4.5 The Dutch Wadden Sea Region

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4.5.1 Geographical position of the Dutch Wadden Sea Region[1]

The Dutch Wadden Sea Region covers the area between the mouth of the Ems and the North Sea. The current Wadden Sea islands are part of it, as is the former Zuiderzee island of Wieringen. And of course it includes the Wadden Sea itself. The Wadden Sea is the shallow plain of unembanked salt-marshes, mud flats and shoals, cut through by channels and gullies, flooded by the water at high tide, with large areas falling dry at low tide. Furthermore the name 'Wadden Sea' is fairly recent: formerly the entire area to the south of the Wadden Sea islands was called the Zuiderzee. The islands formed the boundary between the North Sea and the Zuiderzee. The Zuiderzee was the largest bay in the entire Wadden Sea Region, and if the Afsluitdijk had not been built, the area covered by this report would probably have been far greater, and the entire Zuiderzee, with the adjoining parts of the mainland, would also have been included in this study. But things turned out differently: the construction of the Afsluitdijk removed the southern part of the Zuiderzee from the influence of the sea and changed it into a fresh water lake - the IJsselmeer - which is no longer necessarily regarded as a part of the Wadden Sea Region.[2]

However, a large area on the mainland is regarded as part of the region. It was created through the influence of the sea and has had important connections with the sea in the course of its development. This relates to the old maritime polders in Groningen en Fryslân, generally referred to as the terpen- en wierdengebied (dwelling mound district[3]). In Noord-Holland too, there is an area with large numbers of dwelling mounds: the western part of Westfriesland, in the neighborhood of Schagen. As well as these old residential centers, the more recent polders reclaimed from the sea form an important part of the area.

These three elements, the islands, the Wadden Sea and the mainland, which at first sight are completely different, are so bound up with each other that they can be regarded as part of a greater whole, the landscape of the Wadden Sea Region. This landscape is characterized by the close relationship between man and nature.

In the preceding chapter, Otto Knottnerus described the most important developments in the entire Wadden Sea Region, from Esbjerg to Alkmaar. In some respects the Dutch part occupies a unique position in this larger entity. Before looking at the individual areas which make up the region we would first like to discuss the general characteristics of the Dutch part of the Wadden Sea Region.

One of the special aspects is the enormous extent of the embanked coastal marshes and the peat lands further inland. The Pleistocene subsoil rises only very gradually (if we disregard the boulder clay hummocks of Winschoten, Texel and Wieringen) from north-west to south east, so that a broad girdle of peat bog has developed and the marine clay deposits also cover a large surface area. In the German and Danish areas of the region the Pleistocene soils rise more steeply and the zone containing marine clay deposits and peat bog is generally narrower.

The Dutch part of the Wadden Sea Region is further distinguished by the fact that permanent settlement on dwelling mounds started earlier here than in other parts of the region.

A third difference is that in the Netherlands land loss and land gain went hand in hand, whereas elsewhere the land lost far outweighed the gains. Large-scale land reclamation projects such as the Zijpepolder, the former Middelzee, the Fivel bay and the Dollard polders, are echoed elsewhere on a much more modest scale.

In the fourth place, the Dutch part of the Wadden Sea Region contains a number of specific landscape elements which are not or hardly found in Germany and Denmark, such as 17-th century boat canals, duck decoys and cut-away terps. The dense network of waterways is also remarkable.

Fifthly the Dutch Wadden Sea Region is characterized by the development of a number of small towns within the region itself. Appingedam, Dokkum, Leeuwarden, Franeker, Harlingen, Bolsward and Sneek developed into urban centers. We will not consider the West Frisian towns of Medemblik, Hoorn and Enkhuizen here since they are not regarded as part of the Wadden Sea Region for the purposes of this report. In the Dutch part there is thus a greater variety of settlements than elsewhere in the Wadden Sea Region.

The natural environment

After the end of the last Ice Age (some 10,000 years ago) the level of the North Sea rose by around 100 meters. In the current Wadden Sea Region the coastline moved continually southward and eastward. Because the rise in sea level also caused a rise in the level of the fresh groundwater, a zone of peat developed parallel to the coast. This peat girdle shifted ever higher: on the sea side the peat bog or fen was flooded by the rising sea level; on the land side it extended over the higher sandy areas.

Around 5000 BC the Straits of Dover flooded. The currents in the North Sea changed and began to run more parallel to the coast. This created offshore bars, which were divided by later breaches by the sea into smaller pieces, islands. Between the bars and the peat lands there arose an area with gullies, sandbars and salt-marshes, into which the sea penetrated twice per day. The offshore bars have since remained roughly in place. The young dunes which are still a characteristic feature of the Wadden Sea islands today, began to develop in the Late Middle Ages.

Soil and peat subsidence

The rising sea level at the end of the last Ice Age also raised the groundwater table. In a broad marginal zone along the coast it became so wet that swamps were formed. The plant residues in the soil did not entirely perish under the influence of the wet environment, so that the layer of plant material grew ever thicker. At a certain point this layer was so thick that the area became isolated from eutrophic river water. Then began a long period in which the plants could only obtain the nutrients they needed from rainwater. Few plants can survive under such oligotrophic conditions. One such plant is sphagnum moss, a plant which grows on raised bogs and can form thick peat layers. These peatlands were vast, stretching from the dunes in Noord-Holland to the higher ground of Gelderland and Overijssel; the Zuiderzee was not yet in existence. The peatlands ran northwards to large parts of the present Wadden Sea Region. There are large areas in which the peat formation continued unabated until man began to exploit the land, a development which started in the Carolingian era. The landscape, as it appeared before the advent of man, consisted of a number of raised peat bog islands, which lay like slightly bulging cushions in the area. The rainwater from these raised bogs was drained off via moorland rivers, which carried the wetland water away towards the Almere and the North Sea.

When the first farmers settled in the peatlands this had serious consequences for the environment. In order to work the land, they first had to drain it. Ditches were dug to lower the ground water level. Thereafter began the process referred to as soil subsidence, although ground level subsidence would be more correct.

The cultivation of a peatland is inevitably accompanied by ground level subsidence. The drop in the surface level is caused by settling and oxidation. Settling takes place when water flows out of the peat bog as the groundwater table drops, and thus the volume of the peat bog diminishes. This causes the land to sink: the surface sinks along with the groundwater, as it were.

The rate of ground level subsidence is accelerated by oxidation. After drainage the pores in the peat soil fill with air and the non-decayed plant residues are gradually converted by the intake of oxygen into carbon dioxide and water in the drained peat bog. The bog is thus actually very slowly burned. Settling and oxidation can lower the surface level of a bog by a maximum of around two centimeters per year. It is assumed that the surface at the higher parts of the peat bog islands was previously around 4 meters above NAP (Normal Amsterdam Level). The surface of the peatlands in the Wadden Sea Region is around 1.5 meters below NAP. This means that the surface has dropped by around 5.5 meters since it was first taken into use. The speed at which the process can proceed can be seen in an example in England. In 1848 a fen in the East Anglian peatlands was drained. Some distance away a post was driven into the peat so none of it remained above ground. This post, the Holme Post, now protrudes 4 meters above ground level.

Subsidence is greatest at the beginning. The ground level subsidence had consequences for the farmers, since, as the land grew steadily wetter it eventually became impossible to grow grain. The fields were given over to pasture and hay.

Another consequence was that the area became vulnerable to incursions by the sea. Large areas of the original peat bog landscape fell prey to the sea.

Living at the edge of the water

In this dynamic coastal environment Man has tried to wrest an existence since the Neolithic age (5000-2000 BC). Remains of Neolithic settlements can be found in the Groetpolder in Noord-Holland and elsewhere. The settlers were adapted to the coastal environment and lived mainly by catching fish and gathering shellfish. This contrasts with the megalith found under a thick layer of clay near Heveskes monastery in Groningen, which is evidence of agricultural settlement from the mid-Neolithic age without any demonstrable relationship with the coastal environment.

In the Bronze Age (2000-1000 BC) there was settlement on the raised salt mashes in the province of Noord-Holland. The area was relatively densely populated, particularly in the period from 1350 to 900 BC. During this period the sea had no direct impact: the salt-marsh was turned into a fresh-water landscape and was no longer flooded by the sea. Settlement in Noord-Holland came to an end around 800 BC. The area grew increasingly wet, swamps developed and a thick layer of peat was formed. In contrast, conditions in other parts of the Dutch Wadden Sea Region became very favorable for habitation.

From 600 BC people settled in the salt-marsh landscape of Groningen and Fryslân. Initially people only spent the summer there and retreated to the old villages on the sand in the winter. The settlers brought livestock and grew crops. Flooding with salt water would be disastrous for arable farming: the entire harvest could be lost. Evidently the sea had so little impact at this time that the crops were in no real danger. Seasonal habitation eventually became permanent.

With the influx of residents, the settlements were gradually raised up. Manure and household waste piled up, turfs were dug for the walls of farms and to raise the floors. Initially dwelling mounds arose as a result of habitation and there was as yet no intentional raising of the land. When the sea level started to rise again these higher grounds were of course the best suited for arable farming. At a certain point the settlers no doubt switched over to artificial raising and extending of the existing dwelling mounds to protect the fields or extend the area of arable land. Before building a farm or new dwellings they often created an artificial mound (wierde), as evidenced by archaeological excavations of the Tuinster Wierde in Leens (Groningen). The oldest dykes were also primarily intended to protect arable land from the intrusive sea water.

Terps thus arose as a result of - active or passive - raising of individual dwelling places. Such domestic mounds could grow up next to each other into village mounds. The height of the mound gives an indication of the duration of habitation, the number of farms and the construction materials used. The dwelling mounds (terps or wierdes) did not all appear at the same time. This is well illustrated in Westergo. The oldest mounds lie in the center of the area, a long way from the present-day coast. To the north of these is a series of mounds which were first inhabited in Roman times. They are set out in a neat row, because the people chose a higher coastal or salt marsh ridge formed by the sea as a dwelling place. There are mounds from the middle ages on a coastal ridge which was formed later, parallel to the 'Roman' one. There is thus clear evidence that the extension of the coast to the north is closely connected with the development of human habitation.

Digging up the terps

The dwelling mounds were in the past raised using grass sods, domestic waste and manure. An extremely fertile mix, for which there was a sudden and real need when in the 19th century large areas of the moor and cutaways on the sandy soils were opened up for [agricultural] use. The fertility of the poor sandy soils was increased by adding terp earth to the topsoil and this also improved the water-retaining capacity of the soil. To bring one hectare of sandy soil into cultivation required around 120 tons (80 cubic meters) of terp or wierde earth[4].

Terps and wierdes were dug up on a large scale and the earth was transported to the sandy area by tjalk. It was a profitable round trip for the bargees. It was a huge assault on the terps: large parts of terps, and sometimes entire terps, were dug up and distributed over the sandy areas. In some cases houses were broken up and rebuilt after the terp was dug out. The churches and churchyards were usually spared, but there are stories of digging so close to the churchyard that bones protruded from the steep wall. Needless to say, a treasure-house of archaeological information was lost.

Only the very unusual finds, such as the silver treasure of Winsum (Fryslân), were publicised, but no thought was given to less valuable things, such as pottery, never mind organic deposits and organic residues. This changed when the professional archaeologists started taking an interest in the terp and wierde district. Prof. A.E. van Giffen acquired international fame with his excavation of the Ezinge wierde. The excavation was partly financed by the sale of the terp earth....

Building the dykes

Dykes form another type of protection against salt water. The pattern of the dykes indicates the period when they were built. Dykes were already built very early on, as is shown by an excavation at Peins, where a small dyke was found which predated the start of the Christian calendar. Initially dyke building was restricted to the protection of small residential areas. Later larger areas, encompassing several villages, were surrounded by a ring dyke. The first enclosures of larger areas with dykes date from the 10th or 11th centuries. Later estuaries were reclaimed bit by bit from the sea, as in the Middelzee area, the Fivel bay and the Dollard. Each time new sea defenses were laid to seaward, the old dyke was retained as an inner dyke, a dormant sea defense. Usually the old dyke was maintained, to provide extra security if the new sea dyke should give way. Sometimes such a dyke was even specially built for this purpose, as is the case of the Slachte dijk, which runs straight across Westergo. The pattern of dykes is a splendid illustration of the human occupation of the area.

Thus land was captured from the sea, but the sea also took land back. Large marine incursions led to loss of land, such as the incursions which led to the formation of the Zuiderzee (from the 11th century) and the incursion in the Dollard. Sometimes it was a case of natural processes, but often the hand of man was involved. For example, salt mining was an important activity in the coastal area, using the salty peat layers occurring in the subsoil. It was easier for the sea to penetrate in areas where these layers had been dug. But it was not only salt extraction which made the area vulnerable. In the peat lands subsidence caused by agricultural practices also played a large role (see inset). Also, the dykes were neglected. In the Dollard a lot of land loss was due to poorly maintained dykes during the internal struggles between the Schieringers (Cistercians) and the Vetkopers (Premonstratensians). Large areas of cultural land were thus lost through the action or negligence of man. Some of the estuaries were again reclaimed (Middelzee, Lauwersmeer), in other parts the water remained.

The construction of dykes made the inhabitants of the coastal marshes less vulnerable to floods, although these were not entirely banished. The great flood of 1570 (All Saint's Tide) for example, cost hundreds of lives. This was the spur to raise the dyke, and the initiative was taken by the Spanish governor of Fryslân, Caspar de Robles (sometimes called Zwarte Kornel). To the south of Harlingen there is a statue of him on the dyke, and stones in the dyke slope also show how the sea dyke has been raised in the course of history.

Breaches in the dykes caused great trouble in the areas behind them, but in general the dykes gave the inhabitants of the area a greater degree of security. Another consequence of dyke construction however was that a solution had to be found for surplus rainwater. Prior to dyking, this water had naturally run off into the sea. now it stagnated where it was. Provisions had to be made to control the polder water. This was done in the form of broad watercourses to store the polder water and sluices to discharge the water. Of course the further an area was from the sea the harder it was to drain off the water. The many monasteries in the area played an important role in the increasingly complex water control system in the area within the dykes. The construction of dykes and dyke locks or drainage sluices (zijlen) caused the appearance of sluice and dyke villages, such as Oudesluis, Delfzijl and Oude and Nieuwe Bildtzijl.

Trade and travel

The development of the Wadden Sea Region was strongly affected not only by the constant battle against the water but also by trade. Even in Roman times there were extensive trading links between the Wadden Sea Region and the Roman Empire to the south. At that time it was mainly agricultural produce (meat, skins) which were supplied in exchange for pottery, jewellery, wine and other specifically Roman commodities.

