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Birch bark in Danish passage graves

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ABSTRACT

Birch bark has so far been observed in passage graves at eight localities. It appears that the bark had originally lain between all the slabs of the dry walling and the intermediary layer of the chamber; it was folded double, forming two layers, with the fold facing in towards the grave chamber. As the bark was put in place during erection it provides an opportunity for dating the construction. Radiocarbon dates have been obtained for one sample from each of the seven megalithic graves. The graves have an even geographical distribution and as a group they show no constructional divergences from other passage graves. Similarly, the standard of the construction is not exceptional, although two or three of them do have a chamber which is higher than is normal. It is presumed that birch bark was commonly used and was an important element in passage graves, apart from in certain areas where chalk mass was used as a kind of mortar. It is suggested that both the bark and the chalk mass functioned partly as a sealant, partly as a shock absorbent to prevent the slabs breaking during construction. Furthermore, the possibility cannot be excluded that an ornamental effect was also intended. The radiocarbon dates, with one exception, date the passage graves to the Middle Neolithic, but a technological development in the construction cannot be demonstrated. The occurrence of birch at this time is confirmed by pollen analysis. The optimal conditions for preservation of bark in the megalithic graves appear to be that the chamber must have been free of soil since antiquity and that there are large quantities of crushed flint behind the dry walling such that air could circulate around the bark.

INTRODUCTION

One normally associates megalithic graves with large quantities of earth and massive stones weighing many tons, but other materials such as wood were also important elements during construction and in the finished structure. One of the few lines of evidence in this respect is the occurrence of birch bark. This phenomenon was described in the 19th century in connection with the opening of the chambers of two passage graves. In 1823 and 1890 bark was discovered between the slabs of the dry walling which occupy the gaps between the individual orthostats. These early observations have made their mark in twentieth century research solely in connection with Poul Kjærum's investigations of Jordhøj at Mariager, where a radiocarbon date was obtained for bark from the site (Kjærum 1970). As part of the intensification of the National Cultural Heritage Agency and the National Museum's work with the maintenance and restoration of the most frequently visited scheduled megalithic graves a sharp watch was kept for further occurrences. So far in the 1990s a further five localities have been found with bark preserved to very varying degrees. This brings the total of known localities up to eight. As so often previously in the history of archaeology it appears that once a phenomenon has been recognised it suddenly turns up in large numbers.

It seems remarkable that, especially since the advent of radiocarbon dating, greater attention has not been paid to possible other occurrences in addition to the two early examples. There are probably several explanations for the bark having gone unnoticed. Firstly, the very idea that sheets of birch bark lying open to the air for more than 5000 years could be preserved up to the present day seems on the face of it improbable. Another explanation is that where the bark is in a poor state of preservation it is very difficult to discern and to distinguish from roots and other material that lies between the dry walling slabs.

Fig. 1. The eight passage graves where bark has been found between the slabs of the dry walling.

The occurrences registered so far suggest that the bark was an integrated part of the construction of megalithic graves and that its use was quite normal. The bark was put in place during the construction of the grave chambers and provides therefore, in contrast to grave equipment and sacrificial horizons, the possibility of dating the actual construction of the burial monument. Bark has a further advantage in that its internal age is minimal. The bark is however not just interesting with regard to dating. As an important and common part of the construction, the bark contributes to an understanding of the achievement, in terms of work invested and technological expertise, of which a megalithic grave is an expression. The bark is, furthermore, part of the architecture and of the whole organisation of the interior of the burial monument – its appearance, mediated through form and colour, as it was used for its original purpose.

Maglehøj (Hellested parish sb. 3; Boye 1862) is a scheduled passage grave with a chamber and a passage, lying in a partly destroyed round barrow. The farmer opened the earth-free chamber in 1823 when he dug into the barrow. However, the local vicar followed the opening very closely and noticed among other things the bark. In his thorough report to the Commission for the Preservation of Antiquities he describes the wall of the chamber as "a stone wall, comprised of 15 flat, broadly-based and pointed-topped field stones, which touched each other at the base with the gaps above being walled up with flat stone slabs, which looked like pieces of board lying on their flat side and showing their edges. In between these stone slabs a kind of bark has been placed of which a small sample is enclosed in No. 1. The man who excavated the mound says that it is birch bark, which he as a Norwegian claims to know well." There are some artefacts from the opening of the mound in 1823, including flint daggers. These were not professionally excavated.

After the opening the mound was re-established, but in 1909 the National Museum carried out a restoration made necessary by a badger having burrowed behind some orthostats. On this occasion it was also necessary to repair some of the dry walling, particularly in the passage. In the chamber between a third and half of the dry walling has been rebuilt, while in the passage the proportion is more than half. Apart from this restoration, and a secondary intrusion through one gable later in antiquity, the chamber stands unaltered since its construction. During a combined investigation and restoration in 1996 (Rigsantikvarens Arkæologiske Sekretariat (ed.) 1997, 146, no. 125) only minor repairs were carried out. The monument is well built with a layer of stones, each 40-80 cm in thickness, between the orthostats and the capstones, supplemented with sandstone slabs of very variable size. In one corner the intermediary layer consists exclusively of up to five courses of sandstone slabs. The megalithic grave must be said to be well built with a construction that is both well known and common without being considered technically advanced. The building work was apparently carefully executed with very solid fills of crushed, unburned flint behind the walls of the chamber and, according to the description from 1823, also with a roof construction of flat slabs over the capstones within the mound.

Remains of birch bark can be seen in the dry wal-

Fig. 2. Dry walling with birch bark *in situ* in Maglehøj. In the uppermost course no bark can be seen but in the second to the fifth course from the top the fold is preserved to varying degrees. In the sixth course there is bark but the fold is missing. The section shown is 50 cm high. Photo Torben Dehn.

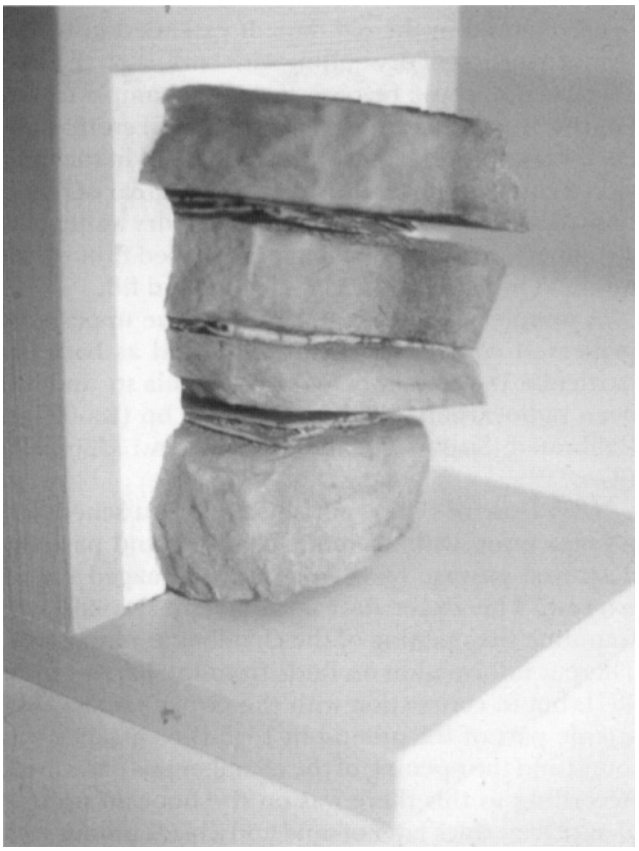

Fig. 3. During the investigations of the passage grave Maglehøj in 1996 a section of characteristic dry walling with birch bark was removed. It was immediately stabilised and later fixed in a plaster cast, which is stored at the National Museum's Conservation Department in Brede. On the picture the specimen is shown partly from the side with the front facing into the chamber to the right so that the two layers of bark and the fold can be seen. Photo Torben Dehn.

ling of the chamber and in the intermediary layer. In many places there is a double layer with a fold running parallel to and in line with the edges of the slabs facing in towards the chamber. Where the bark is best preserved it lies between all the courses in the dry walling and extends across their full breadth. Bark occurs in all the gaps in the chamber where the dry walling is intact, and it is present both at floor level and between the slabs of the intermediary layer at a level above the orthostats. Bark is preserved in a total of about 120 courses, of which there are remains of the fold in about 30, and it lies in courses that are between 4 and 80 cm long. Bark is thus found distributed throughout the whole chamber with the exception of the walls re-erected in 1909. In some places the bark is preserved despite subsidence having occurred due to slabs having fallen out. The fact that bark could not be demonstrated in the passage is probably due to no original walling being preserved here, with the exception of some of the intermediary layer and seven courses of dry walling at the base of a gap between two orthostats. During the investigation in 1996 a trench was cut through the side of the mound which had

been removed in the old days. It extended in to the rear of a section of dry walling with bark, such that the construction could be observed and a sample taken. On the rear of the dry wall it could be seen that the bark was only preserved between the slabs in the individual courses – not at the sides or to the rear of them. Immediately up against the rear of the dry walling lay a compact, earth-free packing of crushed flint which was held in place by the clay-rich mound fill.

A sample of the bark, taken from the uppermost preserved course, has been identified as bark, in particular the cork layer, of birch, Betula sp. and has been radiocarbon dated to 4440 ± 50 bp (Ka-6975). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 3330-2920 BC.

Ubby Dysselod (Ubby parish sb. 29) is a scheduled passage grave with an intact chamber and partially destroyed passage lying in a badly damaged round barrow. The exact date and circumstances surrounding the opening of the chamber are unknown. There is information on finds from the barrow from 1841, but in connection with the owner's removal of a large part of the mound in 1845 the entrance was found and the opening of the chamber was described. According to this there was on the floor an up to 1 alen (2 feet) thick layer of sand and a black humus-rich mass, while the remainder was earth-free (Antiquarisk Tidsskrift 1847, 223). Traces on the orthostats still show the height of the original grave fill.

