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TIDAL GULLIES IN YOUNGEST PEAT LAYER OF GRONINGEN

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1. FIVELGO AND HUNSINGO BORINGS

During the last stages of the war 5588 borings were made in the province of Groningen, the results of which are given here. More borings have been made, as our aim was to know the exact situation of the coastal tidal gullies in the peat layer and often borings at about 5 m distance were necessary to see where the crooked gullies went. Not all those, however, could be noted down.

The results of similar investigations for Zeeland (VLAM, 1942), Westland (VLAM, 1945) and IJsselmonde (VAN VEEN, 1945) have been published. For some other districts (Voorne, Hoekse Waard, Friesland) the investigations have not yet been published.

The work in Groningen was begun by M. VAN DER SCHEE. Later, E. STAMHUIS, a bachelor of the Technical Highschool, checked the work of the former, found some new small gullies which had been overlooked and extended the work in general. He also made the borings in the cross section of the old canal which I had called „Delf” (VAN VEEN, 1930).

Where the top layer of clayey substance was thin and the underlying peat layer thick, the shrinkage of the latter had been such that the clay-filled gullies appeared as ridges of about $\frac{1}{2}$ to 1 m high in the field. Farmers sometimes call these ridges „natural dykes”. In some places they have dug up parts of these ancient depots of good clay and distributed the fertile substance on their fenlands. This was the case south of the Damsterdiep. In Walcheren practically all villages, main roads and farms have been built upon these ridges. In Groningen north of the Damsterdiep, where the clay layer is thicker, the ridges are not so well developed, and the villages and farmsteads have little relation to the old peat-time gullies.

In the Fenlands of Cambridgeshire the same „inversion” of the peat soil took place. The ridges are called „roddons” there.

The gullies in Groningen (FIG. 1) have been silted up long before 400 B.C., the date when the first „wierden” (terpen) are said to have been built up. The base of these artificial mounds is about 2 m above the top of the peat layer. The lapse of time

needed to deposit this silt layer of about 2 m thickness is unknown.

Inversion seems to have been of no importance at this time, as the sites of the mounds were chosen practically regardless of the silted-up gullies. Apparently the mounds were built in an undyked silt-region which we call „kwelder“-landscape (marsh). Several mounds have been constructed on shore ridges, built up by waves in this landscape.

An island covered with shrubs or reeds may have existed during the first stage of mound building south of Baflo. The clayey peat substance is found there on a higher level than the peat in Fivelgo (North of Appingedam) and seems to correspond with the „roodoorn“ type of soil in Fivelgo. Roodoorn means „red veins“. The veins indicate former reed roots and the like. The name Baflo, which means „baften, or behind the wood“ (VAN VEEN, 1951), may indicate that this wilderness already existed when the first settlers came here some centuries before the beginning of our era. The horseshoe row of mounds West, North and East of this „island“ is very striking. Towards the South lay a low area of sticky clay, which was uninhabitable or nearly so until about 800, when it was reclaimed. The conclusion must be that, when the „wold“, or wilderness, could exist in the last centuries B.C. of Baflo at a place which is now about 1 m below the H.W.-level, this sea-level must have changed considerably in relation to the land surface, because no shrub or reed can grow at a lower level than about 1 m above H.W.

It would be worth while to know what vegetation covered the area of clayey peat south of Baflo, and at what height. Reed can endure brackish water of 2/3 fresh and 1/3 sea water.

The wide Fivel-estuary between the wierde-row Westerwijtwerd - Uskwerd on the western shore and the Fivelgo group in the east is quite distinct as no peat occurs here. Zeerijp (Sea-Shore) lay at the eastern shore some time after the top layers of the wierden were put on, e.g. 800, because this village has no wierde. Westeremden was situated at the mouth of the Fivel like (Easter) Emden at the mouth of the Ems (Emden = Ee-mouth = river mouth).

