Land below sea level

Cover photographs, front and back The Veerse Gat (Zeeland) being closed in 1958-'61 will be the first enclosure of the Delta estuaries. In the background is the isle of Walcheren on which Veere is situated. The tidal gap between the new dike and Walcheren will be closed by means of several large concrete structures which can be closed simultaneously at the turning of a tide. *(Photo's Stuvel)*

LAND BELOW SEA LEVEL

Holland in its age-long fight against the waters

BY
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At the special request of the author, mr. H. J. Stuvel,
well-known publicist on the affairs of Waterstaat and hydraulic engineering,
has contributed the new chapter on the Delta Plan and selected
some of the most striking illustrations available.

A nation is really civilized by acquiring the qualities
it by nature is wanting in.

M. Arnold

LAND BELOW SEA LEVEL

Holland in its age-long fight against the waters

Dear Guests,

This booklet is not going to take you to our so-called national emblems – the windmills, the traditional costumes of Marken and Volendam, the clogs, the tulip bulbs. Nor to the churches of Delft, Utrecht or 's-Hertogenbosch, nor to museums, though there are several hundreds in the Netherlands.

Our aim is to interest you in the art of building a land, for the country you are visiting is largely artificial.

Foreign guests are interested in the 'flowers of civilization'. Can one regard engineering works as such flowers? How often have engineers not spoilt the natural beauty of a country? Yet a country which is by nature a cinderella can be made to look like a princess by engineering. Civilization begins with engineering. Look at Egypt and Mesopotamia! Only after their peoples had learnt the art of irrigation could the process of civilization commence. After agriculture, the first necessity was engineering. This alone made it possible for the first real towns to spring up, for henceforth large communities could be fed. Soon learning – reading, writing and arithmetic – became necessary and the higher arts followed in their wake. It was the art of hydraulic engineering, which started the avalanche of learning in the world. The dominion over the waters set the wheels of our whole civilization in motion.

Originally a 'sebcha'

In Holland too it was the dominion over the water which brought civilization and riches. One half of what is now called the Netherlands was disdainfully referred to by a Moorish merchant as late as the 9th century as a sebcha, or salt water and mud plain. The other half of the country consisted of worthless sand, moor and heathlands. Engineering developed both parts.

We Dutch like to hear guests commenting favorably on our museums, our churches and our national costumes, but inwardly we flush with joy when some observant tourist notices the quality of our fields, houses, roads, canals and harbors. Our hearts are in the tasks of making our country better, larger, more productive and more beautiful. We want pretty houses, a lovely garden and a well ordered country in which to live; all must be fresh, lush and colorful. Above all, the light of prosperity and health must illumine the scene.

Modern social economists speak about 'challenge' and 'answer' (Toynbee). Our 'challenge' was the mud and peat sebcha. Our 'answer' we want to show you.

However dreary and inhospitable the sebcha may have been, it now holds a few records in modern civilization, including the following:

1. It is the most densely populated country.
2. The greatest longevity; the average lifetime is 72.
3. One of the lowest infant mortality rates in the world.
4. The highest yields of crops per acre in the world.
5. The highest yield of milk per cow.
6. The income per square mile of the 'sebcha' is the highest in the world.
7. The highest birth rate in Western Europe.

Increase in population was the main motive power for our soil development. Not all the available labor was put into the making of the soil and farming; industry employs about 45% of our labor to-day. The drawbacks which Nature put in our way did not set a limit to the increase in our population. So far we have been able to feed large communities here and abroad, even though Nature was adverse. The increasing population caused more land to be wrested from the sea and more trade and industry to come into existence. There is some coal, salt and oil, but no iron, copper or other metal to be found in the Netherlands. Conditions had largely to be created. The Dutch like to be creators of their country, their wealth, their homes and their work, even of their soils.

There is, of course, another side of this creative character of the Dutch. Engineers were inclined to make new land with absolutely straight roads, straight canals and straight dikes. They planted uniform trees spaced exactly six or seven yards apart along those straight roads and if any tree showed signs of individuality, it was removed and replaced by a new one conforming with the uniform Nurnberg-toy pattern. Only small trees were suffered to grow. You will see no big trees in Holland like those which make the British landscape famous. Such rigid and colorless engineering is disappearing to some extent; our fields are now beginning to be beautified by landscape planning. To be fair, however, the original lilliputism had a charm of its own, the charm of some rustic technical mind.

There may even be grandeur in straight lines, but then some great engineering feat must be the object. Nobody would like to see the Zuiderzee dam laid out with fanciful curves. It is good to be on the straight road on the dam, the ends of which lie below the distant horizon. The Roman roads, too, crossed the hills and valleys in an infinite straightness.

You will experience quite a different sensation if you travel upon the old dikes, of which there are many miles along the branches of the Rhine. The roads, built on the very top of these dikes, afford a wide view over the fields and rivers. The farms are built on the slopes of the dikes, as these were the only safe places in times of flood – each farmer hoping that the dike would not break at the point

(Photo K.L.M.) The Hondsbosse dike is built in a gap between the dunes near Schoorl. Sometimes there are three sea defense walls behind each other. The wall near the sea is called 'Watcher', the second one 'Sleeper' and the third 'Dreamer'. The defense against the currents of the sea is by means of artificial capes placed at regular distances. The initial cost and upkeep of these are great. The aim is to ensure that not a yard of land shall be lost.

where his farm stood. In spring most of these old river dikes are particularly inviting, as they wind through and above the countryside, with its blossoming pink and white orchards. These dikes, which have no straight sections, because they have been broken so often by the impact of water and ice, separate the water and land, and carry your automobile above both, making you feel like a bird flying above the country.

Great Variety

Variety is the quintessence of the Dutch landscape. In some districts it may be possible to drive a car for an hour without seeing much change in the landscape, but generally the scene changes more quickly.

Starting from the coast, with its sweep of white sand, we first meet the green dunes. They used to be pure white all over, but by applying special methods we succeeded in making them bear grasses and shrubs. In this manner all the blown sands are controlled. This reveals already the character of the Dutch; they cannot leave nature alone, be it in the form of trees, dunes, heaths, or shallow seas.

Just behind the sheltering dunes a belt of woods hides the villas set in flower gardens. Here are also the bulbfields, for the bulbs prefer dune sand to thrive. Farther to the east we find a narrow strip of 'old' land, followed immediately by 'new' land, that is reclaimed lake bottoms. Or you may have taken a country road, which has led you amidst lakes whose levels are above the fields. Or, again, you may have chosen a road through the parts of the country where the cows are transported in scows and where every meadow is an island. Soon, however, you will reach sandy soil again, covered with pine woods, moors, cultivated fields, blowing sands, grazing lands and villas in an ever-changing park-like landscape.

In the north the marine clay belt can be followed for a distance of about a hundred miles. This is a healthy and wealthy part of the country, no longer showing any signs of the fierce struggle with the sea. The unmistakable mark of victory is on the fields, though in February 1953 the exceptionally high storm flood brought it to the brink of disaster. The mighty pyramid-like thatched roofs stand proudly in the midst of the richest possible crops. The great solitary farms surrounded by trees and moats break the plain; they make distances look great, because they are like coulisses through which we survey this variegated fertile field. When the coleseed is in bloom, about the middle of May, many people may prefer this to the bulb fields. Although it is a matter of taste, we think the most attractive landscape is presented by the country between Hoorn and Enkhuizen, when in July and August the flower seeds are in their full blossoming period. The country is then just like a fine painting with a richness of soft and bright colors. It is as yet an undiscovered country.

Even the Dutch towns show a marked individuality. Though the three main towns are practically equal in size (each with nearly a million inhabitants, suburbs included) and almost within sight of each other, the differences in character are striking.