This is an unusual monument with very high orthostats. At 2.4 m, the chamber is among the highest, even though it was constructed without an intermediary layer; the two capstones lie on orthostats, regulated solely by a layer of thin flat stones and slabs. The orthostats are of a size only rarely seen. Similarly they appear to have been carefully chosen for their very flat inner surfaces. Furthermore, they have been selected and placed together such that the gaps between them are minimised. Only in two or three places is there dry walling of more normal dimensions. The other gaps have been filled from the rear with vertically placed flat slabs or closed with a small section of dry walling made of very small slabs. The passage is also unusually high. The monument appears impressive due to the quality of the stones and the careful way in which they have been fitted together, including a set of twin stones (Hansen 1993; Dehn *et al.* 1995, 55ff.). Apart from the size of the stones, the construction of the chamber itself does not appear technically unusual or challenging. The unusual composition of the passage and chamber suggests, on the other hand, a certain technical superiority. From the chamber it is possible, through the gaps, to see the earth-free packing of crushed unburned flint behind the orthostats and gaps. Looking up between the capstones a covering of flat stones can be perceived. Together with details such as the small units of dry walling between the capstones and so on, this gives the monument a mark of precision. It is striking that another scheduled passage grave, lying a mere 70 metres away, has a completely identical ground plan and correspondence with regard to the use of certain characteristic materials, but constructionally it is quite ordinary and of an ordinary height (Grønnehøj sb. 26; Dehn *et al.* 2000, 30).

Artefacts were found in connection both during the removal of part of the mound and the later opening of the chamber; in the mound there were, among other

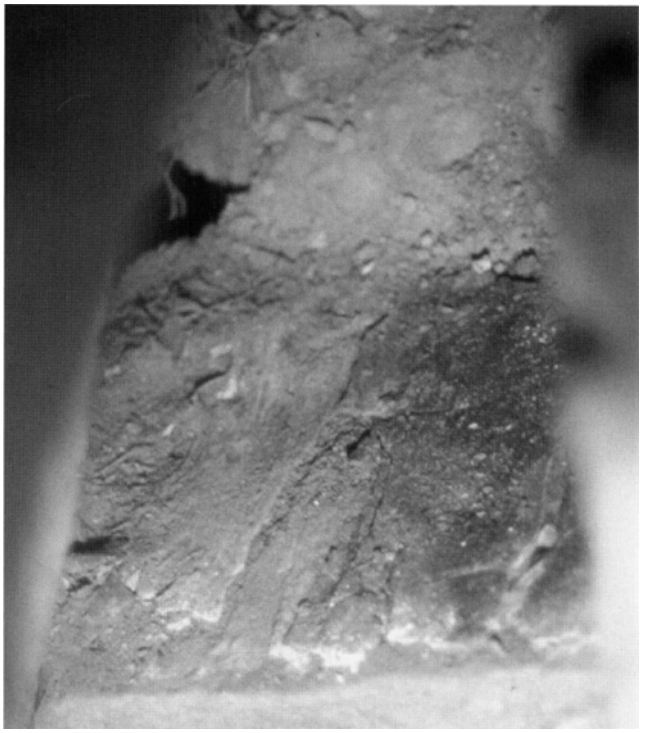

Fig. 4. Birch bark in the passage grave Ubby Dysselod. The picture was taken looking from the chamber in between two orthostats. The uppermost preserved slab has been removed so that the bark can be seen lying on the next slab below. The fold along the front edge of the slab has disappeared and the two layers of bark can no longer be separated. Photo Torben Dehn.

things, secondary Bronze Age graves. In the chamber itself, flint tools and three pots as well as a cranium and some thighbones lay on top of the grave fill. In the passage there were similarly human bones and flint tools. None of the antiquities has been incorporated into museum collections despite the fact that the farmer later offered to sell them.

In connection with the restoration in 1997 of the two passage graves Grønnehøj and Ubby Dysselod, preserved bark was discovered in one of the dry walling sections in the chamber at the latter (Rigsantikvarens Arkæologiske sekretariat (ed.) 1998, 121, no. 103). Between all the preserved slabs lying on a 0.6 m high solestone, bark was preserved in eight courses, in some cases as sheets extending the full length and at one place in particular with a completely intact fold facing in towards the chamber. Bark also lay between the solestone and the lowest course of slabs. A sample was taken by removing a slab from the uppermost course and it could be clearly seen that there were two layers of bark and that these lay with their fibres at right angles to the long axis of the dry walling slabs. The bark, of which a sample was taken, completely covered the underlying slab.

The sample was identified as birch, Betula sp. and has been radiocarbon dated to 4475 ± 45 bp (Ka 6978). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 3340-3030 BC.

Olshøj (or *Onshøj*) is a scheduled round barrow containing two passage graves; the chambers are not integrated in their construction (Rørby parish sb. 12; Dehn *et al.* 2000, 157ff.). The mound was opened in the 1850s, at which time stones were revealed, but it was first in 1871, during excavation by the owner, that the two chambers were found. The only source of information is a newspaper article, according to which a number of potsherds were found. An antiquarian description was first carried out in 1881 and by then some kerbstones and the outer part of the passages had been removed in connection with house construction. Much of the earthen mound had been dug away and the capstones, for example, lay exposed for many years. Through two large restoration projects in 1900 and 1937 the mound was re-established and the derelict dry walling rebuilt. In 1988 it was again necessary to restore a number of sections of dry walling.

Both chambers are well built with a solid intermediary layer comprising one course of substantial stones. The preserved parts of the dry walling comprise carefully shaped sandstone slabs. The monument lies in an area with many double-chambered passage graves and distinguishes itself from some of them only in that the two chambers are not integrated in their construction. Olshøj is characterised by having a large number of high solestones in the dry walling. However, apart from this Olshøj's construction and execution does not distinguish itself from that which is the norm for the area. During the restoration in 1988 it was possible, from the chamber, to observe the mound construction immediately behind the gaps between the orthostats; an earth-free packing of crushed unburned flint bound by clay could be seen.

In the westernmost of the two chambers there are, in the lowest part of a section of dry walling, five courses where a little bark is preserved. This comprises, however, exclusively loose fragments in a poor state of preservation. Furthermore, as the conditions for observation are difficult, nothing can be said with regard to extent of the bark or to the possible presence of folds, only that there appear to have been two layers.

A sample from Olshøj has been identified as birch, Betula sp., and has been radiocarbon dated to 4245 ± 40 bp (AAR 5472). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 2910-2710 BC.

Rævehøj, Dalby is a scheduled passage grave in a round barrow (Kirke Helsinge parish sb. 26). The passage grave was discovered in 1852 when digging a fox out of the mound. On this occasion the south gable of the chamber was opened and a number of finds from the Stone Age and Bronze Age were recovered. As a direct consequence of the opening, one end of the southernmost capstone fell down into the chamber. In the course of the subsequent decades the latter became almost totally filled with earth. During restoration and investigations carried out by G. Rosenberg of the National Museum in 1932, the capstone was restored to its original position and the hole resulting from the opening in 1852 was filled in. The chamber was also emptied of the earth, which had fallen in, and subsequently investigated. The passage, which contained skeletons, was similarly excavated and opened. In connection with this Bronze Age graves were found partly over the passage and in the entrance area. A further investigation in connection with the restoration in 1997 (Rigsantikvarens Arkæologiske Sekretariat (ed.) 1998, 121, no. 106) showed that the kerbstones and outermost part of the passage had been disturbed by a grave at this point, and that the Stone Age mound had been extended. During the

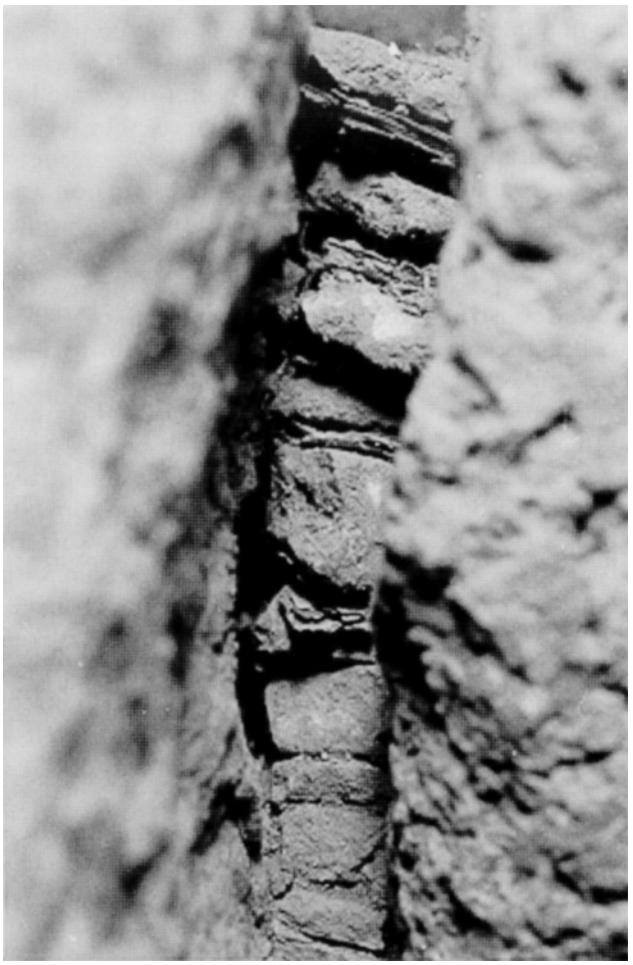

Fig. 5. Birch bark in the passage grave Rævehøj. Between the only 2-4 cm broad slabs in the five uppermost courses between two orthostats the bark can be seen as several layers of thin flakes. In the second lowest course a piece with a fold is preserved. Photo Torben Dehn.

excavation in 1932 there were rich finds of ceramics from the Funnel Beaker culture (Ebbesen 1975, Find list A no. 60, Figs. 39,1; 86,5 and 201,4, Note 176, 231, 272, 297, 304, 336 and 372).