The shore of the Ems, called Bocht van Watum, shows many signs of erosion. The gullies in the peat are widening towards the North and West, but not towards the East. From this it may be inferred that in the peat-time the Ems estuary was rather far East of Delfzijl. A few small and winding channels in the peat layer connect the Fivel- and Ems-estuaries, but they are not important. The erosion of the Bocht van Watum may have taken place essentially after the formation of the Dollard (14th century),

**PEAT AREAS IN GRONINGEN
DRILLINGS ± 4M DEEP**

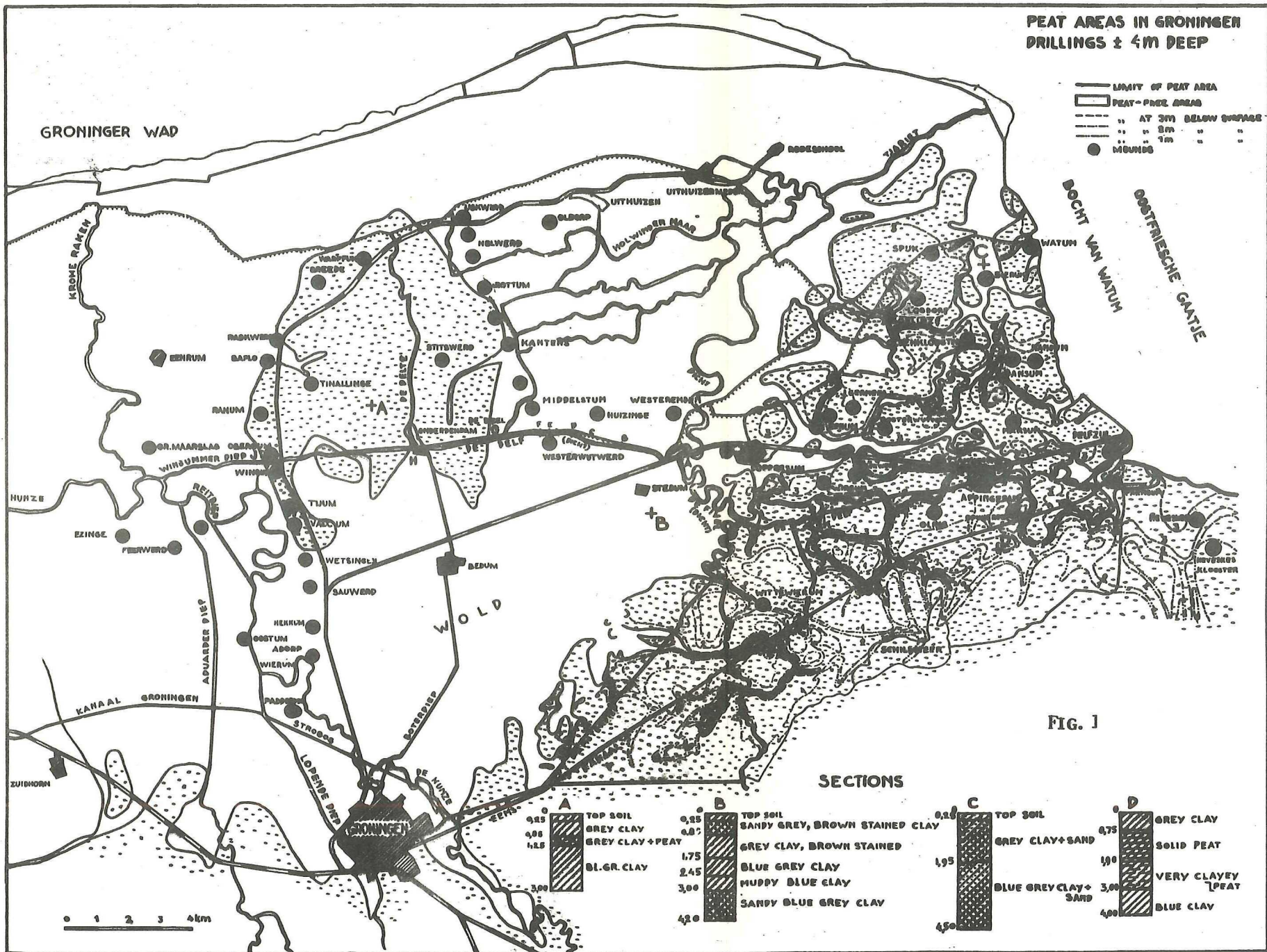


FIG. 1

EXAMPLE OF DRILLING PATTERN

- PEAT
- DETRITAL SEDIMENT

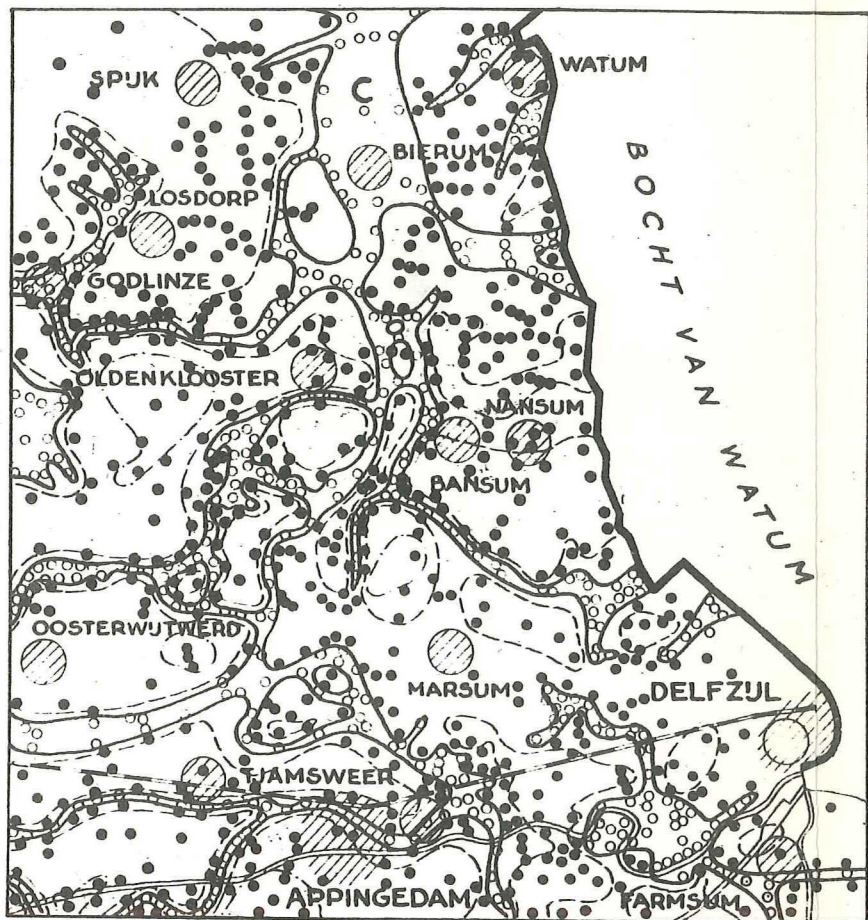


FIG. 1A

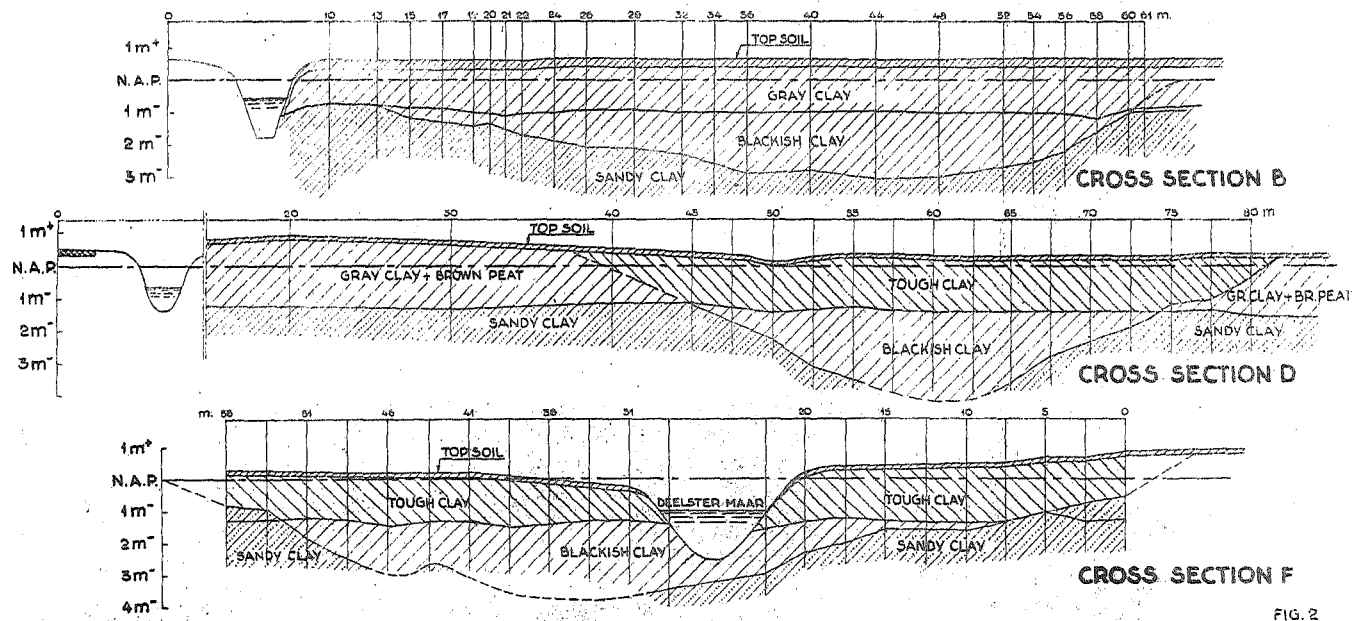


FIG. 2

FIG. 2. Cross sections of the "Delf".