Amsterdam, according to a song sung by our children, 'the great city built upon poles' – on herring bones, as our British competitors always said to tease us –

bears in its center all the dignity and beauty of a glorious past. The mighty merchants of that very mighty town of the 17th century, then larger, far more splendid, and richer than London (what a blessing in disguise it was when this old wooden city burnt down in 1667), can almost be seen still walking in the shadow of the trees along their 'gracht' (canal in the middle of the street).

Rotterdam is becoming an ultra-modern town, especially so after 1940, when its old center was destroyed by bombing. This great port, into which ships enter encountering no locks or docks, is the second in the world. In size it comes after New York and it is taking long energetic strides forward.

The Hague, never a town, but ever a village by volition and tradition – the largest village of Europe as we are taught in our Dutch schools – has the charm of a lady dressed in her Sunday best. It is the only place in Western Holland which is not wholly built on poles, the reason being that it is largely built on dune sand. Though situated on the sea, it did not want to have a harbor, except a small one for the Scheveningen fishing fleet.

Tribal Variety

All our eleven or twelve provinces (the Zuiderzee polders may become the twelfth) have also distinct individuality of their own. The three tribes, which we now call the Franks, the Frisians and the Saxons, met at the mouths of the Rhine and stayed there, leaving their marks while developing their parts. The Frisians lived in the coastal plain, the Saxons inhabited the eastern sandy soils north of the Rhine, and the so-called Franks the sandy soils south of the Rhine. But moors, rivers, lakes and heaths subdivided the three tribes thoroughly, so that even in our modern days of traffic and mixing, the inhabitants of one village may still show differences in costume, dialect and building traditions from the next.

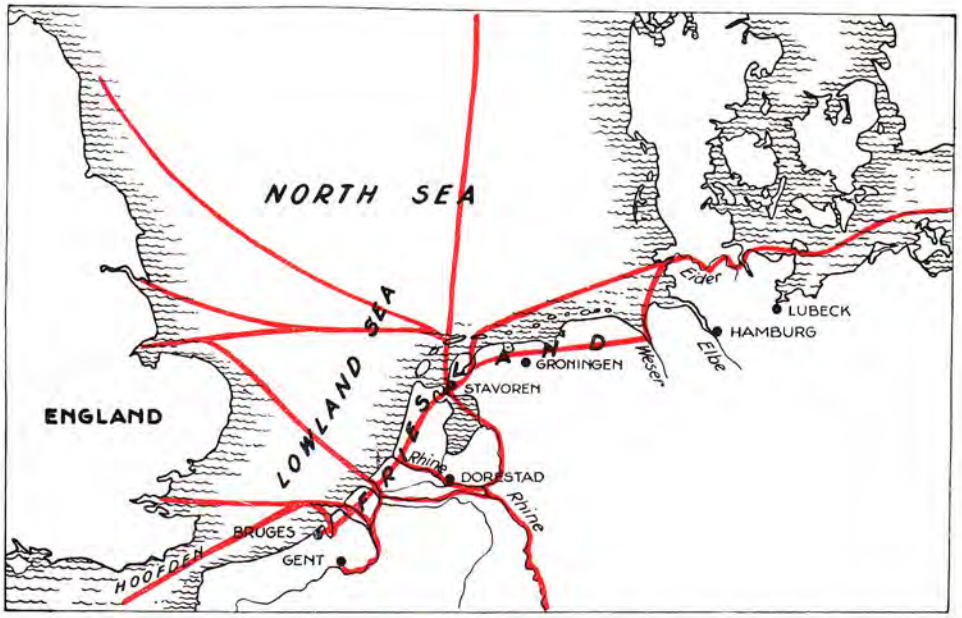
The provinces of the coastal plain are Groningen, Friesland, North Holland, South Holland and Zeeland. Originally this whole area was called 'Friesland', it was the 'sebcha'. But there was hardly any possibility of wresting a living from that bad moor and mud plain and a hut could only be inhabited in summer. In the nooks and crannies of the Zeeland archipelago we still find traces of an ancient race with black hair and dark eyes, which may have given the isle of Walcheren its name – we called all southern foreign people Waal (Walloon, Welsh), the eastern ones Slaves (note the word 'Serve', given by the Romans).

Also Brabant and Limburg, the southern Frankish provinces, show some slight percentage of a dark haired race. The Romans were there for some centuries and there are traces of Walloons.

A Mother-country

There is also great variety in the pattern of old land and new land – the ditches make the *old* land look like a jig-saw puzzle, *new* land, made after 1 000, has straight ditches. Medieval custom was to make long thin parcelation, modern engineers make chess-block parcelation. Such variety in tradition due to historical background has given the Netherlands the name of being a 'mother country'.

England was a place where the emigrants of the eastern and northern North Sea shores went, a melting pot of the old days. France's plains saw great migrations too but the watery region of the Rhine and Maas did not encourage mass movements. Archeologists recently discovered one mass-movement however: the migration of the Anglo-Saxons to England through the Dutch northern provinces. As a whole the original Dutch settlers stayed where they were, worked hard at the development of their secluded spots and multiplied greatly, while hordes and hordes found their



One of the main features for the development of the Netherlands is its position at the cross roads of Western Europe: the Rhine, Maas and Scheldt to the south, the Eider to the Baltic, the 'Lowland Sea' to England and Scotland, the North Sea to Scandinavia, the 'Hoofden' (head lands: i.e. Blanc Nez and Dover cliffs) to the Seven Seas. The 'Inner Dune Route' went from Bruges and Ghent through rivers and canals far to the north-east, probably as far as the Weser.

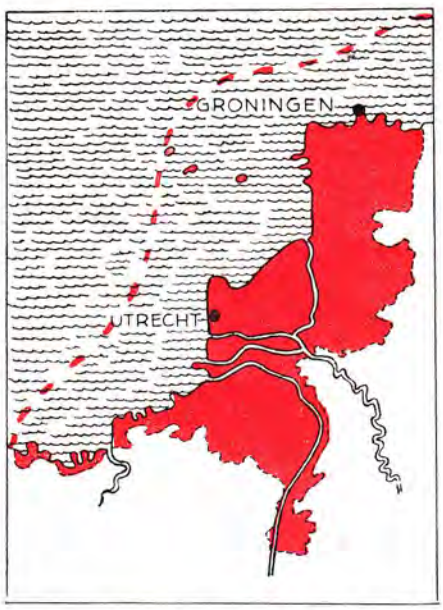
way to France, England, Germany, Russia, South-Africa and America. Many of them emigrated because they wanted total religious freedom.

Here is another item which has caused great variety, but now in the mental realm. The Netherlanders are notoriously serious, perhaps for the following two reasons:

1. They have suffered in the past and suffer still in their struggle for survival, a struggle which was and is severe and which has lasted at least 22 centuries. In the past their 'weapons' were rather poor. The old Frisian laws speak about: 'we defend our land against the sea with three weapons: the spade, the fork and the hand-barrow'. At present they have all modern technical expedients at their disposal, yet the fight remains hard and the suffering great when under exceptional circumstances, such as the 1953 floods, the water has the upper hand.

2. Two great religious clashes occurred on Dutch soil, which gave the inhabitants plenty of opportunity to weigh the arguments pro and con. The first was the clash between Christendom and heathenism from 700 to 1 000, a clash strongly reminding us of our springs, when tough northern air meets the mild winds from the south. One day it is spring, the next day the ice-giants reign.

The coastal Dutch must have been like their King Redbad, who when he was being baptized and already had one foot in the font, asked questions about the new religion, and then withdrew his foot. The monks called him Redbad Unfrithman, Redbad Unpeaceful.



The Netherlands as they would be if there had not been any human activity or if human activity had ceased. The coast would have been at Utrecht and Groningen.