The significance of trade increased in the early Middle Ages. At that time welfare was not only entirely determined by agricultural productivity. Crafts and industry underwent great development and added numerous high-quality products to the growing flow of goods, such as amber and silver and gold jeweler. Some villages, such as Holwerd, became specialized trading posts, evidence of which can still be seen in the country. The Wadden Sea Region enjoyed a period of great prosperity, which continued into the 11th and 12th centuries. The great concentration of Romanesque churches and monasteries was a consequence of the prosperity and wealth of this period.

For numerous reasons (see Otto Knottnerus's contribution in this report) the Wadden Sea Region lost its leading position in trade during the course of the Late Middle Ages. The area was

also only partially able to reap the benefits of the large-scale peat extraction in the hinterland and the trade in turf, which started in the 16th century and expanded enormously in the 17th century. The major centers of trade and industry lay outside the area: the Wadden Sea Region found itself increasingly marginalized. Apart from Leeuwarden, it did not reach the stage of developing large towns. However, it is striking that the various small, prosperous towns did develop, and in addition to performing a regional market and trade function for the surrounding agricultural area, also continued to play a role in long-distance trade. However the Wadden Sea Region was still characterized by habitation in the many villages.

The use of the land and the sea

Many places on the coast and on the islands developed into fishing ports, such as Oudeschild, Zoutkamp, Den Oever and Harlingen. Den Helder - a naval port from the 18th century onwards - saw great expansion in the 19th century after it became a garrison town and the naval dockyard was transferred to the town from Medemblik.

On the islands income from agriculture and fisheries was supplemented with other forms of activity: the merchant navy and whaling became important activities. The commodores' houses and the whale bones in the island villages still bear testimony to this.

Land use was varied. Agricultural operations traditionally took the form of arable and livestock farming as described above. Gradually this 'mixed farm' disappeared however, and the farmers began to specialize. The oldest inhabited areas, such as the southern part of Westergo, were less suitable for arable farming, due to the continuing problems with drainage, and here the focus shifted to dairy farming. Arable farms are found on the higher raised salt marsh ridges and on the younger polders along the coast, such as the Anna Paulowna polder, and the Bildt and the Oldambtster polders. Sheep farming developed on Texel and Wieringen, where they used a form of field enclosure found nowhere else in the Netherlands: piled up sod banks called tuunwallen.

Recent developments in the countryside

In agriculture we saw the separation of the mixed farm, as in the rest of north-western Europe. This meant not only a specialization in livestock or arable farming on each farm, but also whole regions starting to specialize. In Groningen the separation led to specialization in arable farming. The Oldambt district developed after 1800 into one of the most progressive arable areas in Europe. Specialization also had an impact on traditional building: arable farming requires a different type of farm to dairy farming. The Oldambt-style farm is thus somewhat different from the characteristic Frisian 'head, neck and barrel' (kop-hals-romp) farm.

The increased scale of agricultural production and European agricultural policy in the twentieth century left their mark on the region. Land reallocation schemes brought and still bring great changes to the landscape. A part of the Oldambt district, 'the grain republic'[5] of olden times, is being transformed into a „Blue City", a new urban living environment, built around a newly created lake. In recent decades 'alien' forms of agriculture, such as pig farming, bulb fields and glasshouse horticulture have been introduced to the region. Organic agriculture is also on the increase and more and more regional products are being developed.

Industry and mineral extraction

Industrialisation in the area mainly took the form of factories with links to agriculture, such as dairy and feed factories. Apart from these, the main traditional industries in the Wadden Sea Region are brickworks, tile works, pottery and shipbuilding. The importance of shipping is indicated by the presence of shipyards. Large-scale industry has recently developed in Delfzijl, Harlingen and Eemshaven. Exploratory drilling for gas has taken place both onshore and in the Wadden Sea. Dominant new landscape elements include wind turbines, both concentrated in wind parks and distributed over the agricultural area. Activities in the Wadden Sea which affect the underwater landscape include sand and shell extraction and cockle, shrimp and mussel fishing.

Tourism

One development which has had a huge impact on the landscape of the Wadden Sea islands is tourism. It was not until after the Second World War that the Dutch Wadden Sea islands and the coastal area have become very important for recreation and tourism. The trek to the coast is mainly concentrated on the islands, but here and there (very recently) leisure facilities have been created on and near the sea dyke as well. The facilities take the form of hotels, villa parks, camp sites, marinas, airfields and the like. Cul-

tural tourism is a new trend on the main land: walking and cycling to appreciate the landscape and cultural heritage values. In this context numerous historic buildings, such as manor houses, farms and former town halls now serve a new purpose: they are converted into small-scale tourist accommodation, or sometimes into regional museums.

4.5.2 Sub-regions in the Dutch Wadden Sea Area

In geological terms, the Wadden Sea Region is characterized by the processes which occur in a shallow coastal sea with a predominantly sandy bed. Other important factors in its development are the gradual rises in sea level and the extensive transportation of sediment. The action of the wind and waves created elongated offshore bars, broken only by the mouths of rivers and incursions by the sea.

The location of this coastal barrier was and is still determined by the position of the Pleistocene hills of De Hooge Berg (Texel).

Behind the islands lies the Wadden Sea itself, a shallow coastal sea consisting of channels and gullies, sandbars, mud flats and salt marshes. The tide transports the sediment twice daily via the tidal inlets to the Wadden Sea. The sand carried along with it is deposited a short distance from the mud flat channels on sandbanks, sandy flats or sandy ridges along the channels. The finer (clay) particles are transported further inland by the tidal waters and deposited under more peaceful circumstances on mud banks or on the salt marshes. A great part of the salt marshes has been reclaimed and now forms a part of the mainland.

Further inland still, between the area of marine clay deposits and the sandy Pleistocene soils, is an area of peatland. The width of this area varies: in Groningen and Oostergo the peat strip is fairly narrow in places, in Fryslân on the other hand it is sometimes dozens of kilometers wide. In Noord-Holland, finally, the marshland area gives way to an enormous, elongated area of peat moor. In this area it is hard to decide which areas still belong to the Wadden Sea Region and which do not.

The Wadden Sea Region can thus be divided into a number of landscape zones: the Wadden Sea islands, the Wadden Sea itself, the marshland area (enclosed with dykes) and the peat moors bordering the clay area. The marshland area of Groningen, Fryslân and Noord-Holland is subsequently subdivided into individual sub-regions which are clearly distinct from one another due to their genesis and their current landscape features.

4.5.3 The Wadden Sea islands

The Wadden Sea islands were created from the natural coastal barrier in an intensive interaction between man and the forces of nature. Man made full use of the opportunities offered by coastal erosion and the deposition of sediment: securing drifting sands by constructing sand dykes at the points where dunes would be formed. The zoning of the islands is a characteristic feature: beach, dune area, inner dune fringe and (former) salt marshes. On the North Sea side the islands have a natural sea defense in the form of dunes. Where the belt of dunes was very narrow or low, people often reinforced the natural defense with artificial defenses, for example using sand dykes. On the Wadden Sea side most islands have a strip of salt marsh which has gradually been brought into cultivation. Often the open salt marsh soils are enclosed by dykes to protect them from flooding by the Wadden Sea, but there are also (parts of) islands which are not protected by dykes, and which are submerged at high tide. Examples include the 'grieën' on Terschelling and Ameland.

For a long time the agricultural lands provided an important but meager means of subsistence for the island population. The inhabitants tried many ways to broaden the basis and sought other sources of income. Trade, fishing and seafaring (including whaling) were all important, and were supplemented with activities such as beachcombing (or 'wrecking') and smuggling. The western Wadden Sea islands served an important function as piloting and supply points for shipping. On some islands whale bones and jawbones, used as fencing in front of the houses, are reminders of the inhabitants' whaling past. Beacons and light houses were built on many islands for the benefit of shipping.

The originally agricultural villages are generally situated on the fringe of the inner dune: the transition from dunes to former salt marsh. The landscape here has a fairly 'closed' nature. The farming villages are different from the harbor settlements (West-Terschelling, East Vlieland, Oudeschild) and the recently developed leisure villages ('recreatiedorpen'). Tourism began to play an important role in the 20th century.

Based on the history of their development and inhabitation it is natural to make a distinction between the islands of Texel and Wieringen, which have a Pleistocene core (boulder clay and wind-borne sand deposits from the Pleistocene age), and the barrier islands of Vlieland, Terschelling, Ameland and Schiermonnikoog. As a result of the construction of the Afsluitdijk and the reclamation of the Wieringermeerpolder, Wieringen is no longer an island, although it has not lost its island character.

The Dutch islands with a Pleistocene core: Texel and Wieringen

The current island of Texel came into being when a sand dyke was created (1629-30) between the original island of Texel, which consisted mainly of boulder clay and wind-borne sand hills, and the barrier island of Eijerland. The salt marsh to its east was reclaimed in 1835 (the Eijerland Polder). Seawards from the first sand dyke, a new sand dyke was created in 1855 which was breached by the sea in three places in 1858. One of the openings, de Slufter, still exists, and is now a nature reserve.

The highest point on Texel outside the dune area is the Hoge Berg at Den Burg (15 m). On the south-western side the island is extended by a series of arched sandbanks with dunes and a connecting sand flat, de Hors, and on the south-eastern side by a salt marsh polder, the Prins Hendrikpolder of 1847. The original very small-scale system of plots was lost as a result of land consolidation schemes. The major settlements are Oudeschild (the old harbor), Den Hoorn, Den Burg, De Waal, De Koog and Oosterend. The new ferry port at the southern tip of the island is accessible by boat over the Marsdiep from the naval port of Den Helder. The island is famous for its bird sanctuaries and is much-visited by tourists.

The island has specific characteristic features: sod banks (tuunwallen), aisled sheep-sheds (schapenboeten) and a diversity of village types. Tuunwallen are field dividers, approximately one meter high, consisting of piled-up grass or heather sods. They date from the 17th or 18th centuries. Sheep-sheds, like the tuunwallen, are found mainly on the high Pleistocene part of the island. These are prominent elements in the landscape, which reflect the important role played by sheep farming on the island. Apart from elongated nucleated row villages, which can be found elsewhere on the islands, Texel has a real harbor at Oudeschild. Oudeschild was a naval base for some time until that role was transferred to Den Helder by the end of the eighteen's century. The port dates from 1780, but long before that ocean-going ships lay at anchor here in the Texel Roads while waiting for favorable winds. Water to supply the ships was drawn from the wells of the Brakenstein farmstead at the foot of the Hoge Berg. To the south of Oudeschild lies the Oude Schans (Old Redoubt) from the Eighty Years' War. The center of Den Burg has two 'rings': circular streets. The inner ring is said to date back to defensive works from Viking times, the outer ring is a bulwark from the 14th century.

Fig. 4.84:
Tuunwallen on Texel

Finally, the Russian graveyard is a special cultural heritage element. It harks back to the uprising of the Georgians, who, with the inhabitants of Texel, fought a bloody battle against the German occupation forces from 5 April to 20 May 1945. 565 Georgians were among the dead.

Wieringen is - or rather was - not actually a Wadden Sea island, but a Zuiderzee island. By this we mean that, just like the former islands of Urk, Schokland and Marken, the island has no offshore bars, dunes or beaches. Before it was connected to the mainland the old island consisted of a Pleistocene core of a somewhat smaller scale than Texel with a salt marsh polder on the south side, the Waard Nieuwland polder. The traditional small-scale plots disappeared during a land re-allotment scheme in the nineteen thirties. Practically all the tuunwallen which had been common here, too, also disappeared. It is interesting to note that in recent years new tuunwallen have been built as part of another land re-allotment scheme.

The most important towns are the harbour and fishing town of Den Oever, where the Afsluitdijk begins, Oosterland, Hippolytushoef ,Westerland and De Haukes, the former harbor town of the island. The island itself has retained its agricultural character.

Two activities are worthy of special note. First, the harvesting of seaweed, or sea wrack (Zostera maritima). This was used for all manner of purposes: roof covering, litter for stalls, dyke-building. When people also started to use it to stuff mattresses, seaweed harvesting became one of islanders' main occupations. The southern dyke of Wieringen still consists partly of seaweed. There are also still some seaweed storehouses, but the finest example has been moved to the Zuiderzee museum. The harvesting of seaweed came to an end following a disease in the 1930s, which seriously affected the seaweed beds. Another activity relates to ducks. In the 17th century there were 15 decoys on the island, two of which remain. Wild ducks for the table were caught in the decoys. Tame ducks were also kept, particularly around De Haukes. They were kept for their down and eggs, and were fed with undersize fish which could not be sold. Duck keeping was thus closely associated with fishing.

In recent years there have been some important finds from the Viking era. The first Viking treasure was found in 1996, in a meadow near Westerklief, to the south of Hippolytushoef. An earthenware pot was found, containing a many pieces of jewellery, coins and silver bars. The pot containing the treasures was buried around 850. In all probability the treasure belonged to a Danish nobleman who took up residence on Wieringen. This is the first indication that the Norsemen or Vikings were not only robbers and plunderers, but also took up residence in the coastal area[6].

The shape of the farm is a notable feature on both Texel and Wieringen. It is a variant of the Noord-Holland 'cloche'-house (stolp), in which the living quarters extended from the front. In the corner, where the living quarters meet the work areas, we find the chimney of the bakehouse.

Decoys

Decoys[7] are an original Dutch invention, which has been known for around 700 years. It is assumed that around 145 decoys existed in the Wadden Sea Region. The decoy business is seen as a form of hunting with a clear historical tradition and value. Decoys are strange, centuries-old elements in the landscape and now form recreational and nature areas of international interest.

A decoy consists of a pool of water surrounded by woods, laid out in a quiet place in an area which is rich in water (and waterfowl). The average area is around 2 hectares. Around the generally rectangular cage pool lie 4 to 6 trap ditches. All of this is surrounded by an wall of earth. Duck catching is a type of hunting with lures, unique teamwork between the decoy-man and his tame domestic ducks and the decoy dog, with a smouldering turf and some food. In addition to catching ducks the decoy business involved management and maintenance of the decoy, duck pond, duck decoy tree belt and trap ditches, as well as caring for the tame ducks and the decoy dog.