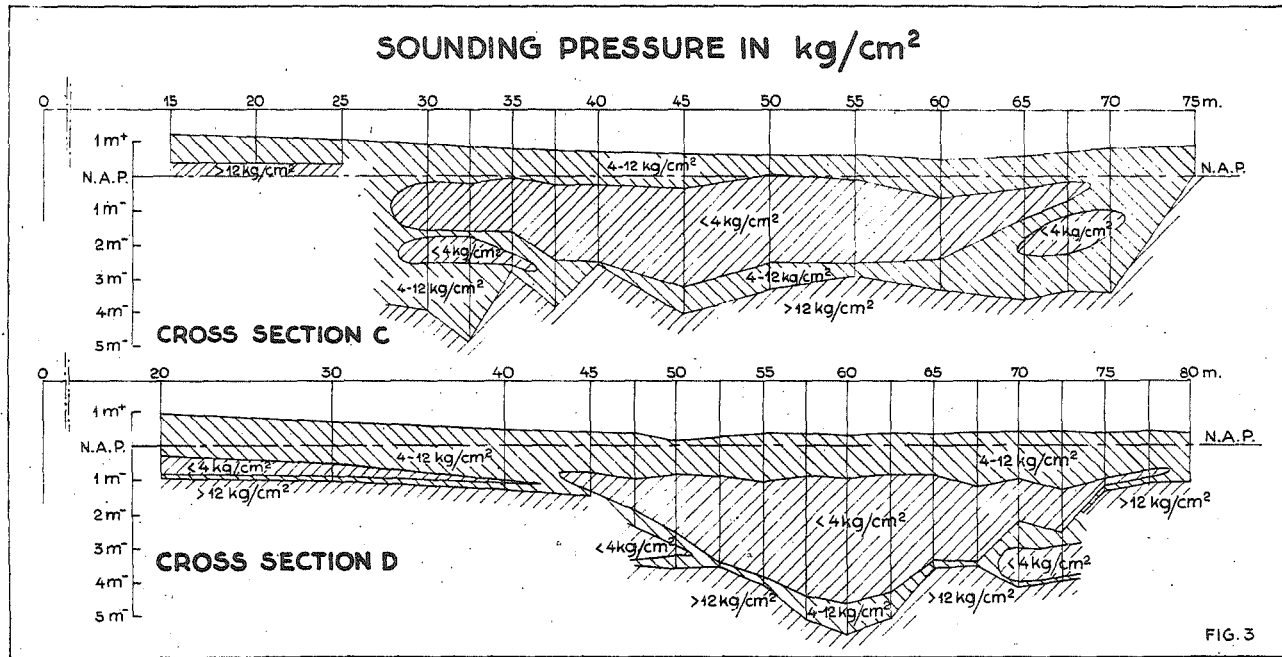


FIG. 3. Pressure sounding sections across the „Delf“

because this wide new basin now had to be filled and emptied twice daily by the tide. No historical data, however, are available about any recent erosion between Delfzijl and Watum. It is hydrologically obvious, however, that the Ems estuary must have become wider and deeper from about 1300 to 1500, when the tidal Ems basin grew to several times its original size. Probably the eastern shore has been eroded more than the western. This also appears from old maps (FIG. 4).

The general features of the buried peat landscape in Fivelgo are identical with those found in Walcheren, Zuid Beveland and other areas near the sea. The peat layer near the sea is divided into several small islands. The areas farther inland show more peat and no more peat-islands, but winding „roddons” ending in the midst of wide peat-areas; cf. the Westland (VLAM, 1945), and the area south of the Eemskanaal in Groningen (FIG. 1). The Dollard peat has been covered in yet another way (cf. chapter 3), because it was affected by a sudden burst of the dykes, a catastrophe which occurred after the dyked peat land had shrunk already.

2. THE DELF.

One of the instructions to the drilling parties has been to establish cross sections of the old canal Delf, between Winsum and Delfzijl. The existence of a connection, either a river or a canal, between the Hunze and the Ems was supposed, because there were, what farmers called „bottomless” ditches N. of the Delweg, and even „uterdieken”, i.e. lands outside the dykes. Therefore there must have been (small) dykes along this waterway, which I had called „Delf”. The first who made a sketch of this supposed ancient, but partly silted up canal or river, was H.P. STEENHUIS, a teacher at Appingedam, about a century ago. Later P.M. BOS, a farmer at Zijldijk (Gr.) mentioned it again and called it a „connecting river”. I was asked in 1927 by the widow of Mr. BOS, to write a note to BOS' map and I called the „connecting river” a „canal,” named Delf” (VAN VEEN, 1930). It could now be