The second clash was between 1400 and 1600, when Protestantism was weighed in the scale against Catholicism and inquisition took its much hated toll. Historians agree that religious troubles have been very fierce in the Netherlands. Why? Perhaps because the country lies at one of the cross-roads of Western Europe, halfway between north and south. Perhaps also because its inhabitants originally worshipped the so-called Law of Eternal Right, or 'Ewa' (means ewig, eternal, aye, ever). 'The Ewa is innate in thee, teaching thee what is right and wrong'. 'Ewa is Divine Right, it teaches a man's mind to judge itself, and to conquer what is wrong, to help innocence and to ban cruelty.' Also: 'Human law is human, man-made.'*)

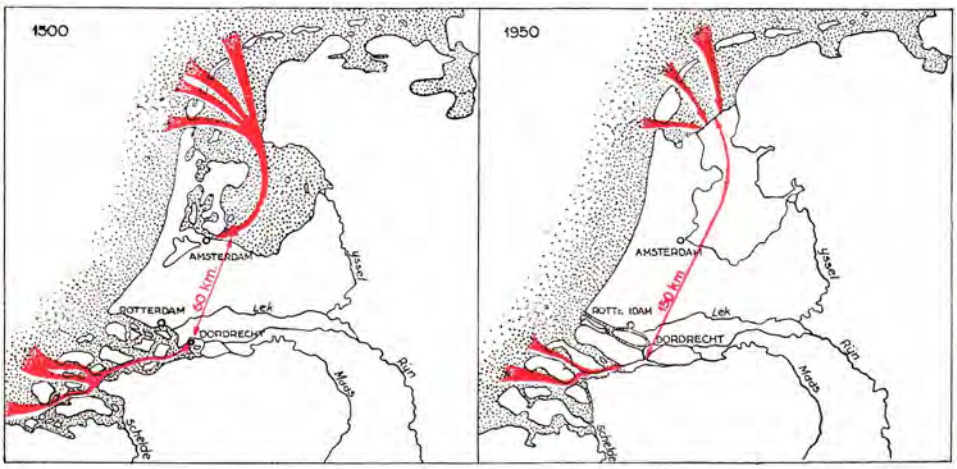
The fundamental belief is still that 'the Eternal is innate in thee', hence individualism, variety, emigration, stubbornness, sects, tolerance for refugees. When the first Jews were abducted during the last war, for instance, the whole city of Amsterdam went on strike spontaneously as a gesture of disgust and indignation.

Internal delta

Many consider the Netherlands to be a delta. The form suggests it, but this is not right. Though the Rhine and Maas bring some sediment from the interior, their combined delta is but a small one. It does not extend much farther than the town of Utrecht. On the best parts of this small delta apple, pear and cherry orchards thrive. These best parts are the silted-up branches of the ancient Rhine, the so-called river bank soils. The smallness of the Rhine delta is a sure sign that Western Europe has but little soil erosion. As a matter of fact the archipelago in the south-

*) These are about the oldest words ever written in Old-Frisian, a language practically equal to Old-English.

west of the Netherlands, where soon after the flood disaster of February 1953 the so-called Delta Plan was started, is not a delta, but a marine formation. Our river delta is an internal one, it lies far from the sea where the dune belt came into existence as a result of waves pounding on the shallow sandy bottom. If there were no dune belt, the lower part of the Netherlands would not exist and the coast would be roughly from Groningen in the north to Utrecht in the middle and



Several claws of the sea, of which two were extremely dangerous, threatened to destroy the lower half of the Netherlands. The claws advanced bit by bit until about 1600, when they were checked by stronger dikes. The period 1580–1600 was the most dangerous. In that time of political troubles (revolt) a not too severe storm might have spelt the final blow to central Holland. From 1600 to 1932 there was an equilibrium between the forces of the sea and human resistance against them. In 1932 the main northern 'claw' was pushed back by building the Zuiderzee dam. The southern 'claw' is being pushed since 1950. In 1953 it proved to be a formidable threat still.

Breda in the south. No wonder that the Dutch try to maintain their dunes, as well as the necklace of the islands in the north.

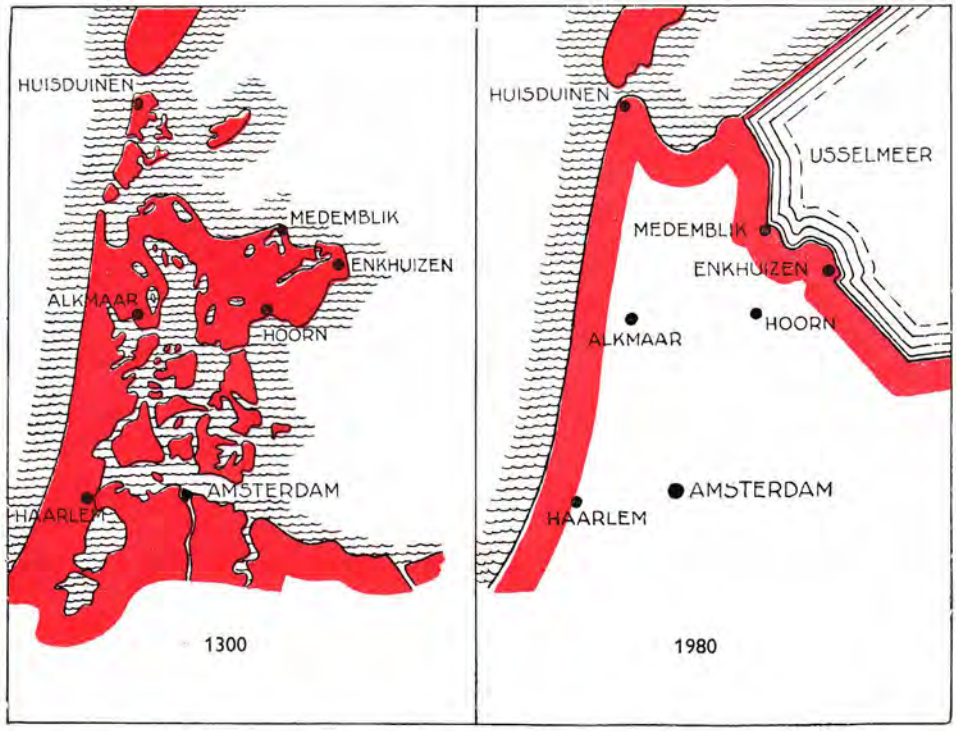
There was a time that we nearly lost the main half of the Netherlands, and if it had happened, Amsterdam, Rotterdam, The Hague, Delft, Leiden and many other well-known towns would not exist. The intercoastal plain, originally a vast moor extending from the Straits of Dover all along the southern shores of the North Sea was threatened with destruction when the level of the sea rose ever so slightly. Here was a challenge!

Two claws of the sea

The destruction of the coastal plain behind the dunes came from the south and from the north, like two claws of a crab closing upon its prey. We know little about the earliest inundations, but early classical authors already mention the floods. The aggression was slow but sure. In the north, about the year 1200, the Zuiderzee came into existence. Formerly there had been a freshwater lake here,

called Flevo, or Almere, but the outlet of that lake widened and the sea-water now came as far as Haarlem and Amsterdam, then a tiny fishing village.