Apart from the limited disturbances during the Bronze Age and the opening in 1852, the passage grave appears to be relatively intact. Only a few limited repairs have been carried out since 1932. The chamber, with a height of 2.5 m, is among one of the highest in the country. The chamber, by virtue of its construction, is seen as being one of the more technically complicated examples of Danish megalithic architecture. The individual stones are of a normal size for passage graves, but the five capstones lie on three layers of stones that have been inserted as an intermediary layer above the orthostats. The intermediary layer comprises two thin (10-30 cm) layers lying respectively over and under a layer of larger stones c. 60-70 cm in thickness. The two thin layers comprise flat stones or slabs which have the function of evening out the differences between the orthostats, the central intermediary layer and the capstones. The orthostats have, as is normally the case, an inwardly-leaning posture and the stones of the intermediary layer are, furthermore, slightly displaced inwards so the breadth of the chamber is reduced vertically. The length of the capstones is such that their extremities rest on the upper course of stones in the intermediary layer, i.e. they are so short that they could lie at floor level without their ends touching the orthostats. The intermediary layer forms a kind of vault – a construction that demonstrates technical superiority. Firstly, the length of the capstones is exploited to the limits and, in so far as these were chosen in advance, the builders had, already when determining the dimensions of the monument at ground level, calculated very precisely how broad and how long the chamber was to be at roof height. Secondly, the actual positioning of the five capstones on top of the three courses of intermediary stones is an unusual display of craftsmanship.

The dry walling has suffered heavy deterioration, but that which remains suggests very careful construction. The slabs used are either of sandstone or claystone, relatively thin and very well fitted. Small openings in the intermediary layer appear to have been filled up with small sections of dry walling. Both in the openings in the intermediary layer and between the orthostats a solid packing of crushed unburned flint could be seen.

A small section of wall in a narrow gap between the orthostats in the south-eastern corner of the chamber was an example of the care that had been exercised in building the dry walling. Often such gaps are seen filled up with larger slabs placed vertically, but here there were 12 courses of slabs preserved, each measuring no more than 2-4 cm in each direction. In eight of the courses there were still two layers of birch bark present and in two places a fold could be demonstrated. The section of dry walling with bark was not exactly in place between the two stones but had been pushed a little to the rear. The small slabs lay therefore irregularly and the bark was no longer

under pressure from the weight of the slabs and had separated into up to four thin sheets. A sample was taken by lifting the uppermost preserved slab and taking out the bark. The pieces of bark were of the same size as the slabs. Now the preserved wall and bark are not immediately visible, but sealed behind a new construction.

The sample from Rævehøj has been identified as bark, in particular the cork layer, of birch, Betula sp and has been radiocarbon dated to 4540 ± 45 bp (Ka-7000). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 3360-3100 BC.

Jordhøj is a scheduled passage grave in a round barrow (Mariager rural parish sb. 36: Kjærum 1970). The grave chamber was discovered in 1890 when the owner, out of curiosity, dug into the top of the mound. After having removed a large slab that lay between orthostat and capstone he could look into the undisturbed earth-free chamber. Directly afterwards Vilhelm Boye and Daniel Bruun of the National Museum undertook an investigation of the chamber in which the grave goods and a plank construction lay exposed on the floor. In several sections of dry walling there was bark, including in a gap in a niche: "In the southern corner a kind of niche had been formed in that there was here an opening, 31.4 cm in breadth and depth, between two sidestones. This had a rear wall of flat slabs, in between which could be seen birch bark sheets in a few places; these had been folded over and placed in such a way that the fold pointed in towards the chamber [sketch, figure 6]. This suggests that the bark sheets must have been put in place when the slabs were built up. In this niche there is a thick flat slab which has been jammed in 0.63 m over the base to form a kind of shelf". These precise measurements, 31.4 cm and 0.63 m, are presumably conversions from the old measurements fod and alen. In the section in the report on the passage it is mentioned that in "the beautifully stacked stone slabs" between the eastern corner stone and the adjacent stone in the passage there also lay "folded birch bark sheets" in the same fashion. After the investigation, the hole in the roof of the chamber and the excavated shaft in the top of the mound were filled in.

In the grave layer lay charcoal and pieces of wood; these have been subjected to analysis, as have the planks that lay in the chamber. The small fragments come from birch, pine, hazel and oak while the planks are of birch (Bahnson 1892, 199).

The so-called niche is a gap between two orthostats,

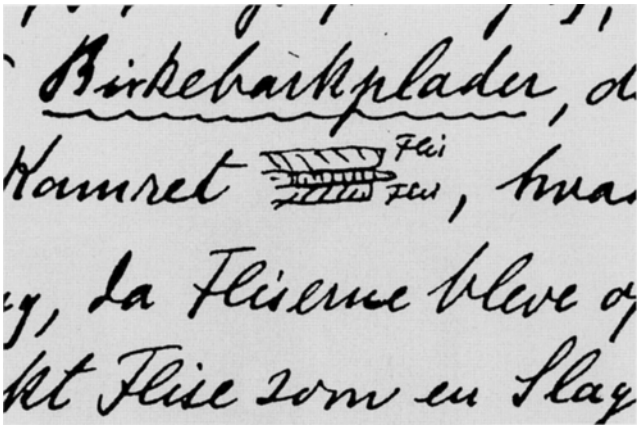

Fig. 6. In his report on the investigations at Jordhøj in 1890 Vilhelm Boye made this sketch in connection with a description of the birch bark between the dry walling slabs. The sketch shows two slabs with bark in between seen in cross-section from the side and with the chamber to the right. The rounded edge of the bark must be the fold. The two small words immediately to the right of the drawing are the Danish words for "slab". Photo Torben Dehn.

where the dry walling stands a little further recessed than in the other gaps in the chamber (Hansen 1993, 33). It is a quite common feature, especially in northern Jutland, that one or more of the dry walling sections stands markedly recessed relative to the others. Often clay vessels or crania are found in these deep recesses; this could of course be due to the fact that the artefacts here have been less subject to disturbance. However, the stone shelf in Jordhøj, along with several other examples, suggests that this constructional feature was intentional. Similarly, evidence from the floor indicates that these deep recesses or niches have had special significance. In reality the transition from these deep recesses to proper niches, which are formed by the intentional displacement of the orthostats is rather fluid; an example of such a niche is seen in Mutter Gribs Hule in northern Zealand (Dehn *et al.* 2000, 271ff.).

During a minor restoration of Jordhøj in 1910 the exposed part of the passage was re-established and two sections of dry walling in the passage and one in the rear wall of the chamber were repaired. The latter repair was presumably a restoration of the upper part of the dry walling which was removed during the opening in 1890. In 1964-65 Poul Kjærum, of Moesgård

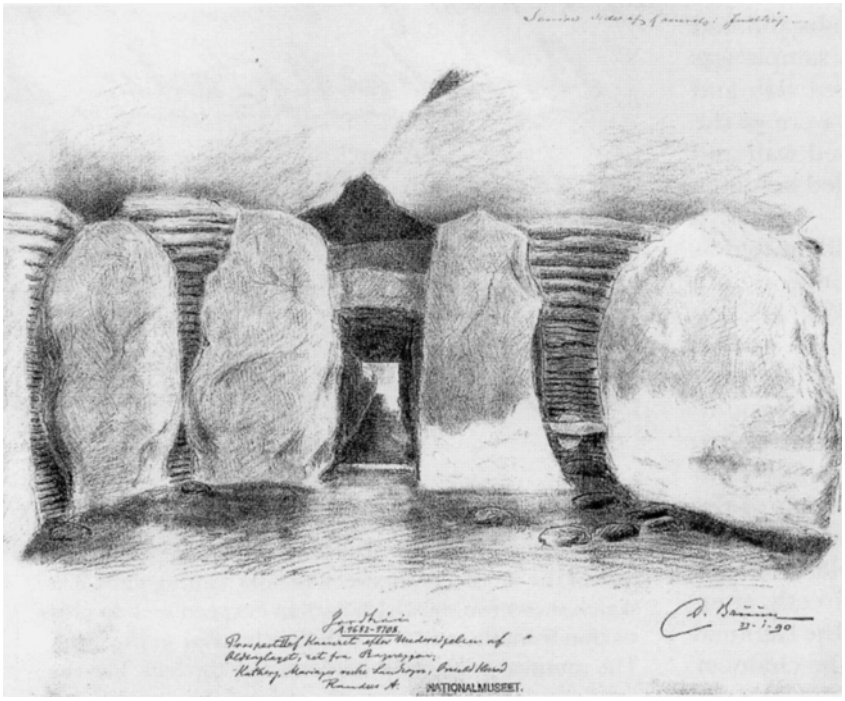

Fig. 7. One side of Jordhøj's chamber, drawn by Daniel Bruun just after the investigation of the grave layer in 1890. Most of the bark was present in the deep recess immediately to the right of the passage. Here a stone can also be seen, inserted as a shelf between the two orthostats.

Museum, carried out an investigation of the entrance with the aim of shedding some light on the question of clearance layers versus sacrificial layers in front of passage graves. At the same time the nature of the construction of the mound was established by way of an excavation field located in the side of the mound. Similarly, the kerbstone construction was exposed together with the sacrificial layer (Kjærum 1970).

During this investigation around 7000 potsherds were found in front of, and on, the facade at the passage mouth. From these sherds 44 clay vessels could be identified in various states of preservation, but the original number must have been much greater. On opening in 1890, the chamber and passage were found to contain flint daggers and clay vessels or fragments of vessels, all from the Single Grave culture or Late Neolithic (Kjærum 1970, 25ff.). The vessels connected with the facade come from the whole of the Funnel Beaker culture, spanning the period from MNIb to III. Subsequently there was activity in period V and in the Late Neolithic (Ebbesen 1985, Find list A no. 74).