determined by means of borings whether this canal had existed or not, and how wide it had been. STAMHUIS made the cross-sectional borings and also two cross-sectional „soundings” with the Barendse pressure-sounder. The fillings of the old canal proved to be soft and blackish fine silt. The same silt fills the meanders of the Fivel, which can still be seen in the fields as low pastures between Westeremden and Muda. The Barendse sounder gives the force per square centimetre of an iron cone pressed into the soil. It is a well known soil-mechanical instrument used for measuring the

bearing power of the soil up to great depths. FIG. 2 gives an example of the cross-sectional borings, FIG. 3 of the „soundings”. Both prove that the width of the canal near Westeremden was about 40 m, and the depth about 4 m below the surface.

These dimensions are quite large for a canal of an ancient date, but supposedly the tide scoured the originally narrow canal, and is also responsible for the sinusoid trend, which is apparent over the whole length between the Hunze and the Ems, being 32 km. I do not think that the Delf has been formed as a river, because in Groningen the natural rivers run in a northerly direction and the general trend of the Delf is straight and it has an east-westerly direction.

As only 8 km has been silted up and 24 km are still serving as a canal up to this present day, cross sections have been taken also in the sides of the existing canals, called Winsummer Diep and Deelster Maar in the West and Damsterdiep in the eastern part. Especially in the inner bends of the sine-curves the blackish silt could be retraced (VAN VEEN, 1951).

Abbot Emo, the founder of Wittewierum monastery (on the river Fivel) wrote in his well known diary in 1248 that the water between Fivel and Delfzijl was called „Delf”, and that the water of the rivulet Fivel had been diverted a long time before 1248 into this Delf to run into the Ems. The name Delfzijl is evident: sluice in the Delf. According to Emo it must have been built in 1192. There is no evidence of any earlier sluice in the Netherlands.