Another claw advanced in November 1421 from the south. In a single night a great polder, which had been made as early as 1213, was inundated and lost, wiped out as it were from the map, together with its 72 villages and its 50,000 inhabitants. Here the salt water came as far as Dordrecht. A small central part of

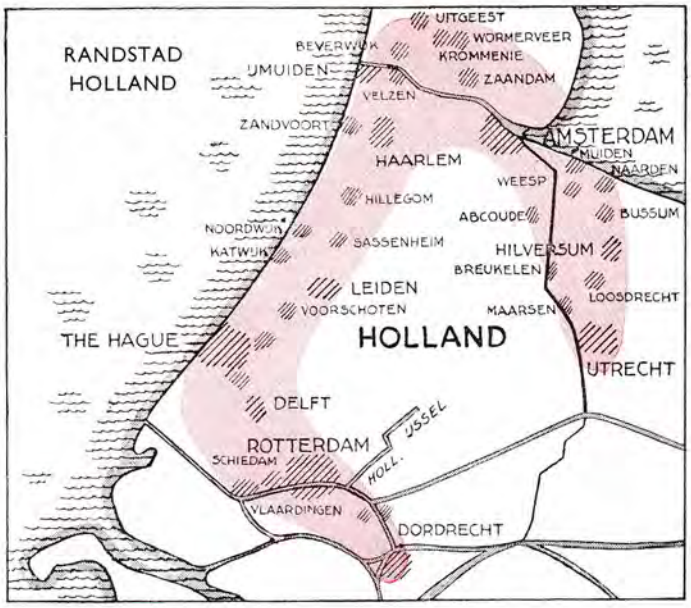


The North-Holland peninsula, one of the 'Seven Frisian Sealands', was separated from the other parts of Friesland about 1100 or 1200 and its bad general shape at about 1300 suggested but little hope for the future. However, gradually the sea has been and is being pushed out.

the coastal plain, however, continued to exist between Rotterdam and Amsterdam, a distance of only 36 miles. This was all that was left of the once long peat district in the intercoastal plain between Calais and Denmark.

The sea did not penetrate farther, because of human action. Owing to better knowledge and organization, we have not lost much land since 1600. However, the situation continued to be critical for three centuries to come. Especially in the beginning of the Dutch war against the Spaniards about 1570, the so-called 'trouble-times', the sea had a very good chance to grab the last remnant. Those 36 miles of moors and lakes were defended so fiercely against the Spaniards and against the sea, that this small hybrid area was saved. Henceforth it became the center of the Netherlands. This center, called Holland-proper, has had a very narrow escape indeed, and by the laws of Nature should not exist at all.

Until as late as 1930 the safety of this center of the Netherlands was not very great, and even until 1958 a storm could have broken the dike south of Gouda – one of our weakest dikes – or rise higher than its top. But the northern claw was pushed back in 1932, when the Enclosing Dike of the Zuiderzee was finished. In that year the distance between the two claws became 100 miles. The safety of the heart of the country has increased much, because of this Zuiderzee dam, but the



The so-called 'Randstad Holland', comprising the towns of Amsterdam, Haarlem, Leyden, The Hague, Delft, Schiedam, Rotterdam and Dordrecht, population about 4,000,000. It grew around the big central moor, called Holland-proper; first a moor, then a conglomeration of lakes, because the moor was burned in the stoves of the Dutchmen, and after that a fertile field, because the lakes were pumped dry.

southern claw is still threatening, as the events on the 1st February 1953 with their serious consequences have made abundantly clear. As the first project of the Delta Plan the hugest movable stormflood defense in the world has been constructed some miles east of Rotterdam. This defense bars stormfloods from entering the river Hollandse IJssel, thus providing a better safeguard for what is called Holland-proper.

Three centers of civilization

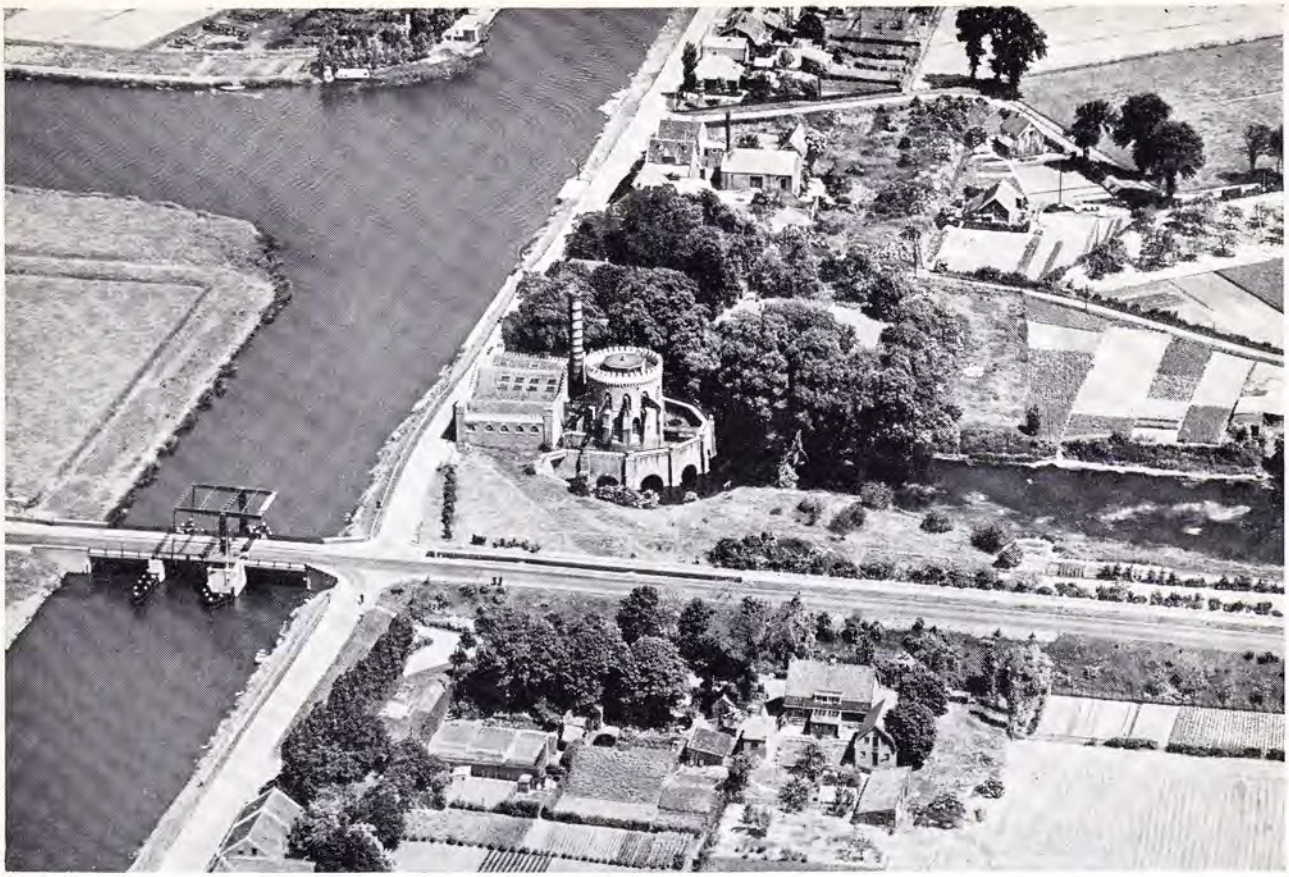
Three successive centers of civilization have sprung up in the intercoastal plain between Cape Blanc Nez and the Weser. They were of more than local importance, they were the centers of Western Europe.

The first center was the Frisian one in the north. Excavations show that the first farms had been built about 400 B.C. on the saltings. These farms were already

(Photo K.L.M.) The Biesbos. This deltaic region was formed after the flood of 1421 had destroyed a large area south of Dordrecht, originally the place which was called 'Holland'. The Biesbos is now being reclaimed, the many creeks will become tideless, but as such they will better serve the purpose of providing recreation (sailing, swimming). The population, now about 8 per square kilometre, will be increased to an estimated 150. The polder 'Holland', destroyed in 1421, had been made as early as 1210 by damming off the tidal mouth of the river Maas. The water of the river had to flow into the Rhine at Gorkum. This scheme had proved to be too ambitious, but it was kept up for some 200 years, then collapsed; about 70 villages disappeared.

large ones and their construction shows the same characteristics as the present-day type of the Frisian farm. They are essentially wooden structures, great thatched roofs only. The walls are small and non-essential. Pliny wrote about these mound dwellers in the year 47. They, the Frisii, were beings shivering in the cold winds, marooned on the top of their mounds like shipwrecked mariners. There were no trees, no cattle, no sun, no fires in their hearths except 'mud' fires (peat-fires). Their hands were their spades, etc. Pliny may have exaggerated somewhat, but we must believe him when he says that the country of the Frisii was hybrid, sometimes a sea, sometimes a mud flat, soaked in poisonous salt water.