The chamber and passage in Jordhøj appear now in a relatively undisturbed state. Two capstones have been placed directly on seven orthostats, just as is the case in the passage, while a large flat stone over the capstones covers the opening of the passage into the chamber. In its ground plan, form and construction the passage grave is quite usual for the area, where it lies in a close concentration of megalithic graves. Similarly, the execution of the monument does not deviate from the norm. As mentioned in Vilhelm Boye's report from 1890, bark occurs in both the passage and the chamber, partly in the innermost right hand gap in the passage seen looking from outside, partly just to the left of the mouth of the passage. Bark was found in several courses in both places; in the passage both in the upper and the lower parts. When the monument was opened in 1890, a flat stone was found jammed horizontally in the gap between the orthostats to form a shelf in the chamber just to the left of the mouth of the passage. It has been remarked upon that bark only occurred above this shelf (Hansen 1993, 53; Kjærum 1970, Fig. 6). This is however not the case; in the fourth course from the base, about 20 cm below the level at which the shelf sat, there are still remains of bark. In addition to the two cases already mentioned, there are also a few pieces of bark between two courses in a gap in the south-western corner of the chamber.

The bark in Jordhøj is in a disturbingly poor state

of preservation relative to that described in 1890. It is now only seen as loose flakes lying deep between the courses and as a partly dissolved mass where the slabs rest on one another. There are no longer preserved pieces with folds but in some places the double layer can still be observed. Behind the dry walling there are very substantial packings of fire-bleached flint. Immediately to the rear of the slabs these packings are largely earth-free, while further out into the mound there is more earth mixed in. The flint-packings behind the dry walling in passage graves normally comprises crushed unburned flint, but in eastern Jutland it is quite normal for the flint to be burnt.

In connection with the investigation in 1964-65 a sample of birch bark taken in 1890 from dry walling in the south-western corner of the chamber was submitted for radiocarbon dating (Tauber 1967, 109). It was dated to 4490 ± 120 bp (K-978). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 3360-3020 BC. In 1998, in order to avoid any possible inconsistencies with the new series of samples from other localities, a further sample was taken which was radiocarbon dated to 4485 ± 50 bp (Ka 7001). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 3340-3090 BC. There is thus good agreement between the two dates.

Hvalshøje, Iglsø (Fly parish sb. 82; Bahnson 1892, 201; Ebbesen 1978, 121ff.). One of the mounds is a scheduled round barrow containing two passage graves, which are not integrated in their construction. The name Hvalshøje (or Kokshøje) covers a group of in all four barrows, of which only one is known to contain a megalithic monument. The two passage grave chambers in the southernmost of the mounds were discovered in 1887 when the owner, by excavating a trench into the north side, struck the orthostats and capstones of one of the chambers. Subsequently, Vilhelm Boye of the National Museum undertook an investigation the same year. The two chambers lie in a primary mound with kerbstones, covered by a secondary mound. They lie close to one another but are not integrated in their construction. The northern chamber was filled up to the capstones with white sand and, just like in Jordhøj, "stripes of rotten wood" lay on the floor. Both the passage and the chamber contained the very poorly preserved remains of numerous skeletons. In the southern chamber the southern end was almost completely filled with heath soil, while the remaining part was only half-filled; the passage was filled with both sand and heath soil. In addition to several skeletons, the finds included flint blades and amber beads. The occurrence of kerbstones within the mound indicates that several phases are represented in the barrow. A fragment of a fire-damaged flint chisel lay associated with the chain of kerbstones (Ebbesen 1978, Find list A no. 35, Figs. 118-119).

Already in 1900 it was necessary for G. Rosenberg of the National Museum to carry out a restoration of the two chambers. During this numerous sections of dry walling had to be repaired by inserting new slabs and the mound itself was evened up. In 1961 Dorthe Hansen of the National Museum repaired damage arising from the activities of burrowing animals; a few sections of dry walling had also to be repaired. During a restoration in 1996, which was prompted by a fallen stone from the roof construction of the northern chamber and a badger's burrowing under the orthostats, it was again necessary to repair damage to some of the sections of dry walling. On the same occasion the chambers were re-examined (Rigsantikvarens Arkæologiske Sekretariat (ed.) 1997, 175, no. 248).

The ground plan of the two chambers shows that they are more or less identical in shape and size. The walls in the two chambers are similar in that the two corner stones in each chamber are relatively tall and that the largest stone in each chamber is the stone standing opposite the mouth of the passage. There is however one extra orthostat in the southern chamber relative to the northern chamber, because the stones in the latter are generally narrower. The two chambers differ on one point and that is the construction of the roof. While the southern chamber is covered in the usual way by two flat horizontal stones of regular shape lying beside one another, supplemented by smaller stones, the roof of the northern chamber is rather untraditional in its construction. One stone of normal capstone size covers approximately one third of the chamber, while two large and three lesser stones cover the remainder. The lower surfaces of the stones are not flat and several of the stones rest partly on one another and not exclusively on the orthostats or the intermediary layer, as is the norm. In two other double passage graves from this part of Jutland a similar technique has been used. There are several possible explanations for this unusual construction, including the lack of suitable stones or the requirement that particular stones should be included in the construction. The latter appears to be the case in the passage grave Ørnhøj in Himmerland (Dehn & Hansen 2000a).

The construction of the two structures in Hvalshøje

is in its entirety characteristic of the megalithic graves in the area, and the special roof of the northern chamber probably created problems in the construction, but does not appear to be technically advanced. The construction is an expression of a technically superior treatment of the large stones, but does not appear more superior than that seen in ordinary megalith building.

With regard to bark, Hvalshøje has the sparsest occurrence seen so far. A few small fragments less than ½ cm in size were found only in a single course in the gap between the corner stone and the first orthostat to the left of the entrance (seen from outside) in the southern chamber. In between the slabs there was very light-coloured sand. In this chamber the opportunities for observing possible packings behind the dry walling were poor, but in the northern chamber the dry walling was more derelict. Here, behind the base of the dry walling, a border of burnt stone material could be seen, while higher up there was sand and larger stones. Fire-bleached flint occurred behind a few of the sections of dry walling, but it was not possible to gain an impression of the amount.

The sample from Hvalshøje has been radiocarbon dated to 4620 ± 55 bp (Ka-6976). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 3520-3340 BC.

Snibhøj is a scheduled round barrow containing two passage graves that do not have an integrated construction (Snæbum parish sb. 26; Ebbesen 1978, 22ff.; Madsen 1900, 16ff.). The entrance to the northern chamber was discovered in 1895, when the owner wanted to make use of some of the kerbstones and the southern chamber was found in the same way the following year. Both chambers were free of earth on opening and were investigated by the National Museum, the first by G. Sarauw, the second by A. P. Madsen. In the northern structure, stones had been laid to form the floor of both the chamber and the passage. On these lay disarticulated bones, partly in the passage, partly in the chamber. In the middle of the latter lay also parts of a skeleton, apparently in an outstretched position, under a covering of stone slabs. The southern structure also had a stone floor on this in the passage lay two skeletons in an outstretched position. In the chamber lay the bones of at least 12 individuals; some bones lay covered by slabs and others lay freely exposed. Some bones lay disarticulated while two skeletons lay outstretched in the middle of the chamber. Not many artefacts were found in connection with the opening of the two chambers. From the northern chamber there are three blades and from the southern chamber there was one blade, an arrowhead and sherds from four clay vessels (Ebbesen 1978, Find list A no. 75, Fig. 12).

The two structures are not unusual in their construction or ground plans, but their dimensions are extraordinary and the chambers are some of the largest and best preserved in Jutland. The northern chamber is rather smaller in size and height than the southern chamber, which is almost circular in its ground plan and has orthostats exceeding 2 m in height. On these lie two capstones, of which the weight of the largest is estimated at almost 20 tons. The orthostats have a slightly forward-leaning stance such that their sides support one another like cards in a house of cards. The dry walling is well built and comprises substantial split stones of granite and gneiss. Where the orthostats are too low, they are supplemented with an intermediary layer of large stones. At the opening of the passage into the chamber the roof is formed by a triangular keystone jammed between the two corner stones so that the point extends into the chamber; above this lies another keystone. This building technique, comprising a single or double triangular keystone, is characteristic for central and northern Jutland (Hansen 1993, 46ff.). The rear wall, directly opposite the mouth of the passage, is formed by an exceedingly large and broad stone, which like a few of the other orthostats is almost triangular in shape and stands with one of its points downwards. The flint-packings behind the dry walling consist of burnt flint and are slightly mixed with mound fill.

Bark has only been demonstrated at Snibhøj in the southern chamber, where it has been found in three sections of dry walling lying adjacent to each other towards the north-west. Bark occurs sporadically in one, two and five courses respectively at a height of 43-100 cm above the floor. At one place a fold can be seen.

A sample of the bark from Snibhøj has been radiocarbon dated to 4590 ± 40 bp (AAR 5473). Calibrated (Stuiver *et al.* 1998) ± 1 st. dev.: 3500-3120 BC. An identification of the bark has not been carried out.

The occurrence of bark in passage graves

Bark in dry walling has so far been observed at a total of eight localities. Maglehøj, where the conditions for preservation have been good, is particularly informa-

tive with regard to the occurrence of bark in the construction. However, making use of the supplementary information from the seven other structures, it seems most likely that bark was used both in the passage and the chamber, and in both the dry walling and in the intermediary layer and from floor to roof. It was used between the smallest slabs measuring only 2-4 cm and between the long flat stones in the intermediary layer, which are up to 80 cm in length. The bark appears to have been used consistently in the same way; at 6-7 localities it lies in a double layer and at six of them there are, to varying degrees, the remains of a fold. In five of the chambers there is evidence showing that the bark can fill the gap extending the full length of a course and at four sites it has been seen to cover the slab across its full breadth. This could also be the case at Snibhøj, and on the basis of V. Boye's sketch figure 6 it was probably also the case in 1890 at Jordhøj, but it has not been possible to confirm this today. At seven of the localities the bark has been identified as being of birch, while no identification of the material from Snibhøj has been carried out.