A charter of 1252 calls the water between Winsum and Zoutkamp, now the Hunze-outfall, also Delf. This was one of my reasons to contend that a waterway had existed between the Lauwerszee and the Ems, called Delf. The original outfall of the Hunze was North of Eenrum, through a water now called Kromme Raken. The existing Hunze-outfall might be natural and its name Delf might be borrowed from the stretches further to the East.

Along the southern bank of the Delf runs the „Delweg”, the only east-west road possible in old days, lying on the narrow strip of silt land between the Fivel estuary and the lowlands. These lowlands or „wolds” became not cultivated before the Middle Ages, and did not provide a good foundation for any road. A local expression used in the province of Groningen is: „as old as Delweg”(TER LAAN), this road apparently being considered as the summum of ancientness. The name may have been originally Delfwæg; the stress is on the second syllable, so that the f would easily be obliterated.

I presume that the Delf between the Lauwers and the Ems, was part of the much greater waterway stretching from the Middel-

parts of the Netherlands, there must have been a few land roads also, like the above mentioned Delfweg. One of the old legends near Appingedam (Opwierde) is that there has been an ancient road, going in east-westerly direction, called „Konrebbersweg”, and people say this means: „King Redbads Way”.*) Now, on Cortelius' map, (to which my attention was drawn by Ir. T. EDELMAN) printed in 1584 (FIG. 4), we find a road going in an east-westerly direction passing near the places Opwierde, Delfzijl and Emden, called „Robertis Regis Via”. Possibly this was the main road of the Frisians leading to the Upstal-tree near Aurich.

There must have been a ferry across the Ems at Delfzijl to „the best of all Seven Sealands, Emsgo” (Emo). The Delfweg will have been part of this highway, as there can hardly be found another one going in a west-easterly direction. North of Emden towards Knock (East Friesland) there is a straight road, called Konrebbersweg on the modern official maps, and also on the 1945 war maps of the United States this road is mentioned by that name.

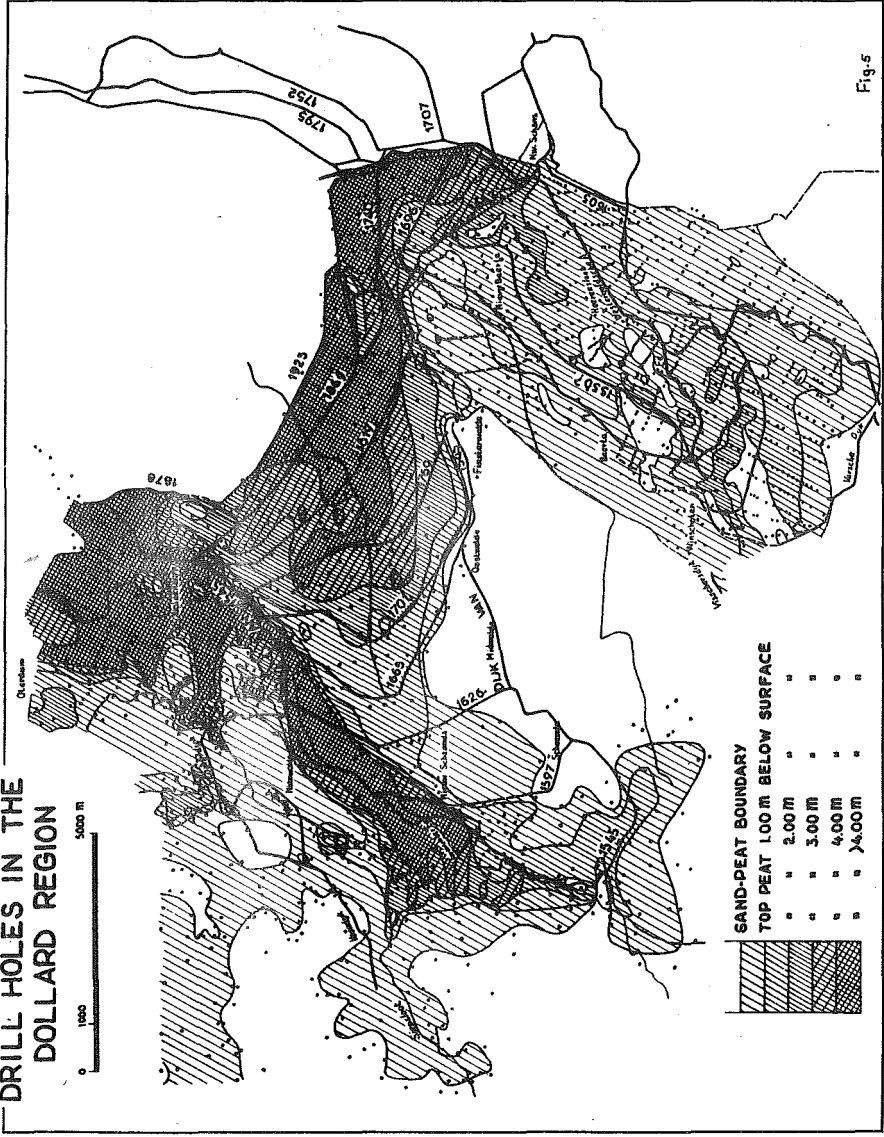
The water- and landroads of Redbad, or who ever it may have been, could not function for a long time. The geography of the long but narrow Frisian „Sealands” was such that a canal without locks and a road without paving could not provide for the much needed connection. The Frisian coastal zone was split-up too much and no lasting unity could be accomplished. The main roads of the country got a N-S instead of an E-W direction. In the region of the Zuiderzee and further southward, silting was less detrimental and the „Inner Dunes Route” remained open until this day.