In the marine clay belt of our northern provinces, now called Groningen and Friesland, the Frisians made about 1500 mounds. There must have been more of them, as the sea has swept away many others. Further east along the coast there may be a thousand more in East Friesland. Often these mounds, called wierden or terpen, still carry whole villages. Their content may be as great as one of the Egyptian pyramids. Imagine that they were made in a pyramid shape, what a fantastic sight the northern coastal clay belt would offer! In the wet North Sea climate pyramids of clay would not be permanent, as they are in the dry climate



(Photo K.L.M.) The Cruquius pumping station near Haarlem was one of the three which pumped the Haarlemmermeer dry after some years of pumping (1852). It is a museum to-day. The bottom of the lake can be seen in the right part of the picture. The water was pumped into the ring canal (left). To-day modern pumps do the work of keeping the lake bottom dry. Schiphol airport lies on that bottom.

of Egypt; also the mounds were not built for monumental purposes, but out of sheer necessity. Without the spade and the hands used as spades the inhabitants could not possibly have survived. And even with that worthiest of all ancient tools, the spade, they were often decimated by the storm floods.

The ancient Frisians' center was north of the Zuiderzee, their 'towns' being Stavoren and Medemblik (Meadowlake), where for instance King Redbad (Redbeard?), the opponent of Charlemagne, held his court. 'King' means well-to-do farmer or war-leader. The 'Seven Frisian Zeelands' were wholly democratic republics with a parliament. There was a road from Stavoren towards the east, there was another from Groningen to the south, but these were the only ones. Further there was the waterway along the northern branch of the Rhine, called IJssel, and the Zuiderzee. This was all there was to connect Friesland with its neighbors. The swamps and lakes separated it thoroughly from the rest of Europe and made the Frisians feel as safe as the fishermen who founded Venice.

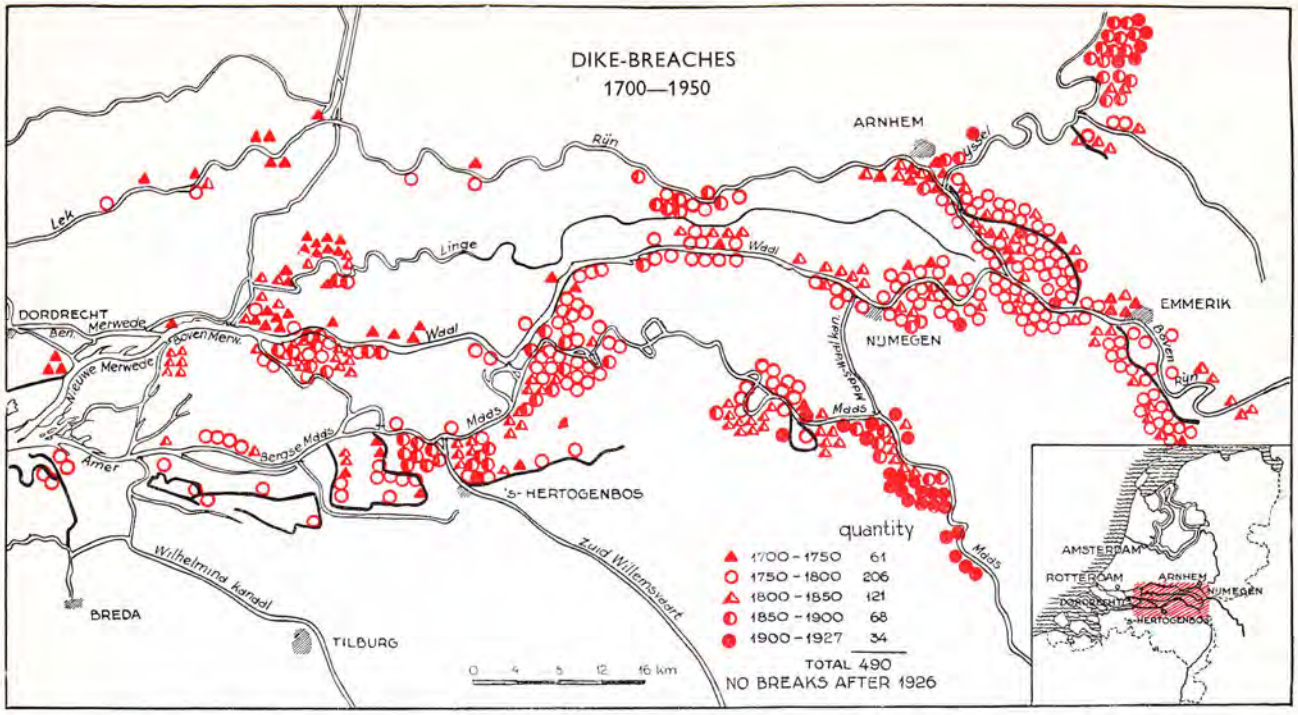
Accustomed to do everything by water, they partly developed into skippers and traders. Their ships darted from England to Schleswig and along the Rhine, Maas and Scheldt. The name Frisian at an early date became synonymous with trader. This first beginning of civilization in the Low Lands was largely halted by

Defending the underwater parts of the shores of tidal waters by means of willow mattresses is a continuous business. Without these the lower parts of the Netherlands would be scoured away.

the Vikings raids from 800 to 1000; the gold coins of the traders were made into bracelets for the northern Belles. At the same time the sea seems to have damaged the Frisian marshes so badly that survival became exceedingly problematical. However, resistance was stubborn and success came in due course with a mighty effort to build dikes, but trade and commerce had by then found a new center.

The second center, the Flemish one, sprang up in the south of the intercoastal plain soon after the Viking raids ceased. Bruges (Bridge) and Ghent developed on the southern part of the peat plain which had been destroyed and afterwards had silted up at an early date. The first center in the north (Friesland) had had no towns to speak of, but the second center became the seat of very powerful towns with a huge international trade where the arts flourished. Both the first and the second center were extremely democratic. The Flemish towns destroyed the mighty armies of Knights and so did the Frisians, as well as the Saxons at the same time. But eventually (1400) Kings and Dukes got the upper hand in Flanders, while the trade suffered because of silting harbors. The Dutch coastal plain was always subject to natural changes, but Antwerp and Ghent still shrive as harbors.

The third center, called Holland, was the region between Rotterdam and Amsterdam, left over by the two sea claws. This name Holland may mean holtland = woodland, or hollow land = weak, soaked land. The part of our country called Holland might be originally the low land on both sides of the river Maas, the land



Since 1700 almost 500 breaks have occurred in the main river dikes. The period 1750–1800 was the worst with 4 breaks a year. After 1926 until 1953 no further breaks had occurred and in February 1953 the breaks in the dikes of the downstream polders were not due to the overflowing rivers, but to the water being driven in from the sea side through the simultaneous action of the spring-tide and a very heavy northwestern storm.

south of Dordrecht, which was its capital. It was the land reclaimed in 1210 and utterly destroyed in that memorable night of the Saint Elizabeth flood of 1421, when 72 villages disappeared together with 50,000 inhabitants of which about 10,000 were drowned. Dordrecht remained a small island within its defense walls, but its trade suffered much, because the flood had taken away its hinterland and the vessels now sailed over the drowned country; they bypassed Dordrecht. The name Holland moved to the north where the central moor district, left over between the sea claws, was being reclaimed.