The eight chambers in which bark has been recognised are constructionally very different, as is generally the case with passage graves. Some of the differences appear to be regionally determined. For example, in Jutland the capstones rest directly on the orthostats, but there can be fills, in the form of flat stones, between smaller orthostats and the capstone. The sections of dry walling are often markedly recessed relative to the line of the chamber wall, sometimes as far as the rear of the orthostats. In northern Jutland there is a characteristic keystone construction as described in the section on Snibhøj. There are also cases of chambers being eccentrically placed within the mounds; in mounds with two chambers these do not have an integrated construction. On Zealand, two chambers within the same mound normally have an integrated construction forming actual double passage graves. In these cases use is also often made of 1-3 intermediary layers of large regularly shaped stones supplemented by large slabs. On Zealand, dry walling is often seen with very high solestone and on Lolland and Falster keystones are rarely used but the capstones are laid directly on the corner stones. Such regional differences and characteristics are partly due to differences in the building materials available, but craft traditions and the various demands made by the persons instigating the building work also play a role. This also applies within the various regions, where despite general similarities in shape and form there can be differences in technical execution, both the visible part in the chamber and that hidden behind the walls. These local variations are similarly to a certain extent determined by the available materials, but the resources devoted to obtaining optimal materials must also have been important. Corresponding differences in detail in the execution of the building work can be observed in the double passage graves, where one chamber, because of the ideal materials used, appears to be the primary, while the other with slightly poorer materials and more compromised constructional solutions appears secondary. Even in a monument such as Troldstuerne, where the chambers are of identical size and form, such differences can be observed (Dehn *et al.* 2000, 133ff.; Dehn & Hansen 2000a).

The seven passage graves in which bark has been recognised in the construction do not stand out as a group relative to other passage graves. Ubby Dysselod and Snibhøj are both unusual because of the high quality stone used in their construction and their size, but the actual construction itself is in both cases normal for the areas in which they lie. Ubby Dysselod does however have a unique roof construction in the innermost part of the passage where it meets the chamber, but in ground plan it is identical to Grønnehøj which lies 70 metres away. Rævehøj does not especially distinguish itself constructionally from other monuments in the area, but its execution is remarkable due to the optimal exploitation of the size of the stones, resulting in the chamber being among the highest known. The chamber in Maglehøj distinguishes itself today due its good state of preservation, but according to central and eastern Zealand norms the construction is nothing special. It is about 2 metres shorter than the chamber in the demolished passage grave Højgård (or Ildhøj) 110 metres away, which is the largest in a group lying east of Tryggevælde river (Tornbjerg 1992, 67). Neither Olshøj nor the southern chamber in the Hvalshøj passage grave stand out in terms of construction or size relative to the standards in the areas in which they lie. Only the roof construction in Hvalshøj's northern chamber is distinctive, but not unusual. Neither does Jordhøj distinguish itself sizewise or constructionally from other megalithic graves in the area along the south coast of Mariager Fjord. At Ormehøj 120 metres away there is, however, a secondary chamber with an unusual construction (Rigsantikvarens Arkæologiske Sekretariat (ed.) 1995, 175, no. 408).

The inventory of artefacts, and the general find

picture in the monuments with preserved bark, are not different from those of passage graves generally. It does not seem that bark is only found in monuments that are distinguished by a higher standard of construction and execution. It may seem remarkable that bark has been found in two of the highest chambers in the country, Ubby Dysselod and Rævehøj, but several megalithic graves in north-western Zealand can be said to be among the most technically advanced and variable in the country. Snibhøj also stands out on account of its size, but Hvalshøje and Jordhøj also lie in the same part of Jutland. The fact that there are three relatively high chambers among the seven with preserved bark may suggest that a contributing factor could be that efforts to protect and preserve through time have, to a greater extent, been directed towards more unusual monuments. There is, furthermore, a greater chance of these high chambers have been partly earth-free. Accordingly, the use of bark in the construction of the dry walling cannot be linked unequivocally to chambers of a particular constructional standard.

Neither are there unequivocal indications that particular parts of the chamber were preferred in this respect. Similarly, bark occurs in passage graves of widely differing types and with a geographic distribution covering most of the country, from Hvalshøje in the west to Maglehøj in the east. As will be apparent later, a relationship can be perceived between the state of preservation of the bark and conditions in the chamber and behind the dry walling. Against this background it appears, on the basis of the eight occurrences known to date, that bark was a usual component in passage grave construction, and that it was used in connection with the building of the dry walling and the intermediary layer. It is still however questionable whether it also was used in the passages as Jordhøj is the only known occurrence and here it is found in dry walling standing closest to the chamber. It is possible that bark was not necessary in the passages as the capstones here are substantially lighter than those of the chamber and the pressure on the dry walling is therefore less. The lack of occurrences in passages is however more likely to be explained in terms of the poor conditions for preservation; wind and weather have a greater effect on preservation the nearer one approaches the entrance. As a consequence, dry walling in the passage is often seen to have suffered greater deterioration and has thus been restored to a greater extent.

In a number of monuments it seems, however, most unlikely that bark was ever used, namely those monuments in which chalk mass was used between the courses. This phenomenon is known from some areas of the country and here it is of course illogical to use the term "dry walling", as the chalk/water mixture has been used as a building material with a parallel function to mortar. As the word "dry walling" is so ingrained in the terminology concerning megalithic graves, the word is used anyway to refer to a wall of horizontal slabs stacked up between the orthostats, regardless of which material there is between the individual slabs. Chalk mass between the slabs of the dry walling is seen for example in Regnershøj in western Zealand (Dehn *et al.* 2000, 229ff.) and in one of the passage graves on Knudshoved Odde in southern Zealand (Vordingborg parish sb. 63). On Møn chalk mass has been used to excess in Jordehøj, where it is also included in the roof construction over the chamber (Dehn *et al.* 2000, 93ff.; Hansen 1993, Fig. 78). In the Sparresminde passage grave in the same area, chalk mass is used as a sealant both in the intermediary layer and on the rear of the dry walling. There are natural occurrences of chalk visible in the ploughed fields in the vicinity (Rigsantikvarens Arkæologiske Sekretariat (ed.) 2000, 136, no. 157). Attempts have been made to locate bark in passage graves where chalk mass has been used between the slabs but its presence has not been demonstrated.

At a few places a clay/water mixture seems to have been used as a sealant between the slabs. This applies to among others Kong Svends Høj (Hansen 1993, 53) and Ettrup (Rigsantikvarens Arkæologiske Sekretariat (ed.) 1997, 178f., no. 273). Birch bark was not, however, observed in connection with these, neither is it to be expected solely in the light of the conditions for preservation in the monuments in question.

With the exception of a small minority of passage graves where, due to natural occurrences in the vicinity, chalk mass or similar material has been used between the individual courses, there is a great deal of evidence to suggest that the use of bark between the slabs was common across the whole country. Furthermore, it seems probable that it originally was present in the whole chamber and possibly also in the passage. Experiments with the use of birch bark in connection with restoration work show that the total work involved in obtaining, preparing, shaping and finally using the bark for each individual monument has been considerable. This process is therefore an

important factor when attempting to calculate the resources used in megalith construction; the same applies of course also to use of chalk mass. In the light of this it must be presumed that the use of bark was a significant element in the construction, but to what end? It was hoped that the investigation of Maglehøj in 1996 would provide some answers to this question, but this hope was not fulfilled. It could only be established with certainty that the bark today lies in two layers between the surfaces of the slabs and not along the edges at the sides or to the rear.

The purpose of using birch bark in megalithic graves

As the investigations at Maglehøj did not give clear answers to the question of use we must make do with conjecture. Birch bark has been used for many purposes through time in different parts of the world, for example in North America, Siberia and Northern Europe. In Indo-European languages the word "birk" (=birch) means "the white". Examples from Danish prehistory include the birch bark found at the causewayed camp at Markildegård in southern Zealand (Østergård Sørensen 1995, 18ff.) and from the Bronze Age, the Egtved grave, where there were two bark buckets, one made from lime, the other from birch. At Nydam, one of the sacrificial bogs with war booty from the Iron Age, recent investigations have recovered a box made of birch and pieces of birch bark of unknown function. Birch bark letters are known from Russia and Sweden from the Late Viking Age. There are also Neolithic finds of bark from Sweden, but only as impressions; burned fragments of clay in a dolmen chamber bore impressions which included rushes, straw and bark. The pieces are however interpreted as traces of an earlier house on the site (Bägerfeldt 1992, 73). In recent times birch bark has been used in Finland, Norway and Sweden for many kinds of domestic items and personal equipment such as boxes, cooking vessels, rucksacks, waterproof clothing and wind (musical) instruments; the bark has been used both as whole sheets and as woven strips. In the Sami culture in particular the material has many uses. In early Scandinavian building culture birch bark was used for roofing log cabins, partly as a roofing material in itself, partly as a water-repellent underlay for grass turves. When used as an underlay there could be up to 15 layers of bark under the turves arnd it was important that the bark extended beyond the underlying timber construction. Both Olaus Magnus in the 16th century and Carl von Linné (Linnaeus) in the 19th century give accounts of the production of, trade in, and use of, birch bark. In trade there were defined sizes for the bundles of bark (Ågren & Lundholm 1970, 7ff.). In Denmark a practice is known from recent times whereby the ends of beams in walls were wound with birch bark in order to prevent the wood rotting (Suenson 1922, 82). Where birch bark has been used in connection with buildings – tents, wooden or stone houses - it has often been with function of a membrane to repel water or damp. The same could also have been the case in passage graves.