3. THE DOLLARD

FIG. 4 gives an extract of Cortelius' Chart (1584), indicating the burst of the Ems dyke opposite Emden, and the situation, as Ortelius thought it was in 1277. Not before two centuries afterwards, the Dollard obtained its greatest extension, as the struggle for keeping the land was kept up energetically. The date 1277 is probably wrong. There was a large inundation in 1287, however, but the main date of the loss of the country may be even later. The dates of the dykes given in FIG. 5 show when the succeeding new endykements have been made. The first dyke was

*) Redbad died in 719, but since immemorial times this popular heathen hero is considered to be the champion of the unity of the „Seven Frisian Sealands”. The oldest Frisian laws (12th century) written by monks, who had not much liking for him, call him „Redbate tha unfreth monne”, Redbad Unpeaceful.

DRILL HOLES IN THE DOLLARD REGION



SAND-PEAT BOUNDARY	
TOP PEAT 1.00 m BELOW SURFACE	
▨	2.00 m
▨	3.00 m
▨	4.00 m
▨	>4.00 m

Fig. 5

built in 1545. The greatest extension was over an area of 38.000 hectares.

We might suppose that the original fen landscape would have been totally destroyed by the sea. The borings proved, however, that the peat layer in the Dollard estuary has not entirely been destroyed, but that it has been covered by a layer of silt. No peatless gullies are found like in the Fivelgo peat layer. There may have been „floating islands” of peat, as Pliny reports somewhere, but the main body of peat remained on the bottom and became covered with silt scoured in the outfall of the Ems. When dykes broke which sheltered a fen country already shrunken, a sudden covering with silt occurred.

The total amount of silt on top of the peat in the Dollard is now about 492.000.000 cub. metres. This is earth-dry silt, and if the original landscape was a fen district, as is highly probable because catastrophes like this only occur where peat-land has shrunken sufficiently, the average amount of silting may be evaluated to be approximately 1 or 2 millions of cub. metres per year; that is about 2 or 3 millions about 1500, but in our days no more than perhaps one half to one million. Of course, these are very rough figures.

These catastrophes produce bottle-shaped tidal basins. The neck of the bottle is situated in the silt-zone, the wide body in the peat-zone behind the silt area. Bottle shaped basins have been formed in 1421 in the Biesbos (South of Dordrecht), in the Zuiderzee (about 1300), in the Lauwerszee (early), in the Dollard (about 1400) and in the Jade (Germany, about 1500). They have been disappearing slowly, except in the Zuiderzee, where silting was not of great influence.

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