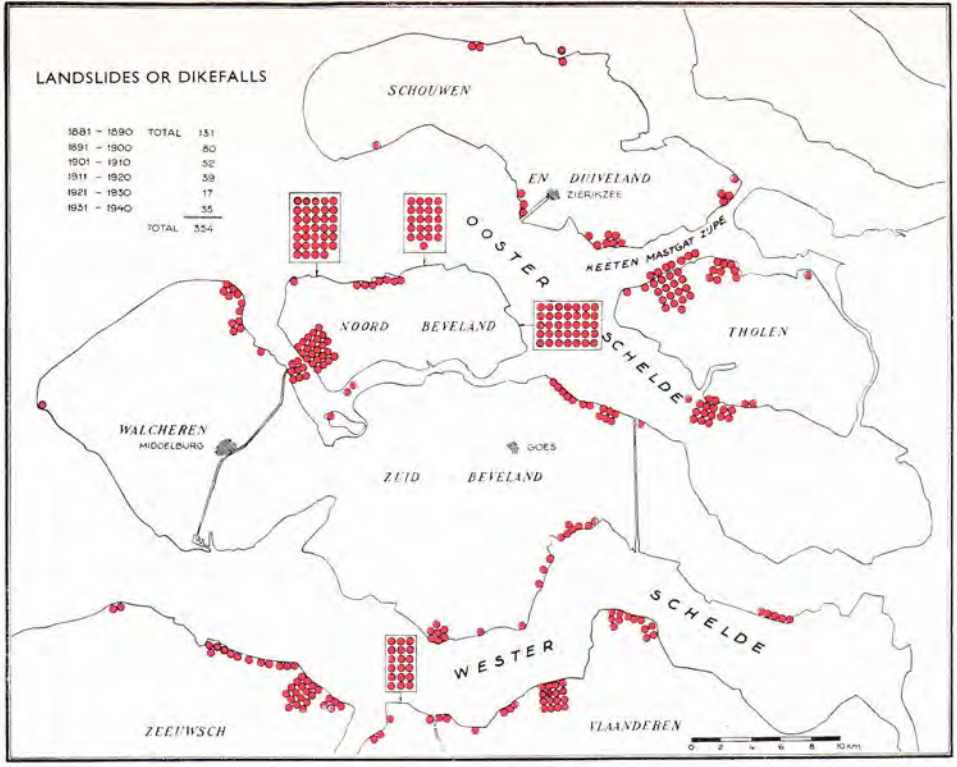
This third center was again democratic, as its art shows as well as its governmental institutions. Its rulers could only govern by way of service, not by dominion. The members of the famous House of Orange gave whatever service they could, but were never allowed to be masterful.

Around that large moor a score of villages developed gradually as the moor was exploited bit by bit after 1200. This string of villages became a string of towns, and each of these towns has expanded so much that they now almost touch each other. Draw a line from Utrecht via Hilversum, Amsterdam, Haarlem, Hillegom, Lisse, Sassenheim, Warmond, Leyden, The Hague, Delft, Schiedam, Rotterdam, Barendrecht and Dordrecht and you have about 40% of the population of the Netherlands (i.e. about 4,000,000) on that line.

It is now called the 'Randstad-Holland', or the Ringtown Holland. It has the form of an inverted interrogation mark. See page 12.

A destroyed country made fertile

This Holland-proper is a peculiar country. Leave the highways and note that the



The above map shows the constant threat of landslides. Zeeland's tidal waters scour its shores in such a way that landslides occur, even though these shores are defended against scour. Viewed over centuries large areas have been lost in Zeeland by landslides and they are still always to be feared.

canals are higher than the fields, that the lakes are like saucers filled to the brim, ready to spill over. A good, though narrow road to follow is the one from Leyden to Amsterdam, passing along the eastern shores of the lakes, a road well-known to yachtsmen and flower lovers. The white sails of the small yachts flit over the lakes and through the canals, while the white-faced black cows graze in the depths on the meadows. All these meadows and fields, as far as the eye can reach, are lake bottoms kept dry by continuous pumping. The level of the lakes, though seemingly high, is about 5 ft below the average floods of the sea, and 15 ft below the highest storm tides. The level of the meadow is about 12 to 15 ft lower than the level of the lakes, and therefore about 27 to 30 ft below the storm tide in the sea. When you drive your car through these polders you must use your imagination. Fancy a glass plate high over the country and fishes swimming underneath it. But there are dikes all around the polders preventing the water from coming in. If the 'watcher dike' should be destroyed, there is still the 'sleeper dike' and behind that there may be the 'dreamer dike', or third defense.

The original level of the land may have been a little higher than normal high water in the sea, but gradually the land has been burnt in the stoves of the Dutchmen. In the east of the Netherlands people burned their woods, in the west they had no woods and therefore they burned their soil. This was the Dutch 'Rape of the Earth'. What the claws of the sea had left, man destroyed. Of course there was an excuse: man needs some warmth in winter and cooked foods as well, but never-

(Photo K.L.M.) The northern coast of the Netherlands is largely natural, even wild and empty. Such areas as these are also going to be reclaimed later.

theless this destruction was paving the way for the annihilation of the whole of the low parts of the Netherlands.

But Nature has more doors than a single one and man is often clever at finding a way out. An ancient clay layer far under the peat proved to be fertile, and wind, later steam and electricity, became the servants of science and provided the power to pump the large man-made lakes dry. Mark the good crops on these lake bottoms, they are splendid, exceeding those of other countries as shown by the following figures for wheat crops:

In 1949:	Netherlands (all soils) . . .	4260 kg-ha
	England	2820 kg-ha
	France	1910 kg-ha
	United States	1110 kg-ha

People had migrated into the big central swamp called Holland by means of existing or man-made creeks. They built their farms along those creeks and they carried the peat from the interior in such a way that all the spaces between the creeks became lakes. The old farms and villages stand on peat on the side of the main drains and are therefore rather high. These drains have kept a fairly high level. Some new farms may have been built on the lake bottoms, but not many. Lake bottoms are 'new soil' with straight patterns and few inhabitants.

Spartina townsendii grass is planted in salt areas on sand and spreads quickly. It is originally a South-American plant which has spread northwards. It catches silt so that salt or brackish tidal sands can be changed into fertile fields.

It is not difficult to reconstruct the old situation. Holland-proper had nearly become one great lake, but this lake was intersected by left-over bands of peat bearing a canal, a road and the farms. The existing lakes near Gouda and near Hilversum show how narrow stretches of the old peat soil were spared to separate the waters. People had learned to grow afraid of the waves lapping against the shores and eating them up, as it were. If it was too large, the lake became known as a 'Waterwolf'; the great Haarlem lake, before it was drained in 1852, even threatened to destroy Amsterdam.

There are still some lakes in Holland which have not been drained. This is because the country needs reservoirs, called 'bosoms', fit to receive the water pumped out of the low polders before it can flow into the sea. Yachting is another reason for not draining all the lakes. The busy and densely populated 'Randstad Holland' needs many recreational facilities. I remember how a foreign official, studying recreation in Holland, stood on board a little yacht gazing silently at the white sails upon the wide expanses of blue water, hearing the lapping of the wavelets against the shores, the quiet song of the wind in the reeds, and the shouts of swimmers. 'They are perfectly relaxed and perfectly happy', he mused to himself. And a little later: 'It is obvious that they forget all their daily troubles, and this is what recreation is meant to do'.

If you are in need of relaxation after a strenuous time in the home towns, do not go to the ants, go to the cows and the lakes and become wise.

Soil artists

Flowers thrive very well on peaty soil, especially when this soil is renewed with fresh mud taken from the bottom of a lake. Hence the daily flower markets of Aalsmeer, which are the worlds' greatest. The lilac islands in the Westeinder Plas, where the people of Amsterdam go sailing, are also unique. Noticing all these very fine flowers which grow so abundantly in gardens, in hothouses, on islands, and behind every window, one member of the World Soil Congress of 1950 said to another: 'The Dutch are so restrained, but in the matter of flowers they let themselves go'. Well, Aalsmeer (near Amsterdam), Boskoop (near Gouda), Naaldwijk and other flower districts are business undertakings, though beauty is their basis.