'Kooirecht' is the right to catch ducks. The 'afpalingsrecht' (demarcation right) is a circular area within which the peace must not be disturbed. The size of the circle varies: in Groningen the circles have a radius of only a few hundred meters, in Fryslân a radius of 1200 meters was common; in Noord-Holland there were circles with a radius of 1130 or 1500 meters. The shape and layout of the decoys also varied, depending on the way they developed, the hunting area and the hunting season. Because the decoys are often found in the open grassland polders the

decoy woodlands are striking and form characteristic elements in the landscape. In the dune areas they form a green contrast to the sloping fringes of the dunes.

In view of the once large numbers of decoys, this was an authentic feature of land use and was a traditional hunting method for catching birds (in addition to goose and plover catching). A survey dating from 1494 shows that half the population of Wieringen was involved in fishing and bird catching. Each Wednesday in the summer a special 'bird barge' left for Amsterdam8. Bird catching was thus an important rural activity. In social terms the decoys have added significance because in a number of situations they were in common ownership.

The Netherlands was the birthplace of the decoy, and has the oldest and largest number of decoys. From here decoys and the decoy business were introduced to other parts of the Wadden Sea Region: in the 18th century in Germany and at the end of the 19th century in Denmark.

There were around 175 duck decoys in the Wadden Sea Region as a whole. The majority of these have disappeared entirely and can only be traced on old maps or in historical documents. Others are no longer used as decoys, but are marked in the landscape by the residual tree belt, the duck pond or the structure of duck pond and trap ditches. Of the 33 decoys still in tact, 29 are in the Netherlands and 4 on the German island of Föhr.

The barrier islands: Schiermonnikoog, Ameland, Terschelling and Vlieland

The islands of Schiermonnikoog, Ameland and Terschelling have a very similar structure to that of the East Frisian Islands: an elongated shape, tapering to the east, one or more villages in the shelter of the dunes, hook-shaped sand bars on the western side, an extensive dune and salt-marsh area on the eastern side and an enclosed salt marsh. Here, too, the islands show a marked tendency to shift eastwards. Sand dykes were built to in an attempt to strengthen the adhesion between the islands and the accumulating sand-bars and salt marshes on the eastern side and to gain some control over the process of island movement. Vlieland differs from the other three islands in that it consists purely of dunes with a settlement on the south-eastern side.

The islands now belong to the province of Fryslân. Tourism is very important to all these islands. It began later than on the German Wadden Sea islands and partly because of this it is slightly different. There are no boulevards, few large hotels, but rather guest houses, farmyard and general camp sites and private summer houses for rent. Tourists are not permitted to take vehicles onto Vlieland and Schiermonnikoog.

In addition to these inhabited islands there are other uninhabited ones. Some of them were once inhabited and are relics of far larger islands, as in the case of Griend. Others are 'young' islands.

PROVINCE	DECOY (REGISTERED)	DECOY RELIC	DUCK DECOY NOW DISAPPEARED	TOTAL
Noord-Holland	**8**	**6**	**27**	**41**
Fryslân	**19**	**5**	**47**	**71**
Groningen	**2**	**2**	**26**	**30**
Totals	**29**	**13**	**100**	**142**

Table 4.1: Overview of decoys in The Netherlands in the LANCEWAD research area

COUNTRY	DUCK DECOY (REGISTERED)	DECOY RELIC	DUCK DECOY NOW DISAPPEARED	TOTAL
THE NETHERLANDS	**29**	**13**	**100**	**142**
GERMANY	**4**	**11**	**2**	**17**
DENMARK	**-**	**4**	**-**	**4**
TOTAL	**33**	**28**	**102**	**163**

Table 4.2: Overview of duck decoys in the entire LANCEWAD research area

Schiermonnikoog, the smallest inhabited Wadden island has suffered constantly from erosion on the western side. It was already causing concern in the 16th century. The church of the former village of Westerburen had to be moved in 1717, but the new church was endangered by 1760. In 1762 the third church was built and in accordance with the wishes of the then landlord, construction continued in regular 'streken' (strokes) which now characterize the village. It is the only planned village on the Wadden Sea islands. There are still six active farms on the salt march polder adjoining the village.

The island was originally in the possession of the Cistercian monastery Klaarkamp (schier monnik = grey monk, after the color of their habit). Later, in 1638, it fell into private hands. At the start of the Second World War the island was owned by the German Graf Von Bernstorff; but it was confiscated after the war. Since then it has been under the management of the State Property Department, which transferred ownership of the dunes and unembanked salt-marshes to the Society for Nature Conservation in the Netherlands a few years ago. The dune and salt marsh area on the eastern side of the island (Kobbeduinen, Willemsduin and the depressions between them) is an important nature reserve.

Ameland was first named in the 9th century. The island consists of four villages situated in the lee of the dunes: from east to west Buren, Nes, Ballum and Hollum. Formerly each had its own salt marsh polder. The dune area on the eastern side of the island is crowned by the Oerd, a 24 meter-high dune. The first land re-allotment scheme in the Netherlands took place on Ameland in 1924. The typical farmhouses were also built at that time. Before the re-allotment farmers still operated from the villages of Hollum and Ballum. The remarkable broad sandy ridges between the plots were also created during this period. They came into being because the plots in between had to be dug out to get closer to the groundwater.

In the years following 1943 around 200 wells appeared on the beach to the west of Hollum. They originated from the neighborhood of Sier, which was buried under the sand in the 15th century. The site is now submerged in the Borndiep channel again. Over the last three centuries the island has grown in an easterly direction at an average rate of a kilometer per century.

The Ameland polders were not provided with dykes until the 19th century. Even now there is still a part, the Nieuwlandsreid between the Kooiduinen and the Oerd, which is only separated from the sea by a summer dyke. Unusually this area, like all the wastelands before, is still in common ownership.

Terschelling, at 30 km, is the longest of the Dutch Wadden Sea islands. Due to its strategic position Terschelling was involved in many wars. In 1374, 1396 and 1499 villages were raised to the ground by invaders. From 1569 to 1576 the island was used as a base by the 'Watergeuzen' (Sea Beggars). In 1666, during the Second Anglo-Dutch War, the English set fire to a large number of merchant ships and the village of West-Terschelling. West-Terschelling, like the village of Vlieland, is a traditional settlement of fishermen, pilots and seafarers. The other villages have a more agricultural character. From east to west, in the lee of the dunes, lie the villages of Oosterend, Hoorn, Lies, Formerum, Landerum and Midsland. The villages are built on what was once an offshore bar and some, such as Formerum and Midsland, have a structure reminiscent of the 'Geest' villages in Noord-Holland, with roads which run along the foot of the barrier beach. In addition there are several terp-like settlements in the salt marsh area, such as Kaart, Kinnum and Seeryp.

West-Terschelling and Midsland are densely built, the other villages have a more open structure. West-Terschelling is particularly interesting in terms of cultural heritage due to the many old houses (17th century) and of course the Brandaris (1594), the oldest remaining lighthouse in the Netherlands. The Brandaris was built on the orders of the States of Holland, when the old beacon was lost to the sea. Terschelling was then still part of Holland, and the States considered the island to be of such strategic importance (partly due to the war with Spain), that it ordered the enormous lighthouse to be built. The churchyard is also very unusual, lying at the foot of the Brandaris, where numerous images and inscriptions on gravestones refer to the maritime past of the dead. There is something touching about the graves of the unknown, which are literally left to one side.

Various land re-allotment schemes improved the agricultural structure of the island. The cranberry is an unusual agricultural crop here. It was accidentally washed ashore in the 19th century, and grew abundantly in the humid dune valleys with little maintenance. The large dune and salt marsh area in the east of the island, the Boschplaat, is a nature reserve of European stature.

Vlieland was recorded as early as 1317. For centuries there were two villages, but West-Vlieland disappeared at the beginning of the 18th century. Oost-Vlieland flourished in the 17th century since many ships would lie off Vlieland to wait for a good wind. There are a few 17th century buildings in the village, including the Tromphuis, previously owned by the Admiralty, and now a museum.

The Kroons Polders created at the start of the 20th century, on the western side of the island near the large Vliehors sand bar, are now a nature reserve. The bay itself is a military training ground. The island is prey to erosion practically along the whole length of its North Sea coast, and has to be protected by jetties.

The most important uninhabited islands and sand banks are Rottumeroog, Rottumerplaat, Simonszand, Engelsmanplaat, de Richel, het Balgzand and de Noorderhaaks. In the middle of the Wadden Sea, halfway between Harlingen and West-Terschelling lies the former island of Griend. This island was named in 1215. After the flood of 1287 less than 10 houses remained. In the course of the centuries the population continually reduced: in 1720 there was only a single house standing. Since 1916 it has been a bird sanctuary. What is now left of the island consists of a sand bank with a few low dunes and a small salt marsh. It is moving to the south east. Recently measures have been taken to combat the complete collapse of the island. In working the land people have found shards of pottery from the pre-Roman iron age which indicate that the area, situated in front of the present coastline, was habitable even then.

Rottumeroog was first named in 1354. Ownership was then disputed between two Groningen monasteries. The island was not inhabited until 1483. In 1570 the Watergeuzen had a base here. In 1628 a new schoolmaster was appointed who also had the job of wreck master. However, the island was deserted; from 1738 to 1965 only a wreck master lived there. The island is still decreasing in size and will eventually disappear into the Ems. Contrary to the wishes of those who feel involved in the history of the island, the government has abandoned efforts to preserve it.

Rottumerplaat formed to the west of Rottumeroog. Here some dunes were formed, aided by a sand dyke, and a salt marsh began to form behind the dunes. Active maintenance was continued. The island is largely famous because of the fact that the writers Godfried Bomans and Jan Wolkers each spent a week there alone in the seventies. The peace, wildlife and bird life left a completely different impression on each of them.

4.5.4 The Wadden Sea

The processes that occur in the Wadden Sea are to a large extent determined by the tidal currents. These have made it a very dynamic area - seen in the human time-scale. Erosion and sedimentation are always occurring in different places, depending on the position and size of the sea inlets and tidal channels, and depending on the amount of sediment. Where there is vegetation to secure the washed-up sediment a salt marsh can attain a reasonable height in a fairly short time. In tidal channels and bays the old peat layers have been lost through erosion. Elsewhere the peat is covered with sand or clay layers.

The Dutch Wadden Sea Region beyond the dykes is bordered on the east by the river Ems. One of its major channels, the Bay (Bocht) of Watum, scours the edge of the dwelling mound area of Fivelingo and is responsible for the erosion there. The North Sea and the Marsdiep border the area on the west side. The intermediate area is indented with a series of sea inlets, which divide the islands and sandbanks from each other.

The last two thousand years have witnessed great dynamism in the northern coastal area. Channels moved about, islands drifted gradually to the east, and various sea bays developed to the south. In fact what we are dealing with here is estuaries, because (with the exception of the Marne bay in Fryslân) in all cases we are concerned with a broadening of the existing lower reaches of rivers. Thus the Dollard basin, Fivel bay and Hunze bay, the Lauwerszee, the Middelzee and, largest of all, the Zuiderzee developed. Remarkably, these bays did not all come into existence at once, nor can their development be linked to periods of transgression (periods in which sea level rises relatively quickly). What we find is that the formation of the one bay sometimes coincided with the start of a hydrosere in another. The formation of the Dollard happened at the same time as the Fivel bay silted up and was gradually poldered. The development and silting-up of large marine bays has more to do with changes in the pattern of the currents in the main channels than with rises in sea level.

In the course of the centuries man has exerted great influence over the dynamics of the Wadden Sea. By building dykes around residential areas on the mainland and gradually reclaiming land in former marine bays, the natural processes were increasingly kept at bay. In fact it may be said that the mainland was separated from the Wadden (mud flat) system by dyking. The construction of a connecting dam between the Anna Paulowna polder and the island of Wieringen in 1927 and the construction of the Afsluitdijk between Wieringen and the Frisian village of Zurich in 1932 signified a huge breach in the development of the Dutch Wadden Sea Region. The Zuiderzee became a fresh water lake and was renamed the IJsselmeer. The salt marsh areas of Noord-Holland and southern Westergo in Fryslân lost their direct contact with the sea. Since then the Lauwerszee has also been dammed (1969) and of the large marine bays, only the Dollard remains.

The landscape of the Wadden Sea is subject to great changes. At high tide the area looks to the observer like an extensive expanse of water, a real sea, at low tide we see the sparkling surface of the bare clay shoals and sandbanks, cut through by large and small channels and gullies. The salt marsh with its vegetation is only flooded at very high water levels. The great open expanse is bounded by the islands and the coast of the mainland. The large numbers of birds are essential to the Wadden Sea experience: waders, gulls, ducks and geese find food and rest here. In quiet areas it is not unusual to see seals.

In terms of cultural heritage, the Wadden Sea is very important because of the shipwrecks, particularly around the larger channels which give access to the harbors inland. There are also submerged villages, which may be interesting for future research.

Shipwrecks

On Christmas Eve 1593 a severe storm blew up. No less than 44 merchant ships lying off Texel were lost. In the course of the centuries many hundreds of ships have sunk in the treacherous Wadden Sea Region. The continual shifting of the channels and shoals and the lack of buoying are partly to blame.

Practically all the major ports in our country were situated on the Zuiderzee. The IJssel towns also had to pass through the Zuiderzee before sailing overseas. There were two ways to reach the deep water of the North Sea: via the Vlie (the inlet between Vlieland and Terschelling) and via the Marsdiep (between Den Helder and Texel). The number of wrecks is especially high along these deep channels. The Wadden Sea is therefore very important in terms of marine archaeology. Many of the wrecks are in places where they are covered with a layer of sediment, so that they are reasonably well preserved. Only when a channel moves and a shipwreck is washed free can erosion start up again and parts of the ship and cargo become scattered. The Wadden Sea is thus very important to research into the development of shipping and trade.

Recent developments

Fishing was increasingly important in the Wadden Sea from the 17th century onwards. Even today, shrimp, cockle and mussel catches are important. Due to the serious damage to the seabed, the shipwrecks and to the vulnerable flora and fauna caused by cockle fishing in particular, this type of fishing is meeting with ever greater resistance.

Tourism benefits from of the special qualities of the Wadden Sea Region. The landscape of channels, shoals and mud flats can be admired from the sea, for example from one of the old sailing boats (the 'brown fleet') which are adapted to transport tourists. 'Wadlopen' is another special activity, whereby a guide will take you for a wander around the flats, or even escort you by foot to an island. The area attracts more than 100,000 'wadlopers' (mud flat walkers) per year.