Investigations of the construction of megalithic mounds immediately around the chambers and passages show that efforts were made in several ways to keep the grave chamber sealed and hereby dry. This was observed as early as 1823 with the opening of Maglehøj, as the vicar in his report writes: "Remarkable care has been taken to protect the burial place from penetration by water and damp". It was probably known in the Stone Age that even small leaks could result in material from the mound being eroded into the chamber by water which percolated down through the mound layers. This could result in rapid decay, which would lead to an unstable construction. The precautions that were taken against this vary in nature and extent, but they are always included in the construction in one way or another. Experience from modern restoration shows that they are also effective. Decay necessitating restoration is almost always the result of interference i recent times, while undisturbed original constructions as a rule still fulfil their function. On Møn these precautions can be very thorough as for example those seen at Jordehøj. Here there are two layers of roofing slabs lying in chalk mass, packings of crushed flint at the rear of the walls to lead water away, and a drain channel at the base (Dehn *et al.* 2000, 93ff.). Overlapping flat stones acting as a throating along the edges of the capstones, so that water is led away from the chamber, are common occurrences (Hansen 1993, Fig. 83). Furthermore, clay is seen close to the chamber in mounds that consist predominantly of sand. The use of crushed flint or other stone is also important for ensuring that the construction remains watertight and stable. Bark between the individual stone slabs has presumably contributed to the attainment of this goal. Even though the selection and shaping of slabs for the dry walling was very careful it must have been almost

impossible to achieve a perfect fit between the slabs. They had both to be of a size and shape that fitted into the respective gap between the orthostats and also to lie horizontally, preferably with a slight backward tilt. This is the experience gained from restoration work, which in this respect can also be considered as experimental archaeology. A piece of bark could have evened out the small irregularities in the slabs and kept out any water which may have seeped in.

It is also possible that longer pieces of bark covered the rear of the wall (Hansen 1993, 53). If the individual pieces of birch bark in the wall were of greater length they could have hung down, overlapping each other on the rear of the wall. This would very effectively have kept out water which otherwise could seep from the mound fill, through the wall and into the chamber. At Maglehøj, where the rear of a complete section of dry walling was uncovered during the investigation in 1996, there were no traces of bark having been used in this way. However, not even the smallest piece of bark could be seen outside the surfaces of the slabs; it could easily have been there originally but sheets of bark lacking a stable flat underlay cannot be expected to be preserved.

Experiments in connection with restoration work show that the placing of folded pieces of bark between the slabs can be difficult in practice. During the construction of a wall the many layers of bark have a cushioning effect making it difficult to place the slabs correctly so that the fit ideally relative to the edges of the orthostats; the higher the wall, the more difficult this becomes. The problem can probably be reduced by harvesting the bark at the correct time of year or by using a technique whereby the bark is kept under pressure while the wall is being built. The correct preparation can also help. The bark can be soaked in water before use, as has been tried in the restoration. Here the bark used comprised about 15-20 sheets. The cushioning effect is, however, obviously dependent on the thickness of the bark. From the use of birch bark in recent times we know that the bark is easiest to harvest in the period from early spring until mid-summer, as it is easiest to loosen when it contains sap. Harvesting is possible at other times of year especially after a period of frost, and bark harvested in the autumn and winter is stronger. The bark is cut from the tree in sheets or long strips. The inner side of the bark can be light- or dark-coloured dependant on where the tree has grown and when the bark is harvested. The newly harvested bark should be put under pressure as soon as possible to prevent it from rolling up. The fresher it is the easier it is to use, but if it has dried out it can be made more flexible by soaking it in lukewarm water. If the bark is cut from a tree without damaging the cambium then the tree will not die but will grow more slowly; on the other hand the wood produced by the tree is harder (Ågren & Lundholm 1970, 31ff.).

Perhaps the feathering effect is the very reason for the presence of bark in megalithic graves. The construction of a passage grave takes place in several stages. One of the most decisive is the laying on of the capstone over the chamber, after the orthostats have been raised, the dry walling built up and the possible intermediary layer laid in place – all of it presumably thoroughly braced with timber constructions. When a 5-10 ton stone is lowered onto a newly constructed underlay with 20-30 courses of sandstone slabs in a section of dry walling as well as typically 1-6 courses in an intermediary layer, consolidation will occur. There is therefore a great risk that the slabs in the dry walling, or especially those in the intermediary layer, will crack. This has been observed during restoration work, when the capstone is replaced over the newly constructed dry walling. It can also be seen when, due to decay, subsidence of the capstones occurs. The effect can be registered in the form of broken slabs in the intermediary layer below. Even though slabs and bark have perhaps been under some pressure during construction there will still be a certain cushioning effect which can prevent breaks. The bark has also had another effect. In a construction with many small and large stone slabs, with crossed joints, there are relatively few points of contact between the individual stones; this increases the pressure on individual points. The two layers of bark between all the horizontal slabs will distribute the pressure so that breaks are avoided when there is a sudden increase in load. The laying of a thin layer of lead between granite blocks used in the foundations of 18-19th century houses performed a similar function.

The same must also have applied in the chambers with chalk mass between the slabs. The still wet chalk mass would redistribute the pressure to the whole surface instead of concentrating the weight on 3-5 points of contact between the individual slabs. At the same time the chalk mass also has the ability to give a little when the capstone is added.

The bark used between the slabs in megalithic graves can thus have functioned both as a membrane preventing the entry of damp and mound fill into the

grave chamber and as a pressure absorbent material for avoiding breaks when the capstones were added or during later consolidation due to the many tons of mound fill over the capstones. The same function was performed by the chalk mass. However, in order to achieve these effects it may not have been necessary to place the bark so regularly and systematically with a fold completely in line with the inner side of the dry walling as can best be seen at Maglehøj. It could have been done to satisfy aesthetic demands. An intact well-built and closely-fitting dry walling without preserved bark gives us today the impression of regularity and order; the inner surfaces of the slabs together form a flat, vertical wall with the individual slabs in different nuances of shade and colour. It is often the case that above a slab with a twisted or irregular upper surface a corresponding slab has been placed, the underside of which matches that below, almost likes pieces of a jigsaw puzzle. Correspondingly, a number of slabs with wedge-like facades can be laid alternatively giving a horizontal upper surface. The light-coloured folded bark in all the gaps has, just like the chalk mass, emphasised the slab construction of the wall in the slightly darker gaps between the orthostats and has provided a contrast to the many colour nuances in the freshly broken edges of the slabs. It is very probable that the light-coloured folds of the bark and the white chalk mass have also served a symbolic or decorative purpose and with regard to this it is tempting to compare the light-coloured stripes with the chalk-filled ornamentation on the pottery vessels from the period.

The use of birch bark in the construction of megalithic graves is probably not the only function that this material had in the Neolithic. The base of one of the Early Neolithic system pits at Markildegård appears to have been covered with sheets of birch bark, held in place by horizontally-placed branches; in the basal layer there were also sherds from seven funnel beakers (Østergård Sørensen 1995, 18ff.). Throughout most of prehistory people were presumably familiar with the material for the production of household objects and personal equipment in the same way as is known from the Sami culture. Here, and in recent times over all of Northern Scandinavia, there is a long tradition of harvesting and working with birch bark.

Dating – archaeological and radiocarbon

The birch bark in the dry walling of megalithic graves was put in place during construction. Accordingly, it provides the opportunity for a more correct dating of the construction of the monument than the artefacts placed in or at the monument during its use as a grave chamber and cult site. Establishing the precise date of construction will be a very important indication of whether the many different constructional features are chronologically determined, if techniques were developed and improved and whether for example characteristics of craftsmanship or geography also play a role. In this respect there is unfortunately too great an uncertainty with regard to the available radiocarbon dates. Apart from the result from Olshøj (see Postscript) which fall outside the period to which the passage graves are usually dated, the results from the other monuments confirm the chronological placing of the passage graves in the middle Neolithic. Neither is there any reason to dispute the few dates for monuments based on their Middle Neolithic artefact assemblages.

Birch bark and pollen analysis

Two species of birch occur naturally in Denmark, Betula pendula and Betula pubescens, but the bark sheets from the passage graves are too poorly preserved for it to be possible to determine which species has been used. Neither is this possible by way of pollen analysis. In present-day Sweden it is the latter species which is the most important source of raw materials.

Pollen analyses from megalithic graves are an important factor in revealing the vegetational history of the Neolithic. The samples taken from mound fills and underlying old soil surfaces in connection with the restoration of passage graves since 1987 in collaboration with Svend Th. Andersen, Geological Survey of Greenland and Denmark (Andersen 1997, 161ff.) contribute to this picture.

Of 25 megalithic monuments, five dolmens and 20 passage graves, from which pollen samples have been taken and analysed, there are only two where bark has been observed (Andersen unpublished). Samples were also taken at Maglehøj but here pollen was not preserved. Pollen was, on the other hand, present at Jordhøj and Hvalshøje. At Jordhøj, samples were taken from the old land surface under the mound

in connection with the re-opening in 1994 of one of the excavation fields investigated in 1964-65 (Kjærum 1970; Rigsantikvarens Arkæologiske Sekretariat (ed.) 1995, 175, no. 406). Samples were also taken from the old land surfaces under the mounds at the passage grave of Ormehøj, 120 m to the east of Jordhøj (Rigsantikvarens Arkæologiske Sekretariat (ed.), 1995, 175, no. 408), and the long dolmen Kongehøj, lying 700 m to the west (Rigsantikvarens Arkæologiske Sekretariat (ed.) 1995, 175, no. 407). At all three sites tree pollen dominated in the analyses with values ranging from 78-93%. Of the tree species, birch was dominant with values of 64-91%. At Jordhøj and Ormehøj 40-46% of the pollen had been deformed by exposure to heat and the diagrams show that Jordhøj was built on a site with birch scrub which had been cleared and burnt shortly before the mound was constructed (Andersen 1995, 17ff.).

