-surface and the substructure together with the absence of pegs to fix the trackway to the peat means that the trackway-surface elements can easily slip out of place with respect to the substructure. Evidently the path-builders did not regard this as a serious problem.

The construction of both trackways involved fairly large quantities of wood, that was probably processed within a short space of time. The availability of this wood will be discussed in more detail in the following section (4.5). The wood came mainly from the Hondsrug, the higher sandy areas (3.1.9, 3.2.7). For the transport of the construction elements from the place where they were made to the building site it is presumed that wagons were used, although no direct indications of this have been found. We doubt whether also the hurdles of trackway XIV(Bou) were also used for taking wheeled traffic. In the case of both trackways the transport by wagon is thought to have taken place as far as the bog margin.

The construction of wooden trackways and paths is very labour-intensive. For the hurdle trackway XIV(Bou) it is reasonable to assume that the construction work was done by at least 17 people (3.2.7). For the plank footpath XV(Bou) no such

estimation can be made, but it seems plausible to us that for its construction, out of an estimated 15,000 planks of 3 m in length and 6000 pegs (if the path was c. 12 km long), a few dozen people must have been available. In both cases the estimated workforce would appear to be in excess of the number of workers that one or two farmsteads could provide; see also 4.6.

Both trackways showed hardly any or no traces of wear. This cannot simply be taken to mean that they were used hardly or not at all. With a resilient trackway-surface, like that of both the plank footpath XV(Bou) and the hurdle trackway XIV(Bou), the damage caused by use is inflicted not on the wood but on the underlying peat, which becomes crushed flat and thus loses its structure. With trackway XV(Bou) no such disturbed peat has been found under the longitudinal planks; with XIV(Bou) the crushed, amorphous peat concerned was of limited thickness, as is evident from our peat research (Casparie, 1972: figs 78 and 44, respectively). It is now certain that both trackways were used for a short period at most.

As far as the quality of the building material is concerned, the footpath XV(Bou) could undoubtedly have lasted for many years. As a result of the upward growth of the peat-bog surface, however, it could have remained functional for a relatively limited period, possibly 1-2 decades. In this case the bog burst of 500 BC (2.3) put an end to the potential use of the path. We cannot exclude the possibility that this catastrophe occurred while the construction of the path was in progress, and that consequently it could not be completed. The unimpaired state of the longitudinal planks that we excavated (fig. 20) is indicative of (almost) unused wood. When the path was demolished (3.1.7) a number of planks were probably taken back to the settlement to be used there for some other purpose. Where the planks had been driven into the peat, we may literally speak of destruction of the path.

The durability of hurdles of *Salix* is limited to a few years, at least in a damp environment in the open air. Wattlework made out of willow rods loses its strength in a couple of years. In view of the (apparently) unimpaired state of the hurdles that we found (fig. 34), we presume that the trackway very rapidly became overgrown by fresh *Sphagnum* peat, probably within 5 years. Therefore the trackway could only have been in use for a couple of years at most.

4.5. The use of wood and the forest situation on the higher sandy soils

If the footpath XV(Bou) was 12 km long (3.1.8), then the area of forest that was necessary to supply the timber must have been c. 120 ha (3.1.9); the greater part of this would have been present in Southeast Drenthe, close to the western starting-

point of the path. We have previously stated (Casparie, 1984) that since c. 1300 BC the entire region, that could have been used for providing the timber, had been reclaimed, with a fairly high degree of deforestation. If we assume that the oaks of c. 40 cm thickness were felled and cut up into planks and pegs in a relatively short time (at most a few years), then we are concerned here with a rather heavy demand on the available wood supply. If the timber had to be transported over a maximum distance of 3 km on the high ground, then 8% of this region must have been forest consisting of oaks about 100 years old (the average age of the trees used). If the transport route was at most 2 km, then c. 20% of the region must have consisted of such forest. It is certain that in such an intensively occupied region (4.6) large stands of forest of such high quality could not have been readily available for a single activity like the construction of this trackway XV(Bou); certainly not close to its starting-point in any case. The transport routes for the timber were undoubtedly very long, possibly more than 3 km (see also further on in this section).

If the hurdle trackway XIV(Bou) was 3 km long, then the willow coppices that provided the willow rods for making the hurdles must have extended over an area of (at least) 18 ha (3.2.7). The total area of land that was available for the cultivation of willow coppice was less than 30 ha. Also in this case we must assume that the building of the trackway made heavy demands on the available wood supply; here it must be borne in mind that this was the yield of one year's harvest of willow rods. In terms of deforestation the building of the hurdle trackway did not play a role of any significance; the annual production of willow rods for wattlework was not disadvantageously affected.