For a long time the inhabitants have experimented with their soils. They have never been afraid of huge soil transportations. Large areas of the coastal dunes have been moved inland to be mixed with the clay or the peat. Eventually it was discovered that fine bulbs would grow on dune sand, provided the water table was kept at 22 inches below the surface of the land. This had to be neither 21 inches nor 23 inches, and if the land surface was higher the only thing to do was to lower it, because the water table in the soil cannot be altered so easily. If the farmers in a certain polder have agreed to accept a certain level, it is of great importance to keep that level stable and fixed. So, if a bulb grower is not satisfied with that level, he has to raise or lower his land.

The count who made dikes around Central Holland, which is the most vulnerable and lowest part of the Netherlands, even lower than the Zuiderzee-bottom. He also made the Great Holland Polder south of Dordrecht (destroyed in 1421) and perhaps the dikes around the Zeeland islands Schouwen and Walcheren. He further made the main drainage canals in Central Holland.

The lowering of the dunes to that level of 22 inches above the water in the ditches was no great impediment. One of the greater troubles was that microbic life in the bulb soil had to be kept in good order by turning the whole upside down. Deep sand layers are brought to the surface every now and then, by means of dredges. Thus the odd 5000 varieties of tulip bulbs and so many varieties of hyacinths, daffodils, gladioli, etc. are produced on soil which is constantly kept under close supervision.

At Boskoop, north of Gouda, where garden shrubs are produced, the soil which generations of horticulturists had made became so famous that wagon loads

of it were transported to Germany during the last war. The farmers have been soil artists for many centuries. When the Counts of Holland had installed themselves at The Hague and, about 1200, had become wealthy enough through their exploitation of the vast marshes and because of other clever dealings of their own which may have been more or less legal, they cast their eyes towards the north, where the westernmost of the 'Seven Frisian Sealands' had become separated from the others because of new inroads of the sea, the Zuiderzee. The conquering of this small farmers' peninsula, called West-Friesland, took about a century and cost the lives of two brave Counts of Holland and many noblemen, but eventually West-Friesland did become North-Holland. However, the Count would not hear a bad word about his new subjects, but said they were his best people, well versed in fighting the water and making the most of their soil. It was here that the pumping of lakes started. The famous 'engineer and mill-maker' Jan Leeghwater (1575–1650), whose advise was sought after for the draining of lakes in the whole of Western Europe, was also born there in the well-preserved village of De Rijp, between Amsterdam and Alkmaar, which is worth visiting.

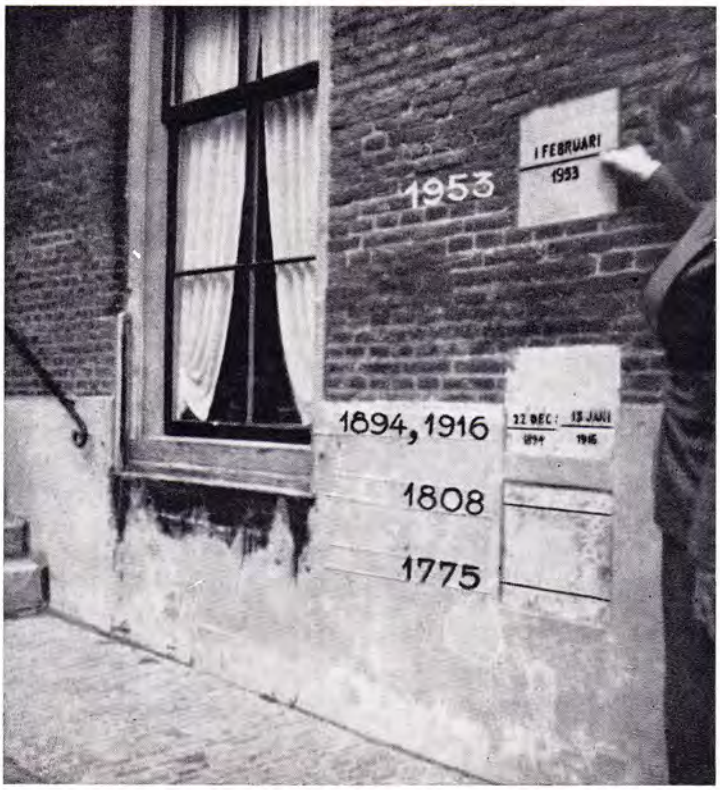
Leeghwater (1575–1650), a famous draining engineer whose advice was sought after all over Europe. His name means Low-Water. He wanted to drain the Haarlem Lake (40,000 acres), the biggest of all Dutch lakes, with the aid of 160 windmills.

'This is no soil' said a famous Russian soil scientist to a Dutch colleague, obviously meaning no 'natural' soil. The answer was: 'This may be no soil but it bears crops'. Clever farmers helped by modern scientists are now better able to improve upon Nature than centuries ago. There is as yet no end of improving upon Nature. A Dutch farmer is called a 'boer', which means a 'builder'; he 'builds up' the land as well as the crops. Boer and civil engineer both spring from the same old root which goes deeply into the soil.

The 'Boers' used the soil not for crops alone. They made mounds of it to survive, later dikes. They also made from it their pottery and bricks for their houses. For heating, they took a special kind of their soil, the peat. For covering their roofs they used sods and the local reeds, for floor-mats the rushes, for sleeping mattresses straw. Boers became civil engineers when they started to make canals, ditches and dikes. For damming the tidal creeks and rivers they used the osiers, growing abundantly in their soaked country. This cleverness at using local material bore fruit. Since about 1100 or earlier, rulers in Europe have wanted Dutch marsh farmers to develop their countries by draining their marshes, making their harbors and controlling their rivers. Hence mass migrations. The service the

'boers' rendered was highly esteemed in Eastern Europe. In the small country of the Netherlands alone they dug (with spades) a quantity equal to that of an imaginary shipping canal from London to Calcutta. The size of that canal would be that of the wide Suez Canal of the near future, the Queen Elizabeth would be able to sail through it easily.

Now that they are helped by scientific research and the millions of horsepower



So-called water stones in old Dutch farms tell the tale of disasters. A farm may have five rooms, each floor about 4 feet higher than the preceding one. When the floods came the family moved to the necessary height. The cows were put in their roof stable about 15 feet above the fields. The farms were protected against waves, floating beams and ice by means of floating willow mattresses, which the farmer 'wove' around the building before the flood came.

in the form of modern mechanical equipment, great opportunities are opening up for them. Engineers and farmers are as eager as their forefathers to develop the world's soils. They are experts in soil treatment, and have been recognized as such since about the year 1000.

Making a Country

As soon as a child is able to understand, he is shown 'God's handiwork' in the palms of his own hands. In his left hand stands the letter M, in the right hand the

letter W, and this token means: Man Work! And this, the Dutch mother says to her sons and daughters, is a Divine Commandment.

Making a country means work, work, work, plus intelligence. This work is considered as a privilege, because Nature gives a farmer tremendous dividends for his labor. He puts a grain of wheat into the soil and the gain is 2000%. Corn gives even 33,600%.

The farmers of the marshlands are known to be a land-proud and home-proud people, but this pride is generally not of the boasting type. All old Dutch ballads seem to boil down to the theme: Pride comes before a fall. They sing about wealthy farmers, who feel like demi-gods in their huge farms surrounded by a moat and a parklike garden, their women covering their heads with pure gold plates, sparkling in the sun. The 'widow' of Stavoren ordering a cargo of very good wheat to be jettisoned in the harbor, because it was not a cargo of gold, jewels and silk – they all get their just reward. In the ballad the wealthy farmers vanish together with the whole district in a single night of flood, the rich 'widow' becomes a beggar. The chronicles moreover show how all priests and clergymen seem to have taught that the many catastrophes due to floods had but one cause: the sin of the inhabitants. Keep humble, keep lowly in mind, was the incessant warning. Wealth is indeed the destruction of any nation. The Dutch proverb is: How strong legs must be that can bear wealth.