4.5.5 The embanked marshland region

The most striking characteristics of the marshland region are the elements which remind us of man's interaction with the water. In one way the water was a friend to man, for example by providing fish and the means for shipping. On the other hand, the water, and certainly the salt water, was a foe to hearth and home, agricultural land and drinking water supplies. In terms of its development, the marshland area formed a single entity with the Wadden Sea, but the construction of dykes removed it from the dynamics of ebb and flow. In fact it is a fossilized salt-marsh landscape, which is no longer directly affected by the sea.

Both periods (before and after the dykes were built) can be clearly traced in the layout of the landscape. On the one hand the development of the area as part of the Wadden Sea can still be clearly recognized by the numeros winding ditches that are remnants of former mudflat

channels. The position of dwelling mounds is an indication of the geomorphology of the area: often mounds are arranged in long rows on the old salt marsh ridges. On the other hand, the many landscape elements which relate to drainage are reminiscent of the huge efforts which had to be made to get rid of surplus rainwater after the ring dykes in the mound area were closed.

Dwelling mounds (Terps)[9]

Population density has steadily increased since the Early Iron Age. The fertile clay soils were very attractive to the farmers from the nearby sandy soils. Originally the area was only inhabited in summer. Later people began to settle permanently.

The first settlements date from around 2600 years ago. The farmers settled on the highest parts of the salt marsh; the dwelling mounds grew higher and higher as a result of the accumulation of manure, settlement waste and active efforts. The various individual dwelling mounds rapidly merged to form common village mounds. Thanks to their height the mounds offered good protection from the high water, but sometimes it was necessary to protect the farm and the surrounding fields from the sea water with a dyke. The farms were built in such a way that the living quarters were oriented towards the center of the mound while the farm buildings were further down the mound. This ensured good communication between the stalls and the surrounding pastures. Often a road was laid out at the foot of the village mounds connecting the farms together (the ox track).

As sea levels rose, the mounds had to be continually raised. This happened in a number of stages: when flooding increased the mounds were raised, in periods of relative peace no active raising of the mounds was required. However, some settlements were abandoned and gradually silted over.

If a mound was to be raised or extended this was usually achieved using manure and grass sods which were stuck onto the salt marsh. These materials ensured excellent preservation conditions for organic deposits, utensils and relics of habitation in the mounds. The environmental is particularly suitable for preserving organic remains, and is thus very different from the conditions of archaeological sites on sandy soils. The artificial dwelling mounds in the former salt marsh area are thus archaeological treasure-houses which still harbor numerous secrets about the lives and conditions of the former inhabitants.

Farmers and traders

Despite the predominance of the salt water, from the outset the farmers attempted not only livestock but even arable farming on the salt marshes. Archaeologists have found seeds including barley, flax and beans. Of course the arable fields were on the highest parts, the high parts of the salt marsh ridges and the flanks of the mounds, since most agricultural crops cannot survive in salt water conditions.

The salt environment restricted them in other ways too. Trees and bushes could not grow on the salt marshes, so that all the wood for building houses and farms had to be brought in from elsewhere. Thus there was always intensive exchange of goods with the surrounding areas. Despite the drawbacks, life in the Wadden Sea Region was so successful that the entire area was colonized and became inhabited in the course of the Iron Age (600 - 0 BC) and the Roman Age (0 - 400 AD).

The mound area flourished in Roman times. Population growth necessitated more intensive use of the land. One method was to divide what had previously been common lands. Individual land use generally produces better yields than common use. Ditches were dug to demark individual possessions. This improved water management, which also increased yields. On the mounds ditches were dug in radii from the center to the lower levels (creating radial plots). On the salt marshes use was made of existing channels and gullies. These winding watercourses formed the core of a land-use scheme (involving the division of land into irregular blocks), which may have originated in the Pre-Roman Iron Age, and which is very characteristic of the older parts of the salt marsh area.

After the Roman era, the marshland area shared in the general economic decline. These were the turbulent times of the great migrations. Large groups of Angles and Saxons, Jutes and Frisians left what is now Germany via the mound area to Britain. Many inhabitants of the Dutch part of the Wadden Sea Region also ventured to make the crossing. Some parts of the area were depopulated.

The situation changed in Merovingian and Carolingian times. The western part of the Wadden Sea Region came to lie at the crossroads of important European trade routes: the east-west route between Great Britain, Denmark, and the

Baltic area on the one hand and the north-south route on the other, running from the Mediterranean via the Rhône/Saône, Meuse and Rhine to the Almere (precursor of the Zuiderzee) and the western Wadden Sea. This favorable position was exploited to the full by the inhabitants and their trading partners. Merchants plied up and down the trade routes always seeking goods to buy and sell. The word Fries was at that time a synonym for trader. The activities of craftsmen and tradesmen during this period led to the development of a different form of mound: whereas farming mounds were generally round, the mounds on which many tradesmen and craftsmen lived and worked were often elongated (trade mounds such as Holwerd and Appingedam). The difference between these mound forms can still be seen in the rural areas.

The population grew in numbers and wealth: parts of the Wadden Sea Region were among the most densely-populated places in North-western Europe. Through its great wealth the region became one of the main cultural centers of Europe. However, the wealth of this period did not leave behind impressive cultural monuments. Archaeological finds dated to this time do however paint a picture of far-reaching trading contacts and the high level of craft and trading activity. The numeros Romanesque churches and monasteries from a few centuries later also show that there was great prosperity in the Wadden Sea Region.

The dykes

The history of dyke building in the mound district goes back a very long way. Historical geographer Meindert Schroor distinguishes no less than 6 stages in the laying of dykes[10]. Parts of a dyke have recently been excavated in the Frisian village of Peins which date from the pre-Roman Iron Age. Such very old dykes are also known elsewhere in Fryslân. Presumably these first dykes protected only one or a few farms and associated fields. Extensive ring dykes were built in the 10th century which enclose different village areas. These are the oldest polders in the world: these 'core' or 'mother' polders are known from the Frisian district of Westergo. The first ring dykes, which enclosed all of Oostergo and Westergo, date from around 1100. The ring dykes of Middag and Humsterland were built at the same time. The later stages in the history of the dykes relate to building dykes to protect (part of) the bays and land reclamation works along the coast.

The construction of the dykes meant a great improvement for the farmers. Larger areas could be used for cultivation, and dairy production received a boost since the pastures in the freshwater environment within the dykes produced more grass than when the sea water had free access. The farm buildings were no longer restricted to the mounds, although people remained loyal to the mound villages for a long time to come. After all you could never be entirely certain of the dykes: numeros eddies and pools bear witness to as many dyke breaches. These breach eddies show that man was not always successful in checking the force of the water in good time. Sometimes man was forced by such events to give up part of the enclosed land. In other places the build-up of sediment was such that there were always new polders to enclose. Former estuaries (such as the Middelzee and the Dollard) were thus re-conquered in stages and once again taken into use by the farmers. Old dyke patterns in many places tell the story of the give and take of the Wadden Sea through the centuries. Land reclamation works here and there along the sea dyke are the last stage in the history of land reclamation.

Reclamation was an exceptional activity. Various methods were used (see inset) to trap as much silt as possible. Next the silt was spread out over the salt marsh. If after some years the salt marsh was raised high enough a new sea dyke could be constructed.

Hydraulic works began to be carried out in connection with the construction of the dykes, such as sluices and dyke locks (zijlen). In some parts of the marshland areas monasteries made a significant contribution to the construction of dykes and the associated hydraulic works. The Aduard monastery owned more than 10,000 hectares of land in the 14th century, and built dykes and sluices in the Reitdiep basin in Groningen.

While agriculture benefited greatly from the dykes, trade in advance did not. The construction of continuous dykes meant that many villages lost their open connection over water with the Wadden Sea and so also with the trade centers further afield. Economic life underwent radical change, and the major shipping and trading activities gradually became concentrated in the existing small towns on the coast or in new dam and lock villages. Complex, small-scale economic activity became more concentrated, and for successful development the new economic centers in the Wadden Sea Region clearly could not

compete adequately with the other similar centers in the surrounding area. The consequences of the disappearing links by water were of course most heavily felt in the mound villages themselves, and particularly those which were devoted to trade and industry. This was partly compensated in the course of time by the development of an ever finer network of canals and waterways. Continuous canals were constructed for long-distance traffic. The Delf was dug in Groningen as early as 1200, forming the connection with the Reitdiep, the Fivel and the Damsterdiep. Thanks to this direct link, the town of Appingedam flourished in the 13th century. Further direct links were created later, like the 17th century boat canals. Approaches were dug to connect individual villages: dead-end waterways which connected a village to a through canal. Later these approaches were used to supply mound earth to the impoverished sandy soils. A great number of terps were wholly or partially leveled in the period from 1850 to 1940 (see inset).

The churches

In the Early Middle Ages missionaries like Boniface and his followers sought to bring Christianity to the inhabitants of the Wadden Sea Region. Many village churches were built. The first churches would have been simple wooden halls but these were gradually enlarged and replaced by buildings which were erected with tuff stone and brick. Tuff stone had to be transported a long way (from the Eifel) and was used until the beginning of the 12th century. After that brick became the main building material, using local clay as the raw material.

Church-building gradually extended further, since every village of any size wanted its own parish church. It is striking that these churches stand at the center of the mound villages. As the dwelling mounds grew, the farms moved further and further towards the edge, leaving room for churches to be built in the center. It is likely that this central space had previously housed the pond (dobbe), which served as a fresh water reservoir for the village.

The old stone churches were built in the Romanesque (or Norman) style. This is further confirmation of the trading links with southern Europe where this architectural style had been in use for far longer. The different orders of monks (particularly the Cistercians and Premonstratensians), who settled in the region from the second half of the 11th century made an important contribution to the dissemination of (late) Romanesque architecture. As a result of this large-scale building activity the Wadden Sea Region has a remarkably high concentration of Romanesque buildings.

Floods and loss of land

Man played an important role in wresting new land from the sea, but also contributed to the loss of land, in three different ways: by neglecting the dykes, by extracting salt, or by opening up the peatlands.

Dykes were neglected mainly in times of economic hardship and in wartime. The great loss of land due to the Dollard breach is often attributed to poor dyke maintenance during the struggles between the Schieringers and the Vetkopers (grey monks and cattle-fattening monks). Whether this really was the reason for the incursion of the Dollard is not sure: the often mentioned date of the incursion, 1287, cannot be proved by historical sources and more probably the incursion of the Dollard occurred in the fifteenth century.

Salt extraction was an important economic activity in the coastal region. The form it took was unusual. Whereas elsewhere on the European coast salt was obtained by evaporating sea water in salt pans, in the Wadden Sea Region it was obtained from peat. In places where the sea water came into contact with peat, the peat absorbed some of the salt and it was profitable to use this salt peat for salt production. The peat was thus cut away, dried, bathed several times with sea water and dried until it was saturated with salt. Next the peat was burned and the salt was taken from the ashes. In the Wadden Sea Region this was the only available source of salt. Since a large population had to be supplied with salt, its extraction had serious consequences for the landscape. The cutting of the salt peat layers was practically an invitation to the sea to penetrate further inland. Numeros disastrous floods were caused by salt extraction. In some places traces can be found of this activity in the form of organic deposits or in the form of plots with a great deal of micro-relief. In the north-east of the province of Fryslân alone some 3000 hectares of peat were dug for salt production[11], including the low-lying area of De Kolken, between Anjum and Ee.

In addition to salt extraction, agricultural use also lowered the level of the peat areas. The lowering of the groundwater level, which was necessary for agriculture, caused setting of the soil.

Furthermore, the increased aeration of the soil led to oxidation of the semi-rotted plant remains, from which peat was formed (see inset). The two processes reinforced each other and led to a lowering of the surface sometimes of as much as a few meters. Clearly this made such areas vulnerable to the sea.

Polders and 'droogmakerijen'.

The Netherlands has 445 'droogmakerijen', with a total area of over 310,000 ha[12]. A droogmakerij is not the same as a polder. A droogmakerij is all or part of a lake or sea which has been drained by pumping. A polder is a piece of land on which the water management is controlled independently of the surroundings. Each droogmakerij is a polder, but not every polder is a droogmakerij. Polders can also come into being through dyking a piece of marshand, which is reclaimed by a dyke or embankment, such as the Wieringerwaard, the Bildt polders and the Dollard polders.

In the Netherlands we distinguish four important periods in which lakes or seas were drained. The first period is the experimental stage, from 1533 to 1565. During this period a number of small lakes in the neighbourhood of Alkmaar were drained. The second period is at the beginning of the 17th century, in which the large lakes in Noord-Holland such as the Beemster (1608-1612), the Purmer (1618-1622) and the Schermer (1633-1635) were created with the help of polder mills.

The third period is in the 19th century, in which among others the Haarlemmermeer (1840-1852) and the IJpolders near Amsterdam were drained by steam engines.

The fourth period is in the 20th century, in which the vast reclamations took place within the framework of the Zuiderzee Project. The Wieringermeerpolder was the first large polder to be drained (1927-1930), before the Afsluitdijk was completed (1932).

There are no large droogmakerijen in the terp district, though a number of small lakes or meres were drained. Examples include the Greate Wergeastermar (195 ha, drained in 1637), the Huningameer (520 ha, 1666), the Hemsermeerpolder (93 ha, 1784/85), the Wieuwertermeer (8 ha,1834), and the Proostmeer (51 ha, 1870).

The landscape today

The marshland region consists mainly of large open spaces. Large-scale agriculture is practiced on more recent reclaimed polders which have risen high by accretion, as in North Groningen, Oldambt and Het Bildt. The rest of the area is given over to grassland. In these large green spaces the villages rise like green, enclosed islands. Sometimes the mound villages are close together, for example on the salt marsh ridges, but some are very isolated. In the winding ditches and elongated depressions we can recognize the former channels in the mud flats, from which the fertile clay was formerly removed. The dykes can be seen from a great distance and are valuable landmarks, both for orientation in the current landscape, and for orientation in time (the high actual sea dykes and the lower, occasionally broken, inner dykes). In spring and summer the vast grasslands are the domain of the meadow birds. In the winter large numbers of geese, ducks and swans descend on the green plains.

4.5.5.1 Groningen

The Pleistocene hinterland is generally fairly flat, with the exception of a low outcrop of boulder clay near Winschoten and the Hondsrug, between the rivers Hunze and Drentse Aa, which runs right into the salt marsh area, without a transitional peat zone. The town of Groningen grew up on the furthermost point of the Hondsrug, along the Drentse Aa.

In the old marshlands we can distinguish different sub-regions. From east to west: Oldambt, Fivelingo, the Reitdiep area (Middag, Humsterland and Marne) and the Lauwerszee area.