On account of the strict use of timber of *Quercus* for XV(Bou) and *Salix* for the surface-layer of XIV(Bou), these trackways provide little information on the species composition of the forest in the Iron Age. From the substructure of XIV(Bou) it is evident that *Alnus*, *Betula*, *Fraxinus* and *Pinus* were present in the surroundings (3.2.5). From the palynological information (2.1.2; fig. 6) it can be deduced that the forest included also other species of trees, that could have been used for building the wooden trackways. These include *Ulmus*, *Corylus*, and later in the Iron Age also *Fagus* and perhaps *Carpinus*. It is not clear whether *Acer*, *Prunus*, *Taxus* and *Populus* (all of which occur regularly in low values in the pollen diagrams) were also present in exploitable quantities. *Tilia* was hardly present in the Iron Age. In 4.6 we shall devote more attention to the extent of the remaining forest in the region where the road builders lived.

4.6. Aspects of the occupation

In 3.2.7 we stated that the landscape in which the

builders of the hurdle trackway XIV(Bou) lived and worked was used intensively, and that forest was only scarcely present. The large concentration of Celtic Fields in this region (fig. 5) and the presence of an extensive area of willow coppice (3.2.7), in a region that had been permanently occupied already since c. 3000 BC (Casparie, 1982; 1984; Casparie & Groenman-van Waateringe, 1980), justify this conclusion. Although the Celtic Fields have no dating, which means that it cannot be said with certainty that they were all in use c. 200 BC, it is nevertheless certain that the land here had already been cleared for a very long time; on this land it would have been hardly or not at all possible for forest to maintain itself for any length of time. Concerning the situation at the time when footpath XV(Bou) was built, c. 500 BC, no such definite assumptions can be made. At that time the occupation was already rather intensive; the extent of the area of arable land was presumably as large as the Celtic Fields indicated by Brongers (1976) and illustrated by us in figure 5. It is known for certain that in the period 700–500 BC a few homesteads with farmhouses and barns within fenced enclosures were present in the southern part of the northern Celtic Fields complex (pers. comm. P.B. Kooi). The fences may have been made of wattlework, though of a type different from that of the hurdles. The marked expansion of *Fagus*, that results in the first *Fagus* maximum of c. 500 BC (Casparie, 1972), indicates the presence of large open spaces where beech was able to become established, presumably abandoned arable land. We consider it very well possible that in the period between c. 600 and 200 BC the higher ground in the vicinity of the starting-points of both wooden trackways, XIV(Bou) and XV(Bou) (fig. 5), consisted for more than 50% of land under tillage. In addition there were the extensive areas of abandoned arable land, where i.a. *Fagus* was able to expand, and the willow coppices. The actual raised-bog region was not exploitable, and the bog-fringing area was too wet to permit reclamation. In depressions on the higher soils of the Hondsrug some peat formation occurred here and there. Consequently the area of long-undisturbed forest that was necessary for providing timber for XV(Bou) could only have been small.

The bog-trackway research gives no definitive answer as to whether the (relatively) intensive occupation close to the starting-points of the wooden trackways was concentrated in a village, or whether the occupation was more scattered, e.g. in the Celtic Fields. In view of the relatively large number of persons that must have been involved in building each of the trackways (4.4), and in view of the presumed system of organization behind the construction method of XV(Bou), the presence of villages in the Iron Age is very plausible.

4.7. Comparison with other Iron Age bog trackways

In the Dutch peat-bog regions two other Iron Age wooden trackways are well known; both were designed to take wheeled traffic, and measure c. 2.5 m in width or slightly more. The Valtherbrug I(Bou), dated to 345±40 BC (Lanting & Mook, 1977), probably spanned the 12-km-wide Bour-tanger Moor (Karsten, 1819; Landweer, 1898; Joosting, 1901; van Zeist, 1958), about 10 km north of the footpath XV(Bou). It consists of a substructure of longitudinals supporting a trackway-surface of transversely laid out planks and roundwood. Pegs were used for fixing the trackway-surface in place.