At Hvalshøje samples were taken from the old land surface in a section between two orthostats in the northern chamber during restoration work in 1996. The analyses here showed a predominance of herb pollen, especially ribwort plantain, Plantago lanceolata and wild grasses, while tree pollen was sparse, only 10-18%. Alder, Alnus was the dominant tree species with 70% of the tree pollen, while birch was very poorly represented with only 1.7%. The conclusion is that the site on which Stone Age Hvalshøje was erected had been used for intensive grazing by domesticated animals over a longer period of time and that the trees stood on damp soils (Andersen 1997, 14ff.).

Quite by chance the results from the two mounds each reflect their part of the vegetationally very varied landscape which is apparent when the results from 35 localities are combined (Andersen 1997, 16ff.). They show great differences between the individual monuments, both with regard to woodland composition and land usage, but no regional differences are apparent. The landscape was dominated by lime, Tilia woodland and woodland consisting of a mixture of lime, hazel, alder and birch. Birch pollen, in particular, occurs in large numbers. Several of the areas of woodland with the character of scrub have been burned and hazel and birch woodland is promoted by human activity. Pollen from the passage grave in the Tustrup complex on Djursland (Kjærum 1958; Rigsantikvarens Arkæologiske Sekretariat (ed.) 1995, 177f., no. 418) has shown that the birch woodland here was burned twice, in between which there was grazing by domesticated animals and regeneration of the birch scrub in a swidden rotation. The reason for birch woodland being included in swidden agriculture is due to the fact that birch regenerates more readily naturally from seed after burning than the other tree available species. 67-89 % of the woodland, generally with birch, hazel and lime, was burned, of this the birch woodland made up 50 %. (Andersen 1997, 16ff.). Several areas of birch woodland in the landscape around the passage graves are thought to have had the character of scrub woodland because they were included in the swidden agriculture. The question is whether the trunks in the scrub woodland were able to provide sheets of bark of the size required for megalith construction. There were, however, areas of more established woodland and it should also be remembered that the pollen spectra from the mounds show in particular the vegetation in the immediate vicinity of the mounds. Regional pollen diagrams also show rich occurrences of birch with a maximum being apparent in the Early Funnel Beaker Culture.

Accordingly it appears that there was no lack of birch bark for megalith construction. In addition it should be remembered that birch is a relatively rapidly growing tree and that the bark of young trees appears to be most suited, whereas that on older trees becomes knotted and difficult to remove in regular sheets. An important feature, which distinguishes bark from all the other materials included in the construction, is that it is easy to transport over long distances. There is naturally the possibility that part of timber that was needed both for transporting the stones and in the building work itself, comprised slender birch trunks, which were fully usable without bark. Birch bark can split into thin sheets as each sheet reflects a single year's growth. At Rævehøj the bark was split into up to four sheets, but it was not possible to establish whether each of these in reality consisted of several compressed pieces.

Conditions for the preservation of bark in passage graves

There are two characteristic features of passage grave chambers with intact bark between the slabs of the dry walling. One is that they are always free of earth. Most chambers have, due to secondary use later in prehistory or opening in recent times, been filled with earth either after being sealed or as a consequence of decay. It is clear that prolonged exposure to earth

will cause the bark to rot and decay leaving no traces. Another characteristic feature is that behind the dry walling there are very substantial packings of crushed flint. The packings are so thick and compact that neither sand nor earth has infiltrated them. The latter depends of course again on which material has been used to hold the packing up against the rear face of the wall. With a mound fill of pure clay the border between the flint-packing and the mound fill will remain very sharp, whereas if the mound fill comprises stones and sandier material the distinction will be less clear.

When the chamber has the original mound covering intact and otherwise satisfies the above two conditions – earth-free chamber since the Stone Age and earth-free stone packings behind the dry walling – there are optimal opportunities for the preservation of bark, as air could circulate around the bark, which has lain without contact with bacteria in the soil. It is a tempting thought that people understood this already in the Stone Age and that the massive flint-packings were built up with this in mind. Factors other than the flint-packing and the earth-free chamber are also involved, as both Maglehøj and Jordhøj satisfy the conditions, but at Maglehøj the bark is still very well preserved whereas at Jordhøj, which was opened 70 years later, it is now in very poor condition. It is apparent from the description in the report from 1890 that the bark that was seen on opening Jordhøj was considerably better preserved than it is today. At Maglehøj today the bark still lies to a great extent *in situ* in large continuous sheets that are dry and crisp. At Jordhøj there is only a little left in the form of small, scattered scraps which do not lie *in situ* and which are soft and decaying. This could mean that factors other than the two mentioned above are involved in preservation. It could be the climatic conditions in the chamber, linked to the size and shape of the monument, as well as the construction and composition of the materials chosen for the enclosing mound. Large fluctuations in temperature over short periods of time often result in condensation forming on the walls and ceiling of the chamber and some chambers are, due to differences in size and construction, susceptible to this to a greater extent. Secondary entry through the roof or the intermediary layer can mean that the roof-covering over the capstones has not been re-established and rainwater can therefore percolate down into parts of the chamber; this is seen for example at Rævehøj. A large number of visitors in the chambers will also have consequences for the air humidity, which ideally should be low and constant.

Not all the eight passage graves known to contain bark have been completely earth-free since the Stone Age but special circumstances apply in these cases. From Maglehøj, Jordhøj and Snibhøj there are reliable reports that a burial layer with grave goods and bones lay exposed on the floor on opening. At Ubby Dysselod there was a small amount of soil on the floor and traces on the wall still show today how high this lay. From this it is apparent that the preserved bark has not been covered. At Olshøj there are no reports concerning the appearance of the chamber on opening, but it is known that there were openings between the capstones in the period between 1871 and 1900. Therefore an earth layer must have accumulated on the floor, at least in this period. We know that the bark in Rævehøj and Hvalshøje was covered by fill for shorter or longer periods, but the observations at Rævehøj can give an indication as to the reason for small pieces of bark being preserved despite this. Shortly after the opening in 1852 one end of a capstone collapsed into the chamber and lay some way above the floor level on recent fill beside the dry walling with bark. This and other information suggests that the chamber was partly earth-free on opening, but theoretically the chamber could have been completely emptied of its possible earth fill on being opened. In any case the earth fill covered the dry walling with bark from the time the capstone collapsed until the time of the restoration, as when the latter commenced in 1932 no capstone was visible due to the presence of recent fill. In the gap there was folded bark between nine slabs, 2-4 cm in size. The reason for this small section of wall with bark not having been destroyed was that the wall had fallen slightly backwards into the narrow gap and had been protected on its outer surface by stones and clay, probably deposited as early as the opening of the chamber in 1852 or immediately after. The relatively good condition of the bark is probably due to an earth-free pocket having been formed in front of the small section of wall. Something similar may also have occurred at Olshøj and Hvalshøje. Fallen slabs or a pile of stones could have formed a pocket in front of the slabs, between which a little bark remains. We know nothing of the conditions on the opening of Olshøj, whereas at Hvalshøje the southern end of the chamber with the dry walling in question was completely filled with heath soil, whereas the remainder was only half filled.

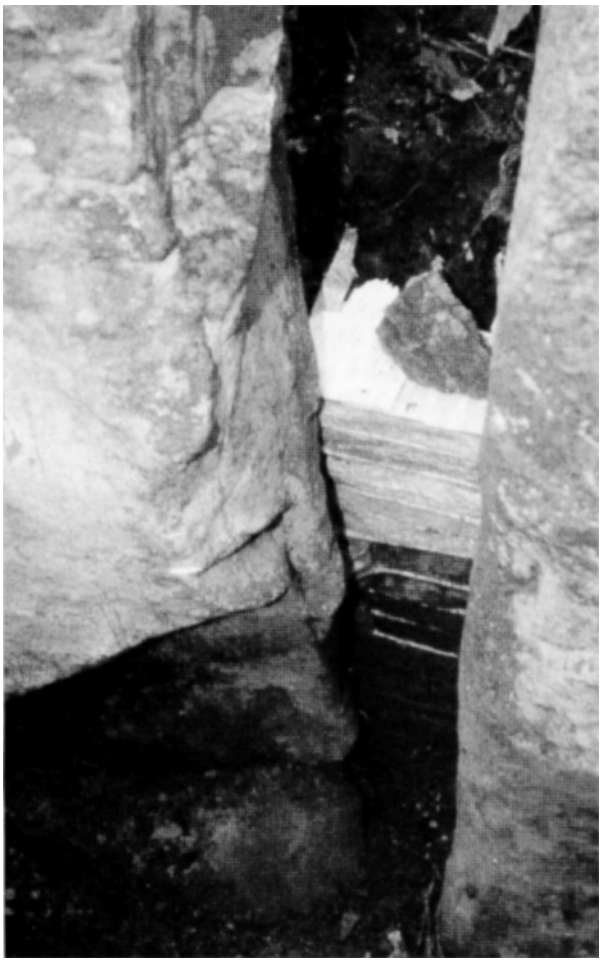

Fig. 8. In connection with the rebuilding of the dry walling under restoration work experiments were carried out with the use of birch bark, both between the original, re-used slabs and between newly shaped additions. Previous softening of the bark in water made handling easier. Passage grave north of Birkerød, 2000. Photo Torben Dehn.