The oldest permanent settlements began in the districts of Fivelingo, Middag and Humsterland where large mounds developed. Excavations have brought Middelstum-Boerdamsterweg and Ezinge to light. Archaeological finds during the excavation of the mound earth show that Ezinge was one of a group of eleven mounds which developed in parallel and are all on the left bank of the Hunze.

In the late Iron Age and Roman times habitation expanded strongly and many new mounds developed, particularly along the right bank of the Hunze, along the edge of the Fivel bay and along the Ems. The mounds between Termunten and Pogum in the German Rheiderland were lost through the penetration of the Dollard.

Many newly established flat settlements and low mounds had to be rapidly abandoned. Examples have been found in Paddepoel, a district in the north of the town of Groningen. A new generation of mounds appeared on the salt marsh ridges which had formed through accretion in the Early Middle Ages to the north of the lower reaches of the Hunze, in the Marne region. An example of these has also been excavated: the Tuinster Wierde near Leens. Finally in the later Middle Ages a few further house mounds were built in the Fivel region which was then silting up.

Many mounds were wholly or partially leveled when they were dug up for their rich soil. The mound earth was transported by boat along the natural watercourses, the former gullies (sometimes called 'maren'), or along specially

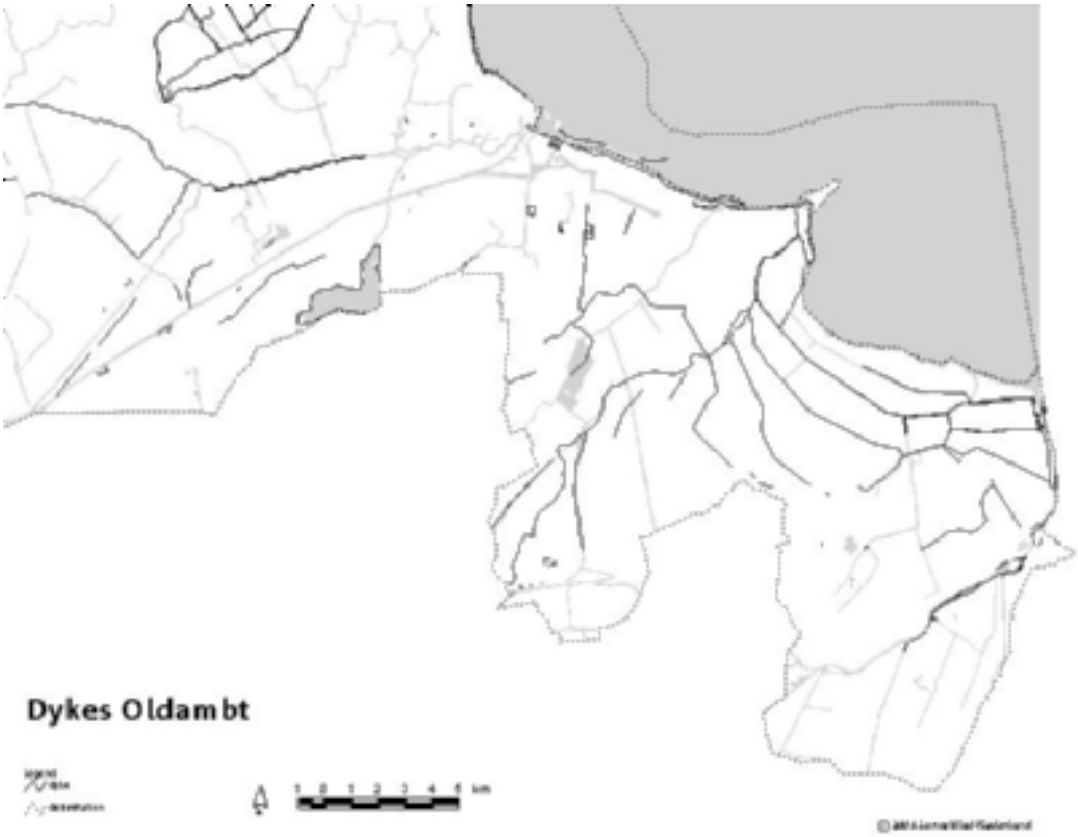

Fig. 4.85:
Dykes in the Dollard basin, Oldambt

excavated canals or widened ditches. The entire region is criss-crossed with waterways, which are important for drainage and have increasingly been used for boat tours.

Oldambt

The Oldambt is the region to the south of the Dollard. It consists of a few low ridges of boulder clay and wind-borne sand, separated by valley-shaped depressions. The ridges grow gradually smaller to the north until they disappear under the clay deposits of the Dollard. Prehistoric relics have been found in places on the surface of these ridges: a Bronze Age urnfield in Zuidbroek and the megalith of Heveskesklooster from the Neolithic Age, buried under 4 meters of clay.

The depressions between the boulder clay and wind-borne sand ridges, as well as the area north of it, were previously covered with peat. This peat region was inhabited in the Middle Ages, as elsewhere in the Wadden Sea Region. The surface was lowered considerably by agricultural use and salt extraction. This decline, combined with poor dyke maintenance, gave the sea a free hand and many large parts of the region were lost.

In the course of the Late Middle Ages there were various storm surges. As said before it's not sure which flood formed the Dollard bay, but most probable is a flood in the fifteenth century. The Dollard was at its largest at the beginning of the 16th century. When it flooded, the seawater penetrated deep into the land via the depressions of the Munter Ee/Oude Geut and the Westerwoldse Aa. These two depressions were separated from each other by the low boulder clay ridge on which Heiligerlee and Winschoten are located. At the time of the maximum expansion of the Dollard this area lay like a peninsula in the water. It is thus sometimes referred to as the 'island of Winschoten'. Here lie the elongated villages of Eexta, Scheemda, Midwolda and Beerta. Some of these villages were previously located more seaward on the peatland. Under the influence of the advancing sea some of these villages were moved landward, while other villages completely disappeared.

From the 16th century on man began to win back the lost territory. The oldest dyke in the western depression is the Scheemderhamrik, which dates from 1542. In 1597 the Scheemderzwaag polder was enclosed by dykes. The area was then reclaimed in seven more

stages, the most recent reclamation being the Carel Coenraadpolder of 1924. More and more silted up salt marshes were dyked in and added to the existing mainland, with the former sea dykes changing into inner dykes. Unfortunately, many of these old dormant dykes have disappeared.

Brickworks

In many places in the Wadden Sea terp and wierde area, clay was extracted for brick-making. The technique of baking bricks was introduced by the monasteries. The clay pan soil, which was deposited by the sea in the lower-lying parts of the marshlands, was an ideal raw material. The clay was dug out, worked into the right shape, dried and finally baked in field kilns. Initially only small quantities were produced. As yet few buildings were made of brick: in the late Middle Ages only monasteries, churches, and manor houses ('stinsen' = brick houses) were built of brick. However, gradually more and more town houses were built of brick (much encouraged by fire regulations) and large-scale brick-making began. Permanent brickworks were founded in which specialist brick-makers from Germany played a prominent role. In addition to the brickworks, businesses also sprung up which made roof tiles and - in the 20th century - drainpipes. A big reorganisation of the brick-making industry in the second half of the 20th century led to the closure of a large number of firms. Many traces can still be found of this activity, which was highly characteristic of the terp and wierde area. Many of the associated buildings - drying sheds, kilns and chimneys - have been converted to other uses.

Fivelingo

The name 'Fivelingo' refers to the area to the north-east of the city of Groningen, from the Punt van Reide in the east to the area surrounding Westernieland, near the former mouth of the river Hunze. The Fivel and the Hunze were rivers which drained the broad peatlands and the Pleistocene hinterland. The river Munte (now renamed Termunter Zijldiep), which flows into the Dollard near Termunterzijl, also belongs to this sub-region. Unlike the Munte however, the Fivel has largely disappeared from the landscape. In the Early Middle Ages the mouth of the Fivel was cut away by the sea and changed into an extensive estuary, the Fivel bay. At the time when it was at its largest, the water must have reached past Ten Post. The oldest dwelling mounds in the area lie in long rows on either side of this estuary, on the high salt marsh ridges. On the western side the series of mounds extends from Lellens to Usquert, on the eastern side from Ten Post via Loppersum and Leermens to Spijk and Hoogwatum. The Fivel bay began to silt up at the end of the Early Middle Ages, particularly on the western side. A new series of villages dating from that time (from Stedum in the south to Oldorp in the north) shows that people started making use of the fertile marshland soil. From the 12th century onwards the rest of the bay was dyked in, bit by bit, until in 1444 there was a dyke from Godlinze to the coastal ridge of Uithuizermeeden and Roodeschool, so that the Fivel bay was no longer subject to the influence of the sea. Winding watercourses, which are locally referred to as 'maar' and 'tjariet', removed surplus water from the land. Further land reclamation took place in stages from 1718 (Oostpolder and Polder Vierburen) to 1944 (Emmapolder). The design of these fairly recent polders to the north of Roodeschool and Uithuizen is characterized by a striking pattern of roads fanning out to the north, to which the layout of the plots is adapted.

To the south of the actual Fivel bay there is a somewhat lower-lying zone with scattered dwelling mounds. To the north-west of Delfzijl there were fine villages of such mounds, such as Marsum and Biessum: radial land-divisions on the mound, an ox track at the foot, farms built neatly in a circle along the ox track, radial land-divisions which in part extended beyond the mound. Marsum is still very beautiful, Biessum has lost much of its attraction now that it is surrounded by the new urban developments of Delfzijl.

The towns of Appingedam and Delfzijl are also located in this low-lying zone. Apart from Groningen, Appingedam is the only settlement in the province which obtained a town charter (1327). A trade settlement developed on a terp near the first dam in the Delf which flourished in the 13th century. However, the sluice was soon removed to the east and economic activity moved with it to the new discharge point, Delfzijl. In the 16th century Appingedam was economically eclipsed by Delfzijl. Appingedam is characterised by the densely-built houses on the Damsterdiep, with the backs of the houses projecting over the deep. Delfzijl was strategically

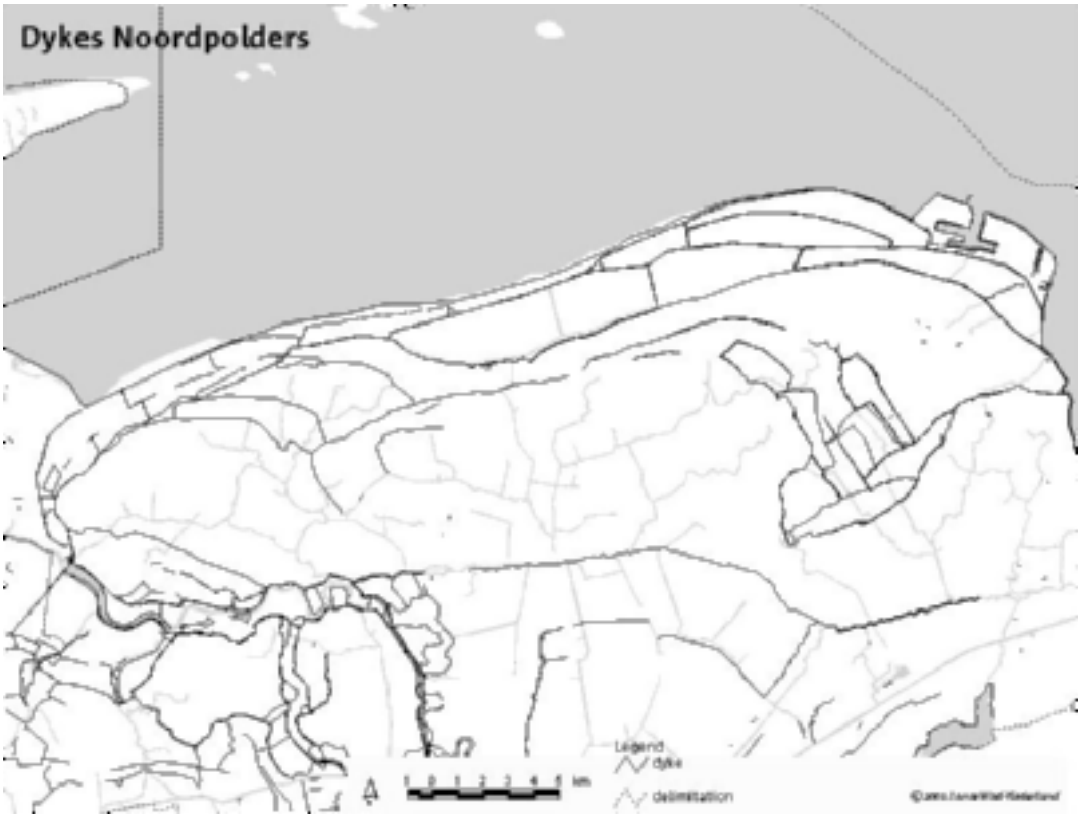

Fig. 4.86:
Dykes in the north of Groningen

important for military purposes because of its position at the mouth of the Ems. Charles V built a redoubt here as early as 1536, and this became an important stronghold in the Eighty Years' War.

Boat and ship canals

As the towns grew and industry expanded there was a need for rapid and regular transport. This led to the introduction of regular barge services sailing from set places at set times to agreed destinations. In the second half of the 17th century there was a seemingly modern network of through waterways not only in the Western Netherlands, but also in the provinces of Groningen and Fryslân. Some of these waterways , such as the Stroobossertrekvaart (1652), had been newly dug, others were based on existing watercourses, such as the Damsterdiep, which was converted into a boat canal in 1650, and the Bolsward boat canal (1648).

The profile of the boat canals in Holland, Fryslân and Groningen is practically the same throughout. The breadth at water level was fifteen to eighteen meters and the depth around two and a half meters. The dredging from the works were used to erect a narrow quay on one side. Another quay was made on the other side, but this was far wider, providing space for a towpath of around 7 meters in width. A drainage ditch was dug behind the towpath.

Trekschuiten (tow barges) were long narrow boats with a covered part with room for 30 to 35 passengers. These barges had a three-man crew. The skipper and his hand worked on the boat itself. The jager (hunter) rode the horse along the towpath. The jager was usually a young lad, but had to be over eight years old.

Although by our standards the barges traveled extremely slowly, it was a fantastic improvement for the 17th century. Before then people had to travel by coach, which was not particularly pleasant on the unpaved roads of the day. Rather the barge anytime! The smooth movement over the water even made it possible to write letters, as Nicolaas Beets remarked in his Camera Obscura.