In the eastern peripheral area of the Smildervenen (i.e. the Smilde bogs) the wooden trackways I and II(Sm) provided passage across two peat-filled depressions, measuring 280 m and 170 m wide respectively, in a route some 9 km long over sand ridges between two Iron Age settlements. I(Sm) has been excavated (Casparie, 1985) and is dated to c. 220 BC. It was made of transversely laid-out roundwood and cleft trunks of *Alnus*, over which a covering layer of sandy heather turves had been placed. A substructure of longitudinals was present in some places; there were no pegs. II(Sm) very probably had the same kind of construction. The Smildervenen are situated about 50 km northwest of the bog region where XIV(Bou) and XV(Bou) are present. The means of construction of I(Bou) and I(Sm) are distinctly different from those of the trackways XIV(Bou) and XV(Bou) dealt with in this article.

In the Somerset Levels in Southwestern England relatively few Iron Age bog trackways are known (Coles, 1975-1982); very little information is available concerning their means of construction. The two known trackways appear to be footpaths, of Early Iron Age date, c. 700-600 BC, consisting of longitudinally laid-out bundles of branches. A few trackways with a surface-covering of wattlework will be discussed in more detail below (4.8); they can be dated in the Neolithic and EBA.

In various bog regions in Northwestern Germany very ingeniously constructed trackways are present, of which a large number have been investigated (Hayen, 1958; 1963a; 1963b; 1965a; 1965b; 1971; 1973; 1975; 1978; 1979; 1984; 1985). These are nearly all trackways for wheeled traffic, measuring c. 2.50 m in width, with a carefully smoothed trackway-surface. The use of planks of *Quercus* is predominant. In a few trackways datable to the Early Iron Age (c. 650 BC) the trackway-surface planks were carefully fixed, by means of substantial pegs driven vertically into the bog, between longitudinally placed wood above and below the trackway surface. This means of construction prevented the planks from shifting and ensured the maximum carrying capacity of the trackway surface. Exam-

ples of this type of trackway are IX(Le), XXI(Le), XII(Ip). A few trackways, that can be dated to c. 250 BC or somewhat later, have a more simple means of construction, involving the fixing of the trackway-surface planks to the peat by means of a peg. All of them have carefully smoothed trackway-surfaces. Examples of this type are VI(Pr), XLII(Ip), XXXI(Bou); the Valtherbrug I(Bou) has a similar means of construction. The trackway I(Cl), dated to c. AD 90, has ditches in each verge. The peat that was dug out of these ditches was used as a sub-layer for supporting the trackway-surface planks. In most cases a covering layer of heather turves or sods had been applied, to provide a smooth and comfortable passage.

Also in the Iron Age some trackways were laid out with a surface-layer of roundwood, like I(Le), that can be dated to c. 300 BC and that was in use for a long time. The trackway XLIII(Ip) has a surface-layer of *Alnus* planks supported by a substructure of longitudinally placed *Alnus* trunks; only a few pegs were used in this construction. The trackway, that can be dated to between 200 BC and the beginning of the Christian Era, is partly burnt. When the trackway was restored the partly burnt timbers were laid out longitudinally, in such a way that the trackway became c. 1.30 m wide and thus suitable for wheeled traffic; these planks were fixed by means of pegs. The trackway originally had a covering layer of turves.

Footpaths were built only very seldom in the Iron Age. No true counterparts of XIV(Bou) or XV(Bou) are known from the Iron Age. XV(Bou) fits well in Hayen's typology (1958); in the bogs of Northwestern Germany footpaths occur mainly in the Bronze Age.

4.8. Prehistoric hurdles

The research on wooden trackways in the peat deposits of the Somerset Levels resulted in the discovery of a few trackways with a surface-covering of wattlework mats, that date from the Neolithic and the EBA (Coles et al., 1975-1982). Wattlework was used for various purposes on a wide scale already in Neolithic times and probably even earlier. The use of wattlework mats as a trackway-surface to provide a passage through peat-bog, however, is very limited. Presumably wattlework mats were not suitable for this purpose, almost certainly because the network of wattles was too loose and the mats were too weak to spread the pressure of trampling over a sufficient large area of peat. This applies notably to the Neolithic and EBA hurdles of the Somerset Levels, that differ considerably from the Iron Age hurdles of XIV(Bou) especially in terms of the choice of wood (*Corylus*, *Betula*) and the distance between the stakes or sails – c. 45 cm. The hurdles of XIV(Bou) were made of

Salix, while the distance between the stakes was c. 24 cm. The method of making hurdles of this type had been developed to such a high standard already by c. 170 BC that during the following 2000 years up to now no further improvements were made (3.2.6, 3.2.7). Together with other wattlework articles these hurdles were undoubtedly extremely useful for various purposes, as is still the case today (Westendorp et al., 1985). Yet they were hardly used in the construction of trackways, as can be deduced from the almost total absence of hurdle trackways in peat-bogs.