Conclusion

The use of birch bark in the construction of passage graves appears to have been common. It has been demonstrated in various types of monuments with a wide geographic distribution covering much of Denmark. In some monuments it appears to have been used throughout in the chamber, whereas its use in the passage is less certain. There are several possible explanations for the use of folded bark between the slabs in the dry walling and the intermediary layer. One of the aims was presumably that the bark, as one of several elements, should prevent water and damp in the mound fill from penetrating the grave chamber. Another function could be that the bark acted as a shock/pressure absorbent material and as such prevented cracking of the slabs during construction. A third possibility is irrational, namely that the dry walling with bark was of significance as a symbolic or decorative expression. Several observations suggest that in European megalithic architecture the colour of the stone could have had some significance (Lynch 1998, 62ff.). In particular the colours white, red and black occur repeatedly. The suggestion of a conscious colour choice occurs also in the Nordic monuments, for example the white burned flint on the floors, the white casing stones at Ubby Dysselod and Grønnehøj, as mentioned above, or the tall, red gable stones at the southern end of Kong Svends Høj (Dehn *et al.* 1995, Figs. 147-148). There are some passage graves from Scania where special attempts appear to have been made to obtain red sandstone slabs especially with regard to the dry walling (Hårdh & Bergström 1988, 49). It is therefore also a possibility that the contrast between the thin, light coloured bark stripes and the freshly cloven dark stone slabs was intended either as an aesthetic or a symbolic expression. None of the three functions mentioned here need necessarily exclude the others – the same constructional element could easily have served several purposes simultaneously.

In any case, the use of birch bark, just like the chalk/water mixture, is yet another piece of evidence for passage graves as complicated and complex constructions. There can be great variation in constructional details, according to the choice or availability of materials, but regardless of how ambitiously or carefully the building work appears to have been carried out, a common thought or intention behind the construction can be traced, namely maximum stability and durability. The extensive use of birch bark in many different chamber types supports this interpretation. At the same time there is a reminder of the fact that megalith construction does not just involve earth and stone but that wood in several forms must have played an important role. If calculations are made regarding the resources involved in the construction – both materials and manpower – the use of bark (or chalk) is therefore not an insignificant factor.

Bark is not known from dolmen chambers, but it is likely that it was used in the larger chambers,

where dry walling was employed in the same way as in passage graves. The construction of the mounds enclosing dolmens varies considerably (Dehn *et al.* 2000, 194), but complicated constructions on a level with that of the passage graves do occur. An example is Klokkehøj on southern Funen, where each individual slab in the dry walling appears to have been set in clay. Similarly, there is a clay panel in the lowermost part of the mound to stabilise the orthostats and the dry walling (Thorsen 1981, 113ff.). The authors investigated a dolmen chamber of a corresponding type in a long barrow in the same area (Pipstorn Skov sb. 26, Diernæs sogn) in 2000. Here there was also a clay panel that was highest behind the dry walling, where crushed flint had also been used. In addition, it could be seen that the mound around the chamber had been constructed at in several stages. These examples suggest that just as much effort and consideration has been put into the construction of some dolmens with regard to sealing and stabilisation as with the passage graves, and it therefore seems likely that birch bark could also been used in some dolmens.

With the recognition of the fact that birch bark was commonly used in megalith construction and that it can reveal the very date of construction there is, by way of ^{14}C-dating, the opportunity for dating various monument types more precisely relative to one another. This means that it will be possible to determine whether technological developments took place in passage grave construction in Denmark or whether this arrived in a fully developed form. It will also be possible, if bark is present in dolmen chambers, to shed some light on the circumstances surrounding the transition from dolmen to passage grave construction. With the exception of the larger dolmens there can be significant constructional differences between dolmens and passage graves. The dates that have been obtained for birch bark confirm previous assumptions that the passage graves were erected in the course of a short period of 200-300 years. Unfortunately, one or two dates from each of eight monuments does not provide a statistical foundation on which to base further conclusions. This requires material from several monuments, and in order to eliminate the uncertainty with calibration of dates in this period several samples are needed from each monument. It is hoped that systematic investigation of monuments with optimal conditions for preservation will give the opportunity for additional and, therefore, more certain dates.

Postscript (January 2005)

The manuscript for this article was submitted in November 2000. Since then additional discoveries have been made particularly by the participation of Jørgen Westphal in investigations of megalithic tombs in recent years. These finds have not however led to changes in the main points of the original article so it has therefore not been altered apart from some editorial corrections. In this postscript the latest observations are described.

From 2001-2004 birch bark has been found in two additional megalithic tombs and a new dating result of material from Olshøj passage grave, which is described in the article, is available. One of the two new occurrences is in the stordysse Grønhøj (Hatting parish sb. 102) (Thorvildsen 1946). Between two courses in the upper part of a dry-stone wall, in the chamber's east side, a small amount of bark was found. It was not possible to distinguish two distinct layers or a fold, but the character of the material was unmistakable as bark similar to the previously identified examples, and the material has also been identified as birch bark. It has been dated to ca. 1650 bp. (AAR-7976), and this remarkably young date means that the reliability of the sample might be questioned. When the chamber was opened in 1835 there was a partial collapse and it wasn't until 1940 that it was restored. For over 100 years the chamber was more or less open and overgrown, and this can conceivably have affected the dating. It is therefore best to leave the find in Grønhøj out of this article until this aspect has been cleared up.

Øm passage grave. The second megalithic tomb with newly found birch bark is Øm passage grave near Lejre (Glim parish sb.13). It is a listed round mound/barrow with a well-preserved megalithic chamber with passage. The chamber and passage were found in 1831 and opened by the owner's sons, who broke a small opening through the chamber's roof stone, but who then searched for the entrance and dug their way in through the passage, having removed its covering stone (Johansen 2003). The passage was full of earth but the chamber was dry and free from soil. As early as in 1833 the mound/barrow and chamber were reinforced with earth, and a stone wall and a locked wooden door were added. Since then only moderate refurbishment has been carried out, most recently in 2003 where it was found that behind the stone wall from 1833 is an intact kerb around the barrow and that a cobbled chamber floor, which was also recorded in

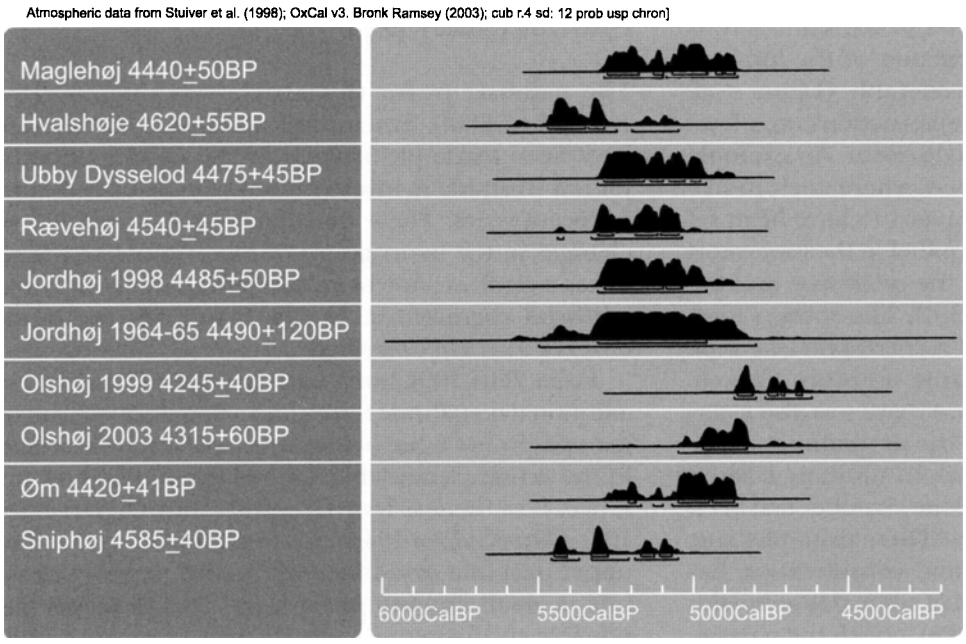

Fig. 9. Calibrated ^{14}C datings of birch bark from eight Danish passage graves. Calibration has been done by the OxCal 3.9 by Jørgen Westphal.

1833, is still preserved.

The chamber is solidly built of almost rectangular orthostats, closely spaced. The four large roofing stones rest on an intermediate layer of large flat stones, which do not form regular course skifter to increase the height, but are rather used to level out the roofing and they also serve to fill the spaces between the roofing stones' narrow ends. Outermost along the passage are a set of twin stones (Hansen 1995) and there is just one sill-stone to one side, which is not an unusual feature. The partially preserved original dry-stone wall consists of somewhat rough flagstones, mostly sandstone, with a considerable amount of crushed unburnt flint as packing behind. The monument is thus a well-built construction, which architecturally or in terms of its construction is very similar to the other passage graves in the area.

When the passage grave was opened in 1831 a volume of bones and a few finds were found, which initially were lost, but some of which were later sent to the Danish National Museum. The find assemblage indicates that the grave was used, not only in TRB but also in the Late Neolithic and in the Bronze Age. The birch bark was found in just one of the chambers' recesses in the 3rd course about 80 cm above the level of the floor. The bark here is remarkably well preserved, in some places in two layers and with traces of a fold, in towards the chamber, similar to that illustrated in Fig. 4. One sample has been identified as birch, *Betula sp.* The sample has been radiocarbon dated to 4420 ± 40 bp. (AAR-8723), calibrated (Stuiver *et al.* 1998) ± 1 st. dev. 3120-2910 BC.

The dates of the birch bark from the passage graves do not conflict with the known find assemblages or with each other (Fig. 9), although there is one ^{14}C dating which is 100-200 years later than expected, specifically the dating from Oldshøj of 4245 ± 40 bp. (AAR 5472), calibrated (Stuiver *et al.* 1998) ± 1 st. dev. 2910-2710 BC. Therefore in 2003 an additional dating of the material from the same place in Oldshøj was undertaken and the result was almost identical, that is 4315 ± 60 bp. (AAR 7975), calibrated (Stuiver *et al.* 1998) ± 1 st. dev. 3010-2885 BC. It is beyond the scope of this postscript to comment on this result.

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Calibration has been done by the Oxcal 2.18 program.

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