Reitdiep area

The Reitdiep area, sometimes referred to as Hunsingo or the northern Westerkwartier, consists of a number of large, old marshlands surrounded by the former marine bays. The oldest of these bays is the estuary of the river Hunze, which into the Early Middle Ages flowed to the north-west and discharged into the sea around Nijenklooster.

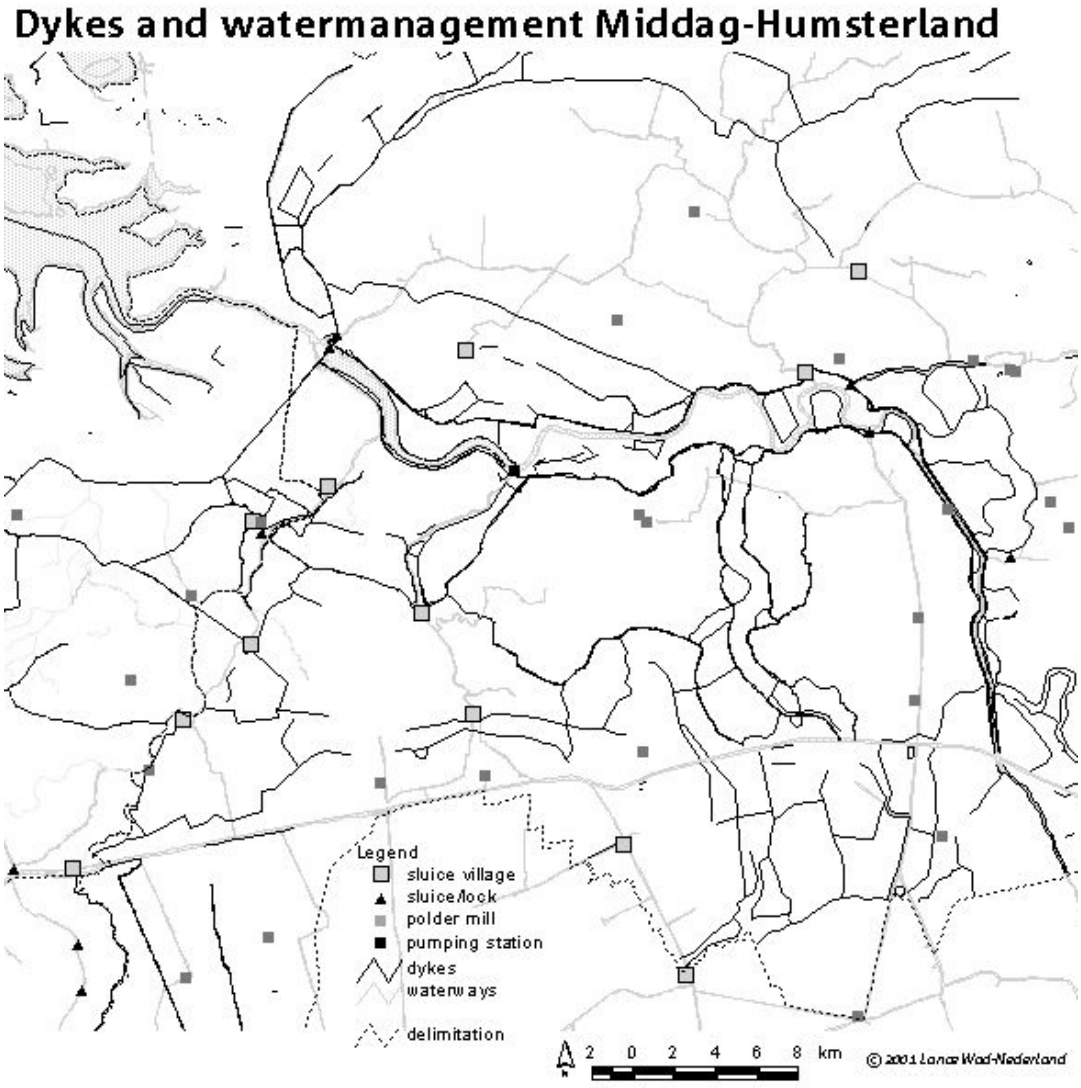

Fig. 4.87:
Water management in the Middag-Humsterland area

Between 700 and 1000 AD the estuary of the Lauwers was formed more westerly, which penetrated the land through a number of channels. One of these channels adjoined the lower reaches of the Hunze, causing the Hunze to branch off to the west and discharge into the Lauwerszee. The former mouth of the Hunze silted up and was finally completely closed off by the salt marsh ridge of Pieterburen and Westernieland. The rivers Drentse A, Eelderdiep, Peizerdiep en Wolddiep (Oude Diep) which still flowed from the Drenthe plateau, now became left branches of the Reitdiep - as the Hunze below Groningen was called from that time.

In this sub-region of the Groningen marshland area dyke building also began with the construction of ring dykes around groups of villages. Such dykes were laid around the nuclei of Middag and Humsterland in the 11th or 12th century. The Marne area, to the north of the Reitdiep, is also supposed to have had such a ring dyke. The oldest continuous sea defense dyke along the North Groningen coast was built around 1200.

In 1877 a dam was constructed in the Reitdiep. Until then the ebb and flow had been able to reach the town of Groningen. The drainage of the hinterland was controlled by polder boards (zijlvesten). Along the course of the Reitdiep they built a series of dyke locks (zijlen): along the left bank the Kommerzijl and the Aduarderzijlen, into which the Aduard Deep - dug by the Aduarder monks in the 14th century - discharged, and along the right bank the Wetsingerzijl, the Schaphalsterzijlen, the Schouwerzijl and the Houwerzijl. The preserved locks are a monument to the constant efforts which had to be made in the past to keep the water under control. Often the fine lock houses ('zijlhuizen') where the 'zijlwaarder' or lock keeper lived, are preserved too.

Nowadays the old nuclei, Middag, Humsterland and the southern part of Marne, are part of a small-scale landscape with small villages, pastures and irregular plots. Numerous depressions indicate the course of the old channels. To the north the land division becomes increasingly regular. There is a clear difference between the old marshland nuclei and the later salt marsh ridge of Pieterburen and Westernieland, which is expressed mainly in the way the land is divided into plots. The polders reclaimed from the sea in the last centuries are even more regular and encircle the older land. Particularly where the polders form connecting layers and the dykes are preserved, a very typical landscape has come into being which is in stark contrast to the dwelling mound landscape behind it.

Lauwerszee area

On the map the former, as yet undammed Lauwerszee looks a little like the body of a squid, with the tentacles formed by the rivers that flow into it. The Rietdiep discharges into the Lauwerszee near Zoutkamp, the river Lauwers near Munnikezijl, the Dokkumer Ee at the Dokkumer Nieuwe Zijlen and the Zuider Ee at Ezumazijl. After the damming of the Reitdiep in 1877 sluices were also built near Zoutkamp. The water of the Lauwers now entered the Lauwerszee via the Friese Sluis, the Provinciale Sluis served the Reitdiep and the Hunsingosluis formed the link with the Hunsingo Canal. When we also consider that there is a further sluice complex within the enclosing dam of the Lauwerszee, it becomes clear that the Lauwerszee area is characterized by an abundance of hydraulic engineering works. The old marine bay, which came into being in the Early Middle Ages, was closed off from the Wadden Sea by a dam in 1969. Since then the water level in the newly created Lauwersmeer has been kept at 1 meter below NAP (Amsterdam Ordnance Datum). As a result former salt marshes and sandbars were drained. Part of the area has been given over to agriculture, part is in use as military training area while the rest is forest and nature area. A new port has been created near the sluices, which took over the role of the former fishing harbor of Zoutkamp. Next to the new port the youngest village in the Netherlands, Lauwersoog, has developed.

Land reclamation

The deposition of silt on the salt marshes against the sea dyke was promoted by specific measures, so the salt marsh reached the required height more rapidly, and could be made into a polder. Two methods were used. The farmers' method was used from the beginning of the 19th century. In this method, pits were dug in the salt marsh to catch the silt. When the pits were full the silt was distributed over the marsh and the process could be repeated, just until the salt marsh was high enough. In the 1930s another method was adopted: the 'Schleswig-Holstein method'. Here the salt marsh was divided into settlement fields of roughly 400 by 400 meters, which were surrounded by earth embankments or brushwood screens. Ditches were dug in the fields perpendicular to the coast into which the silt could settle. Once or twice a year the silt was shoveled out of the ditches and spread over the salt marsh.

4.5.5.2 Fryslân

The marshland area in the province of Fryslân, between the Lauwerszee and the IJsselmeer, is divided in two by the former Middelzee. This former bay is in fact the estuary of the Boorne, a river which runs from the edge of the Drenthe plateau. It forms a boundary between two subregions Oostergo and Westergo. Important areas within these old marshland areas are the depression of the Dokkumer Ee in Oostergo and the Marne, a former marine bay in Westergo.

The marshland area gradually gives way to the flat hinterlands covered with vast peatlands, in which also a number of low-lying parallel ridges of boulder clay and wind-borne sand can be discerned. The ridges are oriented northeast-southwest, as in Groningen and Ostfriesland. One of these ridges, directly to the south of the upper reaches of the Boorne, continues a long way to the southwest and ends in a considerable outcrop, rising to more than ten meters above NAP. This outcrop is Gaasterland, which lies like an island in the peat land. In geological terms Gaasterland is comparable to the Pleistocene boulder clay islands of Wieringen and Texel, but it has never been entirely surrounded by sea, although a cliff coast was formed on the south side following the incursion of the Zuiderzee.

As in the Groningen marshland area, the oldest settlements in the Frisian area date back to the early Iron Age. This applies both to the central areas of Westergo and to the northern part of Oostergo. In this last area a few very high mounds were created. Hogebeintum, at almost 9 meters, is the highest mound in the entire Wadden Sea Region. The Frisian region also saw a broad expansion of habitation in the late Iron Age and Roman times as well as colonization of the newly reclaimed salt marsh ridges in the northern part of Westergo in the Early Middle Ages.

Differences in the physical condition and in the history of habitation made that there are strong contrasts within Fryslân in the appearance of the mound landscape. The relatively far-flung high mounds on the curved salt marsh ridge in northern Oostergo contrast sharply with the far more dense network of scattered, largely low mounds in central Westergo and the strings of low mounds on the salt marsh ridges of northern Westergo.

Some mounds are built in an elongated shape, which can also be seen in a few German trading mounds. Holwerd is one such. In this context Oldeboorn is also interesting: it lies on the Boorne, and may well have played an important role in the colonization of the peatlands upstream.

In the Frisian mound district too, dyke building began with ring dykes to protect houses, livestock and arable land. The 'mother polders' in Westergo are probably the oldest polders in the world, if we disregard the small embanked areas from the pre-Roman era. The oldest continuous sea dykes date from around 1100. The southern part of the Middelzee, in-between Oostergo and Westergo, was already poldered in the Late Middle Ages. The most recent polders, collectively forming Het Bildt, date from post-1500. They are laid out in very regular patterns.

While the entire North Groningen coast, except along the Ems, is surrounded by layers of several recent polders, this is far less common in Fryslân. Here the mound district stretches in various places as far as the current sea dyke, as in Oostergo near Paesens and Wierum and in Westergo in the whole area between Harlingen and Makkum. Where recent polders exist, the polders directly adjoin the villages and are no more than one and a half kilometers deep. The oldest dyke trace often formed a direct link between the mounds or was not far outside them.

While the town of Groningen, located on the Hondsrug, became an important political and economic center for the Groningen mound district, in the Frisian mound district this role was fulfilled by towns which grew up in the mound district itself. The most important are Dokkum and Leeuwarden in Oostergo, and Franeker and Bolsward in Westergo. Next to these towns grew up along waterways in the adjoining peat lands such as Sneek and IJlst, or on the Zuiderzee coast, such as Harlingen, Workum, Hindeloopen and Stavoren.

Oostergo

The marshland area of Oostergo is a 10 - 15 km wide zone, which lies in a great arc around the boulder clay and wind-borne sand landscape of the Frisian forests. On a fairly high salt-marsh ridge along the current sea dyke and the former Middelzee lies a spectacular series of mound villages from Leeuwarden to Ternaard. These are villages of a reasonable size, set about 2 to 3 km apart. Their relatively high position means that the salt marsh ridge is mainly used for arable farming. To the east of Ternaard the salt marsh ridge is less striking, but even here there are villages on the ridge, which veers off to the south in a gentle curve.

The land divisions on the ridge are fairly regular and are not dissimilar to those of the more recent reclamations, which lie like a narrow shell abutting the old land. To the southeast the land is lower-lying. The villages here are smaller and the mounds rise strikingly out of the landscape. The pattern of land division formerly showed irregular blocks, but reallocation schemes in recent decades have spared only small parts of the original layout. This area is used largely as grassland. In the depressions we find traces of natural watercourses: the Dokkumer Ee, Dokkumer Grootdiep, Zuider Ee and Paesens. From the Dokkumer Ee, which previously formed an important link between Leeuwarden and Dokkum, various access ways lead to the different mound villages in the north and to the villages on the edge of the sandy area.

Two of the settlements in Oostergo grew into towns: Dokkum and Leeuwarden. Dokkum is known primarily for the fact that St. Boniface was murdered there. The veneration of this saint has over the centuries brought many pilgrims to the site of his martyrdom. The town flourished on trade from its favorable position at the mouth of the Dokkumer Ee. The typical hexagonal shape of the town center emerged in 1582, when ram-

parts were erected in great haste. Fryslân had aligned itself in 1580 with the insurgent provinces, while Groningen remained Spanish until 1594. Shortly after that, in 1583, a sluice was built which still occupies a striking place in the center of the town. Later new locks were built 10 kilometers to the east of Dokkum: Dokkumernieuwezijlen (Dokkum new locks). The gates were broken off the defences, but the ramparts are largely in tact. The eastern bulwark was transformed into a public garden in the 19th century.

Leeuwarden grew up where the river Ee, that formerly discharged into the Middelzee. The layout of the town is still determined by the course of the Ee and by the three mounds from which the town grew. As early as the 11th century, Leeuwarden was an important center of trade, manifest in the fact that it obtained mintage rights. The town gradually expanded and developed into the capital town of the province. This is seen most clearly in the many secular buildings, such as the Stadhouderlijke Hof (Stateholder's Court), the chancellery, the weigh house and the town hall. And of course the Provinciehuis or county hall. In 1580, during the Reformation, the residence of the abbot of the Bergum monastery was confiscated and was converted in the State Room, where the provincial government since that day meets.