It is appealing to presume that the Iron Age hurdles of the XIV(Bou) type developed from the less efficient type that has been found in the Somerset Levels. The improvements, that can be dated at some time between c. 1500 and 200 BC, include the shorter distance between the stakes, the use of *Salix* rods and the bending back 180° of the horizontal or longitudinal rods, that ensured the firm fixture of the end-sails in the wattlework. The final product is a very strong, flat mat, that can easily be transported and that has a much greater carrying capacity than the wattlework mats of the type found in the Somerset Levels. Much more force is required for making *Salix* hurdles than for making hurdles of the type in the Somerset Levels, that have been copied experimentally (Coles & Darrah, 1977). The similarities between the two types of hurdle lies especially in the dimensions of the raw material (c. 4-year-old rods with a diameter of 2-4 cm at the base), in the woodland management (Rackham, 1977) and in the harvesting of the raw material: coppicing of the underwood from the stools (3.2.7). The necessary woodland management had already been developed in Neolithic times (Coles, Caseldine & Morgan, 1982). It is not clear why notably in the German bog regions no hurdles were used for constructing prehistoric trackways (pers. comm. H. Hayen).

4.9. Final remarks

In his survey of recent archaeological research in the bogs of Northwestern Germany, Hayen (1985) concludes that the (prehistoric) trackways are parts of a traffic network. The form of this network was determined above all by the situation of different areas of occupation, the nature of the soil and the landscape, and the direction in which more remote destinations lay. It is clear that in the Iron Age this network of trackways, that were designed to take especially wheeled traffic, was of considerable importance. Wide stretches of bog – more than 6 km wide – were spanned, and the technical aspects indicate great insight and skill on the part of the builders of these trackways on a weak substratum. We may assume that the high areas of Southeast Drenthe, with intensive prehistoric occupation, also

had such a network of trackways, but that the great width of the Bourtanger Moor made it almost impossible for the bog region to be 'fitted into' this trackway network. Therefore it is much less clear than in the case of many of Hayen's trackways whether and in what way the footpath XV(Bou) and the hurdle trackway XIV(Bou) connected up with this trackway network. An extra complication in our case is that the trackways of Southeast Drenthe were not obviously intended to take wheeled traffic, as the German Iron Age trackways were. The fact that XIV(Bou) and XV(Bou) were in use for only a short time at most means that no supplementary information is available concerning their use, in the form of wear, repairs and lost or discarded objects. From the methods of construction used we can deduce that these trackways were built in a systematic way, involving the effective organization of material, transport and construction activities, in agreement with what Hayen (1985) has formulated; also the presence of well-developed woodland management is certainly in evidence (Rackham, 1977). The skill, demonstrated by Hayen, in constructing an extensive bog trackway was present in this region, as is evident also from the Valtherbrug, dated to 345±55 BC (4.7).

With regard to the hurdle trackway XIV(Bou), it is remarkable that such common articles of use as hurdles, indicative of a long tradition of basketry and wattleworking, were used only exceptionally in building trackways; it is equally remarkable that in this region in the Iron Age only one trackway appears to have been built for the purpose of exploiting bog iron-ore. In the MBA already two of three paths had been laid out for this purpose (Casparie, 1984), and in the Iron Age iron production evidently took place there on a considerable scale (Modderkolk, 1970; Casparie & Smith, 1978; Booij, 1986). There was certainly no tradition here of building trackways on peat-land. Was the raised bog in fact more easily passable than the results of the peat-bog research (Casparie, 1972; 1982; 1984) would suggest? This could only have been the case in dry summer periods at most. The bog burst of 500 BC (2.3) and the demolition of the footpath XV(Bou) (3.1.7) are nevertheless indicative of a great abundance of water, implying that the bog surface was hardly passable.

In the peat-bog of Southeast Drenthe, over a period of about 2000 years (between 2150 and 170 BC) only six wooden trackways were laid out. Partly because they remained in use for only a short period, these trackways played no important role in the development of the prehistoric occupation. Nevertheless the peat-bog trackway research (Casparie, 1982; 1984; this paper) has provided a great deal of information on aspects of building technology and has made important contributions towards our knowledge of the vegetation development and

peat growth (Van Zeist, 1955a; 1955b; 1959; 1967; Casparie, 1972; Casparie & Groenman-van Waateringe, 1980; Casparie & Smith, 1978; Dupont, 1986). In addition this research has enabled us to gain insight into the prehistoric occupation of the areas of higher sandy soils in the neighbourhood.

5. REFERENCES

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