Roodbaard

A man who put his own special stamp on the wierde and mound district was the landscape architect Lucas Pieters Roodbaard. Roodbaard designed dozens of parks and gardens in the north of the Netherlands. He was born in 1782 in Rolde, Drenthe. His father worked as a gardener in Assen and the young Roodbaard followed in his footsteps. He developed a very original style of landscape architecture, in which the forms of the English landscape style were combined with the features of the original landscape. The gardens of Roodbaard and his followers in Groningen were known as 'slingertuinen' (garland gardens). In 1819 Roodbaard and another landscape architect were commissioned to draw up designs for the prince's garden in Leeuwarden. This beautiful garden had been given to the town a few years before by William I on the condition that the garden would be maintained. Around 1824 Roodbaard went to live in Leeuwarden and was involved in plans to landscape the ageing ramparts. In the green belt which thus arose around the town, provisions were also made for building works which were then sorely needed. In 1830 Roodbaard drew up the design for the Municipal Cemetery on Spanjaardslaan. His plan was implemented in the next few years with a few adjustments. The cemetery was given the aura of a park through a romantic, pseudo-natural layout. The commendations received at the time indicate that Roodbaard's design was a great success. Shortly afterwards Roodbaard also designed a promenading park on the former graveyard in the Oldehoofsterkerkhof (Oldehoofst churchyard).
Around the same period, Roodbaard also worked on private gardens in and beyond Leeuwarden. Roodbaard had a good reputation, not only in Fryslân, but also elsewhere. The Frisian nobility in particular had the gardens for their country seats designed by Roodbaard. He thus gave shape to Beetsterzwaag, Oranjewoud, Wolvega, Oentsjerk and Hoogbeintum, among others. Outside Fryslân a further three gardens were made to his designs in Appingedam, Paterswolde and near Assen. Roodbaard died in 1851 at the age of 69. His name however lives on in his unique designs.

Middelzee

The Middelzee was the estuary of the river Boorne, which probably already existed around 500 BC, but gradually spread out further and further inland. It formed the boundary between the districts we now know as Oostergo and Westergo. Around the year 1000 a western branch in the neighborhood of Bolsward linked up with another estuary that came from the west, the Marne. Westergo was then entirely enclosed by water, or at least by salt marshes which were flooded at high tide.

The ring dykes of Oostergo and Westergo came into being in the 11th century, and at the same time the Middelzee began to silt up. Bit by bit the old tidal inlet was embanked and the reclaimed land converted into farmland. To the east of Bolsward, where the former Middelzee widened, the new village of Nijland (Newland) grew up in the new polder. Further to the north the Middelzee was narrower and the reclaimed land was used by the villagers on the adjoining 'old land'. In the embanked Middelzee a ditch

was dug to form a boundary between Oostergo and Westergo: the Zwette. In later times the Zwette was widened to become a boat canal between Sneek and Leeuwarden.

At the end of the 13th century the inlet had been impoldered as far as the Bildtdijk/Skrédyk (between Beetgum and Britsum) and taken into agricultural use. The marshland area to the north of the dyke continued to silt up and in 1505 the Oude Bildtdijk was erected, reclaiming a good 5000 hectares of agricultural land from the sea. Three villages were founded (Sint Annaparochie, Sint Jacobiparochie and Vrouwenparochie). The new inhabitants came for the greater part from outside the region, which explains the difference between the Bildt dialect and the elsewhere spoken Frisian language. The land was divided in a fairly rational way, though still far less strictly than the old Mastenbroek polder near Zwolle and the later reclamations in Noord-Holland. Farms were built along the roads, which formed a rectangular pattern. Along the sea dyke habitation arose in Oude Bildtzijl and Nij Altoenae.

The next step was the building of the Nieuwe Bildtdijk (also called the third sea dyke) in 1600. It is noteworthy that the farms in this newly reclaimed area are mainly in the center of the polder, with access roads linked to the through road on the Oude Bildtdijk. The construction of the Poldijk (1715) and the Noorderleegdijk (1754) were the last stages in the reclamation of the Middelzee.

The creation of polders and the continuing silting up of the salt marshes meant that adjustments had to be made to the drainage systems. Het Bildt originally drained into the sea via a sluice in the Oude Rijd near Oude Bildtzijl. In 1600 a sluice was built in the Nieuwe Bildtdijk (at Nieuwe Bildtzijl), but even in 1655 there were already drainage problems due to the high-

Fig.4.88:
Water management in Middelzee and Westergo

ly silted up salt marshes. After that the water was for centuries carried off via the old land of Westergo and Oostergo, until a pumping station was built at the Zwarte Haan in 1970 to discharge the superfluous rainfall.

A peculiar feature of both the Oude and Nieuwe Bildtdijk is that the - often monumental - farms are on the south side, at the foot of the dyke, while the workers' housing was built on top of the dyke, on the north side of the road.

Mennonites

The many Baptist Chapels are significant elements in our cultural heritage. The churches of the followers of Menno Simons (Baptists or Mennonites) can be found in many places in the Wadden Sea Region. According to their article of faith, Baptists could not fulfill any role in government, and refused to take oaths or carry weapons. This meant that there were numerous jobs they could not do, and forced them largely into the liberal professions. There was however plenty of scope for people in the liberal professions in the Wadden Sea Region in the 17th and 18th centuries. The Baptists became craftsmen, artists, traders, textile merchants, brewers and eventually even bankers. We find Mennonite chapels on almost all of the islands, such as the handsome examples in Hippolytushoef (Wieringen), Den Burg and Oosterend (Texel). But Fryslân is of course the real home of the denomination.

Menno Simons was born in 1496, the son of a farmer in the Frisian village of Witmarsum[13]. He lived in very turbulent times. Fryslân was ravaged by political unrest and acts of war. Menno came fairly late to the calling of priest. He was already 28 years old when he was ordained as a priest in Utrecht Cathedral. Menno Simons took the post of curate in the village of Pingjum. In 1532 he moved from Pingjum to Witmarsum where he was parish priest.

Menno Simons began to doubt Roman Catholic doctrine concerning the Communion. Through contacts with Baptists he began to immerse himself in the sacrament of baptism. He could find no basis in the bible for the baptism of children. On 31 January 1536 he left the presbytery and joined the Baptists.

Under pressure from his persecutors, Menno had to lead a wandering life. He lived for a time in Cologne and in Wismar on the Baltic, but he was continually forced to flee. He also returned to Fryslân from time to time. Finally, in 1554 Menno found refuge in Wüstenfelde, near Oldesloo, halfway between Hamburg and Lübeck on the Fresenburg estate of Graaf Von Ahlefeldt. Nearby was the Mennokate, a small house where he had his printing press.

He died in 1561. In the garden behind the Mennokate is a stone bearing a plaque which reads:

Hier lebte, lehrte und starb Menno Simons, in demuth fromm und still. (Here lived, taught and died Menno Simons, in humility devout and quiet)

In the early days of the Baptist faith in the Netherlands many adherents were persecuted and put to death for their faith. They met in secret in remote places in the middle of meadows and sometimes on boats. Naturally there are no churches remaining from the earliest days of the Baptists. They did not dare to build them. Even when the worst of the persecutions stopped, Baptists were still not allowed to build churches which could be recognized from outside. They had to look like ordinary dwelling houses, preferably away from the street, and they must not have towers or steeples. The Baptists in the Netherlands did not receive civil rights until the advent of the French in 1795. One of the most typical churches-in-hiding is Menno's Formanje (Chapel) at Pingjum. There is nothing to distinguish this church from a dwelling house on the street. It dates from around 1600.

Westergo

Westergo is the most extensive part of the marshland region of the Netherlands. It is not surprising that it also has the most mounds. The structure of the landscape in Westergo is largely determined by the former bays, channels and depressions. The Middelzee used to form the eastern boundary of Westergo. It connected with the Marne in the neighborhood of Bolsward. The Marne was a channel which already existed in Roman times. Then the channel formed part of the drainage system of the Flevomeer. Although

Fig. 4.89:
Dwelling mounds in Westergo

the Vlie took over this role in the Early Middle Ages, the Marne was still an important channel.

To the north of these two estuaries lies the core area of Westergo. Here too are the oldest mounds. Some are situated on the salt marsh ridges of the Marne, the Middelzee or the smaller branch channels which penetrated the area at intervals. Others dwelling mounds, such as the mound of Jorwerd, the village made famous by the writer Geert Mak, lie in the middle of the flat land of the salt mark basins. The landscape is characterized by wide open spaces, with an occasional village or farm. The land is used chiefly as grassland, the land divisions are fanciful and the plots often still show small variations in height (micro-relief). This area has not been as strongly affected by re-allotment projects as for instance Oostergo.

Through roads existed only on the salt marsh ridges; for a long time traffic by water was far more important. The area is criss-crossed by numerous waterways, many with whimsical courses because they followed the course of existing channels and depressions. In the 17th century a number of sailing channels were converted into boat or ship canals: the Franeker boat canal and the Bolswarder boat canal in 1648 are examples. The Sneeker boat canal (1652) was created in the former Middelzee, by widening the Zwette.

While the southern part of Westergo is characterized by a fairly random distribution of mounds, the distribution in the northern part is more ordered. Here the mounds are set out in handsome rows, which coincide with the presence of salt marsh ridges that grew up at various stages of the development of the salt marsh. The oldest series of mounds is found between Winsum and Menaldum, on a ridge along a very old channel which was active around 1000 BC, even before the Middelzee was formed. The settlements on the ridges of Tzum-Hitzum, to the south of Franeker, date from the fourth and third centuries BC. The line of settlements Harlingen-Franeker-Peins-Menaldum dates from the last century BC. The mounds on the ridge Wijnaldum-Dongjum-Ried-Berlikum were created two hundred years later. This is the ridge on which the most northerly villages of Westergo are situated: Sexbierum-Tzummarum-Minnertsga. The mounds date from the 6th-7th centuries AD.

The most northerly lying ridges are the highest, as they silted up longest. The majority of arable farming takes place on the northernmost salt marsh ridge, while the lower-lying basins between the salt marsh ridges are mainly used as grassland.

One of the most striking historical features in Westergo is the dyke system. The assortment, age and function of the dykes is very varied.

There are still parts left of the old ring dykes around the 'mother polders', of the dykes along the Middelzee and the Marne, of the famous 'Pingjumer Gulden Halsband' and the Vijf Delen Slachte dijk, and last but not least, occasionally submerged dykes dating from the pre-Roman era are discovered.

The town of Franeker, still lying within its 17th century bulwarks, is renowned for its Fryske Akademy, the university founded in 1585. In 1811 the academy was closed down by Napoleon, but in the 17th century this educational institution was more important than those of Utrecht and Groningen. The academy was accommodated in the former Kruisbroeders monastery.

Harlingen flourished thanks to its port and shipyards. Originally the port consisted only of the current Noorderhaven (North Harbor), but the Zuiderhaven (South Harbor) was dug in 1597. This was necessary since Harlingen had become a wartime naval port. In 1644 the admiralty also moved from Dokkum to Harlingen.In the 19th century the Wilhelmshaven (1852) and the Nieuwe Willemshaven (1877) were built. Of the two old ports, the Noorderhaven is the more impressive, with fine warehouses, sluices and other historical buildings.

Bolsward was an important market and trading center even in the Carolingian era. The town grew up on two mounds: a large, elongated mound to the south of the current main street and a smaller mound where the splendid Sint Maartenskerk now stands. According to an inscription on the town hall it was built in 1616, and it also notes that this was 901 years after the founding of the town. The Sint Maartenskerk was the mother church of Westergo. It was one of the oldest churches established in Fryslân. The current church building dates from the middle of the 15th century, but it had wooden and tuff stone predecessors.

The mound district to the west of Sneek, which does not actually belong to Westergo, is characterized by a large number of small mound villages and hamlets. In the east this area merges into the moorland region of the Frisian lakes, in the south lie the Pleistocene boulder clay hills of Gaasterland.

Not only the villages are small, but so are the old towns of Staveren, Hindeloopen and Workum.

The landscape in this area is very open and spacious and given over entirely to grassland. In this part of Westergo also some small 'droogmakerijen' can be found.

Outside the dykes are several former salt marshes, the development of which was arrested by the closure of the Zuiderzee. Parts of these are furnished with embankments and are now used for agriculture (Makkumer Zuidwaard, Polder Geele Strand), others are unembanked (Kooiwaard, Makkumer Noordwaard).

4.5.5.3 Noord-Holland

It is difficult to draw the boundary of the Wadden Sea Region in Noord-Holland, as the area of marine clays, deposited by the North Sea, continues quite far south. The southern boundary of the Wadden Sea Region has been chosen where the Zijpe- en Hazepolder meets the old dyke around Westfriesland (Westfriese omringdijk). Consequently the mound district of Schagen and Barsingerhorn is excluded, while the Groet polder falls within the described area. The Zuiderzeepolder Wieringermeer has also been excluded.

After the Roman period the entire northernmost part of Noord-Holland was covered by peat bog[14]. Only the hills of Texel and Wieringen rose above it. The bog was sheltered by the coastal barrier, which lay a few kilometers to the west of the current coastline. The peat bog drained in an easterly direction via the Marsdiep, which was then still a small tributary of the Vlie.

The occupation of the peatlands took place from the areas which were inhabited during the Merovingian period: the present islands of Texel and Wieringen and probably the old dunes south of the Rekere, which have now disappeared into the sea. The first habitation of the moorland, still in Merovingian times, is found along the Marsdiep, the Rekere and along a moorland river in the vicinity of the present town of Medemblik, called the Middenleek. In the Carolingian period there were four large centers of habitation: Texel, Wieringen, northern Westfriesland (between Andijk and Medemblik) and the Geestmerambacht (between Schagen and Warmenhuizen), and a smaller one in the vicinity of Den Helder. The now lost old dune landscape may also have been inhabited, as at that time the coastline between Bergen and Texel was still closed.

Only later was the offshore bar between Bergen and Texel broken at several places by the Zijpe, the Heersdiep and a tidal inlet to the south of Texel, which would later link up with the Marsdiep. Between the newly created inlets north of Schoorl, largely to the west of the pre-

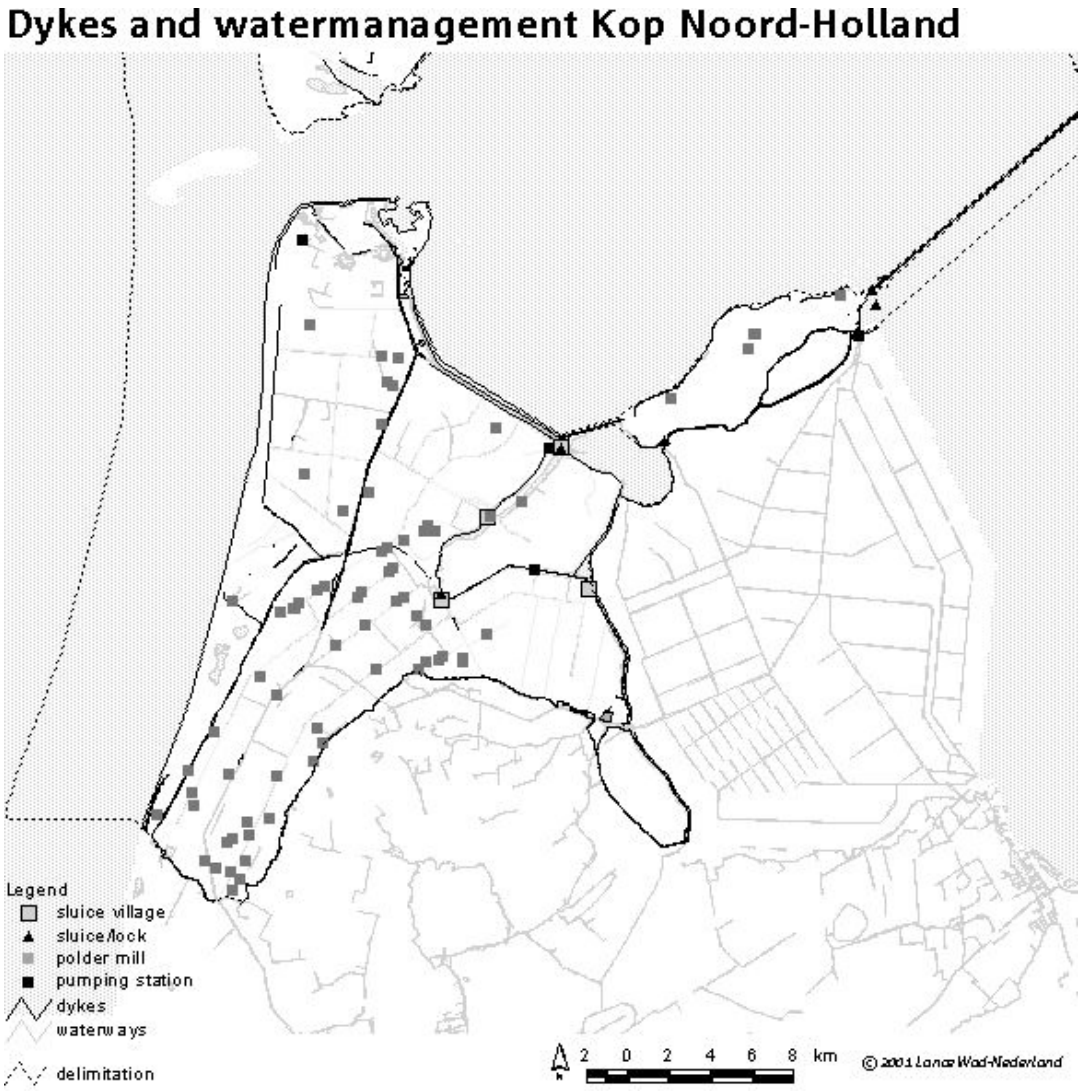

Fig. 4.90:
Water management in the north of Noord-Holland

sent coastline, then lay the islands of Callandsoog and Huisduinen. Behind these islands an area of mud flats extended, on which much sand was deposited through the inlets. These sand deposits now lie at the surface of the Koegras polder and elsewhere. In the 16th century the Zijpe and the Heersdiep inlets filled up with sand. Only the Marsdiep continued to exist as an inlet and became wider and deeper. This was increasingly important for shipping and thus had strategic importance, manifest in the 16th century redoubts constructed on either side of the deep, on Texel and in Den Helder.

Traces of habitation from the Neolithic Age have been found in the Groetpolder, the Zijpepolder and the Hazepolder. These valuable archaeological sites consist of settlements from the Beaker Culture and the Single-grave Culture. The sites of the finds are exceptionally important because of the adaptations of the then inhabitants to the marine environment. The circumstances of the finds are so unusual that the Groetpolder is being considered by the Dutch Government for an inscription in the World Heritage List.

Several attempts were made to reclaim the area of mud flats behind the sea inlet of the Zijpe. In 1597 they finally succeeded, and around 6,500 hectares of sandy soil in the Zijpe and Haze polders could be brought into agricultural use. The way the polder is organized is magnificent. The elongated space is divided lengthwise by three axes, along which farms have been built. The eastern axis is formed by the Groote Sloot (Large Ditch) and is also the most historic, not least because of the many fine 'cloche' farmhouses. The Noord-Holland Canal, created in 1819-1825, fits perfectly into the pattern and runs midway between the central (Ruige Weg) and western (Belkmerweg) axes. The polder is

rationally divided with fairly large, rectangular plots. Some east-west roads, at right angles to the three main axes, forge the link between the dunes and the 'old land' of West Fryslân. Along these roads, on the intersections with the Groote Sloot and the Noord-Holland Canal, lie the villages. The naming of the villages is fairly consistent: the villages on the Groote Sloot end in 'brug' (bridge), those on the canal end in 'vlotbrug' (floating or pontoon bridge). Near Sint Maarten, in West-Fryslân, moving westwards, we come in succession to: Sint Maarten, Sint Maartensbrug and Sint Maartensvlotbrug. The most recent addition is the holiday village of Sint Maartenszee.

North of the Zijpepolder lies the Koegras Polder or Buitenveld (4000 ha), reclaimed in 1817, just before the construction of the Noord-Holland Canal, which forms the boundary between this polder and the Anna Paulownapolder of 1847. This last polder consists of an east and west polder, divided by the Oude Veer, an old marshland channel. Both polders have a rational layout, the most striking feature being the large rectangular plots in the Koegras polder. The Waard and Groetpolders dating from 1844 echo this pattern; by contrast the 17th century Wieringerwaard is plotted into smaller-scale, strips of land. This region of Noord-Holland nowadays is famed for its colourfull bulb-fields.

The town of Den Helder lies at the northernmost point of the mainland of Noord-Holland. This has been a naval port since 1781. Originally its arsenal consisted only of batteries, which commanded the coast. In the French era, the land side was also defended. In the period 1811-1813 extensive defensive works were constructed: Fort Lasalle (later renamed Fort Erfprins), and further south Fort Morland (Kijkduin) and Fort l'Ecluse (Dirks Admiraal). Once the Noord-Holland Canal was finished the forts of Westoever and Oostoever were built. In later times new defenses were added, such as bunkers.

Den Helder nowadays has incorporated the old fishing village of Huisduinen.

Windmills

Mills are such a natural part of the Dutch landscape that we can scarcely imagine a time when they were not there. Yet the first references to mills, at least wind-powered mills, only date back to the 13th century. Generally the topic is the wind right granted by the ruler to the miller. These first references all related to grain mills. The hollow post mill was invented around 1300. A smock mill is a mill in which the entire housing could rotate around a pivot, so that the mill could always be adjusted to catch the wind.

The first polder (draining) mills or wind-and-water mills are mentioned in 1408, in the district of Alkmaar. Another stage of development was the smock mill. In this mill only the upper part, to which the sails are attached, is set to the wind. In the first half of the 15th century smock mills were already being used to drain polders, but Leeghwater made significant improvements to the design to make them more suitable for the drainage of polders. From the 17th century onwards polder mills were built everywhere in the marshland area inside the dykes. Often these were small but prominent mills which we call 'spinnekoppen' (spider mills).

Later further small refinements were made to the drainage system by the tjasker, a small mill for small polders, and the sturdy American windmill, also called the windmotor, which was introduced into the Wadden Sea Region at the start of the 20th century.

4.5.6 The peatlands

To feed the fast-growing population of the Wadden Sea Region in the Carolingian era, people started to open up the peat bogs situated between the marshlands and the higher sandy ground. In order to bring these saturated bogs into use the land first had to be drained. For that purpose parallel ditches were dug close together, from an existing watercourse to deep in the peat bog (creating long, narrow plots). Much water was removed from the peatlands through the ditches, the groundwater level dropped and the soil dried out so that in the course of time it could even be used for arable farming.

There were two distinct forms of land use. On the one hand cultivated blocks, which are very

regular and rectilinear. These contrast strongly with the irregular nature of the adjoining dwelling mound area. Authorities clearly had a considerable say in these works. On the other hand there are small-scale, irregular patches where the peat bog was brought into use. Clearly in these cases it was individuals or small groups of colonists who took the initiative to exploit the peat bog, and who used a natural watercourse to drain, open up and exploit a part of the peat bog. Here there is none of the regularity of rectilinear patterns of the larger planned peat bog developments. The plots are narrow and elongated.

The development and drainage of the peat bogs caused the surface to sink until such time as the peat area was so low-lying, that the polder water began to pose a real problem. The area became so wet that the farmers had to leave. During heavy storm tides the sea could again penetrate and damage the area.

4.5.7 The quality of the cultural landscape in the Dutch Wadden Sea Region.

What then is the quality of the cultural landscape in the Dutch Wadden Sea Region? And which areas are the most important ones, seen from a cultural-historic and landscape point of view? Is Vlieland of greater value than Schiermonnikoog; has Westergo a higher quality than Oldambt? To these questions, many answers can be given. And with each answer given, dispute will arise and new questions will be posed. Because the answer to what is of importance, depends on what is seen as being important, e.g. what criterion is being valued as the most important. Some will say that 'age' is an important criterion ('the older, the better'), while others will stress the rarity of elements ('the only one in the region'). Or should we give priority to the most characteristic elements ('farms of the stolp type 'belong to' Noord-Holland') or rather the rate of conservation ('well conserved versus decayed'). Another criterion can be the spatial context of elements in the physical landscape ('dwelling mounds aligned on a salt marsh ridge') or the functional cohesion of different objects ('harbor-lighthouse-commodore's houses'). Furthermore, one may emphasize the presence of all elements that once were representative for a stage in the regions cultural history ('polder mills and wind turbines both represent a stage in the development of the landscape') or the amount that is still left. Others will stress the importance of the authenticity of the landscape, which immediately will start a discussion about the question what is meant by authenticity. And finally, a criterion to evaluate can be the perception of the cultural landscape.

A lot of criteria to describe the quality of the landscape can be given, but a solid and unquestioned method to evaluate the landscape has - till so far - never been produced.

When preparing the Belvedere Memorandum - a policy plan by the Dutch government, which deals with cultural heritage and spatial planning - an attempt has been made to map the quality of the cultural landscape in the Netherlands. Being aware of the difficulties involved, it was decided to present different evaluation maps: one representing the archaeology, another representing the historical-geographical features and a third representing monumental towns, villages and estates. These maps are presented here, as far as they concern the Wadden Sea Region. A fourth map is added, depicting the 'openness' of the landscape; not a quality map in the strict sense, but anyhow a map that represents an important aspect of the landscape in the region.

It's not well possible just to 'add up' these maps in order to decide which regions have the highest quality. Doing so would not be a solid and scientifically accepted evaluation. Nevertheless, the question of the quality of the cultural landscape might yet be answered by the Trilateral Wadden Sea Plan, where it states that: „the cultural-historic and landscape heritage and the diversity between the regions are essential for the comprehension of the area's development and identity and the inhabitants' identification with the landscape". Because that's what it is all about, when we discuss the quality of the landscape: a distinctive character and identity. And also: everywhere just a little bit different. This is exactly what makes the Wadden Sea Region, up to its' remotest districts, to a unique cultural landscape of exceptional quality.

Notes:

1 Taken from an essay by G.J. Borger and H.T. Waterbolk, 1999. De Waddenzeeregio -een uniek cultuurlandschap (The Wadden Sea Region - a unique cultural landscape).

2 In 1932 the Minister of Public Works announced that the part of the Zuiderzee to the north of the Afsluitdijk would henceforth be known as the Wadden Sea (J.T. Bremer: van Zuiderzee tot Waddenzee, 1996).

3 A dwelling mounds is called terp in Fryslân, wierde in Groningen and werf in Noord-Holland.

4 Kooi, P.B., 1988. Leven langs de Fivel, van Helwerd tot Zwart Lap. (Life along the Fivel, from Helwerd to Zwart Lap) In: M. Bierma et al., 1988. Terpen en wierden in het Fries-Groningse kustgebied (Terps and wierdes on the Frisian-Groningen coast).

5 Frank Westerman,1999. De graanrepubliek.(The grain republic) Amsterdam/Antwerpen.

6 Jan Besteman, 1997. Vikingen in Noord-Holland? (Vikings in Noord-Holland?) Noord-Holland Province Archeological publication, no. 1.

7 This text draws with gratitude on research into decoy and cage operation in the Wadden Sea Region by J.J.H.G.D. Karelse, carried out at the request of Lancewad Nederland.

8 Written statement, J.T. Bremer, 2001.

9 Although the Frisian word 'terp' is now commonly used as a name for a dwelling mounds in the marshland area, the term 'wierde', which is used in Groningen, is historically more correct. It is derived from the old Frisian word 'wir', which means height. As well as in the word 'wierde' we also find this root in names used elsewhere in the coastal area: werf, warf, wurt. 'Terp' is the Frisian word for 'village'.

10 Schroor, Meindert, 2000. Van Middelzee tot Bildt. Landaanwinning in Fryslân in de Middeleeuwen en de vroegmoderne tijd. (From Middelzee to Bildt. Land reclamation in Fryslân in the Middle Ages and the early modern era)

11 Griede, J.W., 1978. Het ontstaan van Fryslâns noordoosthoek. Dissertatie. (The development of Fryslân's northeastern corner. Disseration).

12 Schulz, E., 1992. Waterbeheersing in de Nederlandse droogmakerijen. Dissertatie, (Water Management in Dutch Reclaimed Land. Disseration) Delft.

13 Adapted freely from: Het Spoor van Menno Simons. Een wandeling langs doopsgezinde gedenktekens in Witmarsum en Pingjum. (On the trail of Menno Simons. A walk around the Baptist monumnets in Witmarsum and Pingjum). http//home.planet.nl/~wunsnet/menno.htm

14 Schoorl, Henk, 1999. De Convexe Kustboog. Deel 1: Het westelijk Waddengebied en het eiland Texel tot circa 1550. (The Convex Bow of the Coast. Part 1: The western Wadden Sea Region and the island of Texel to ca 1550)

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