Yet, the joy of the farmers at the fertility and neatness of their fields and the strength of their dikes continued to exist in favorable times, but ever the remembrance of the catastrophes hovered above that inward and silent joy, which might be a sin.

It happened that I had to travel widely and that it became my job to deal with land reclamation and country development. As such, I met again and again the unavoidable humble pride in all the marshes around the North Sea, the consciousness of being in a man-made country, or let us say a Garden. Inside the dike a heaven, outside the dike the permanent threat of the roaring sea and from above the constant warning: 'Thou shalt not eat of the fruit of the tree of pride'.

Making a country first and then making it blossom as a rose is indeed a great task, recognized as such since remote times. The lines of the Gudrun Saga, evidently written by a foreigner in Viking times:

'Hetzel, the Frisian Lord,
Him serve both land and water'

show how even then people were impressed by the way Nature could be made to serve.

The Government is now beginning to realize more and more the importance of the task of developing the country, it comes to the aid of the farmers, who have tried in their own restricted but mighty ways to make the country. They not only tried, but they actually succeeded. They have wielded the spade for 23 centuries, and the work they did is very grand indeed, but the Government is now able to use mighty machines, it can tackle a task of the grandeur of the Zuiderzee scheme. It even has started still greater works, starting the Delta works, fulfilling the dream of generations in former ages, to close the coast and throw out the sea.

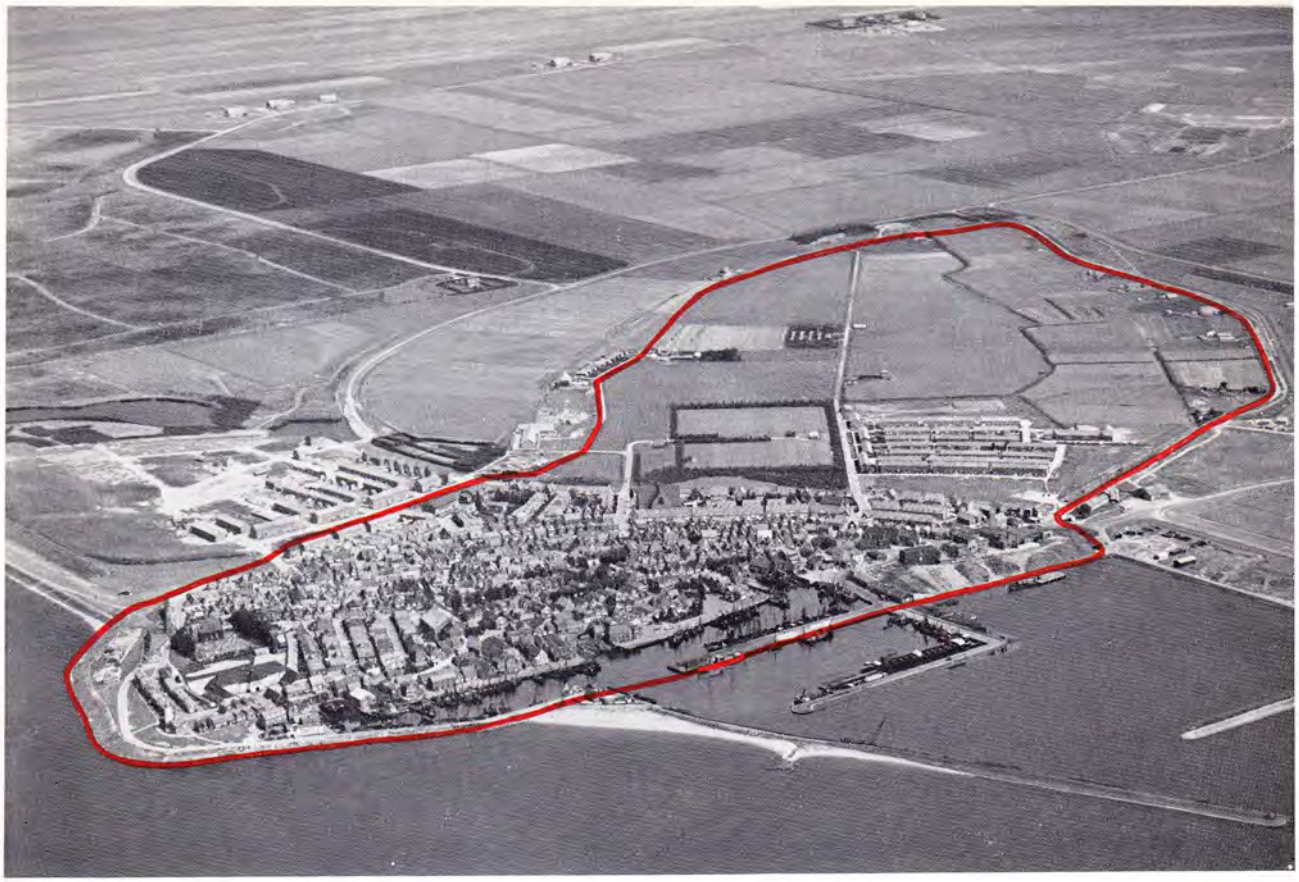
Dike making in the Zuiderzee. Reclaiming the greater part of the Zuiderzee, now called IJsselmeer, enclosed since 1932, is the task of a generation. It will continue until about1980, when the Zuiderzee scheme will be practically finished. It means the building of still nearly 130 miles of dikes.

In a not too far future the Dutch will tackle their last offensive against the sea by closing the gaps between the Wadden isles in the north.

The making and finishing of the Netherlands by means of multiple purpose plans has now started on a modern scale.

Age-old agriculture and its son, modern civil engineering, have come together again and are joining hands in making new countries, here and everywhere. The Zuiderzee works, of approximately the same magnitude as the works in the Tennessee Valley, are proof of what modern tools can do. The spade was mighty in its days, the dredges, draglines and bulldozers are far mightier.

In 1210 Dutch engineers already made two dams in the mouth of the river Maas, a tidal river of imposing width and strong tidal currents working on an easily erodible bottom. They have learned to make bigger and better dams now, especially after the closing of the 67 terrible gaps in the dikes, due to the storm and scouring tides of 1953. The ancient Dutch method of laying willow mattresses on the sand bottoms of the tidal rivers is still used, but nowadays concrete doors of 200 ft length are floated into the gaps in the five minutes' time that it takes the tide to turn. In 1932 the Zuiderzee was closed, in 1945/'46 the four gaps of Walcheren, in 1950 the mouth of the Brielse Maas (near Rotterdam), in 1952 the Braakman on the river Scheldt, and in the same year the Hamse Gat in the Biesbos. This means more land for agriculture, shorter dikes, greater safety, the expulsion of salt water,



(Photo K.L.M.) The former island of Urk (red line) has been connected with Friesland and Overijssel by dikes. It forms a cornerstone of the new North-East Polder, measuring 125,000 acres, which were pumped dry and are now in full production.

better and more fresh water storage inside the dikes, greater fertility and better roads and canals. Also better and more recreation possibilities, for the new lakes thus made attract many yachtsmen.

The tradition has always been to shorten the Dutch coastline. Together with the starting of dike building about the year 1000, villages sprang up with names ending in 'dam': Rotterdam (the dam in the river Rotte), Amsterdam (the dam in the river Amstel), Edam (in the Ee), Schiedam (in the Schie), etc. Originally the Dutch coastline must have been long, because of all the tidal creeks. In 1840 that coastline had still a length of 1150 miles, in 1932 (Zuiderzee closed) 840 miles, in 1952 it was 800 miles long.

This shortening of the coast will go on until a limit of about 300 miles is reached. The 14 gaps in that coastline will then be shut, except the mouth of the Rotterdam Waterway and the mouth of the Scheldt (Antwerp Waterway). Since 1930 two of the four Rhine mouths have been shut: in 1932 the IJssel by making the Zuiderzee dam, in 1950 the Brielse Maas.

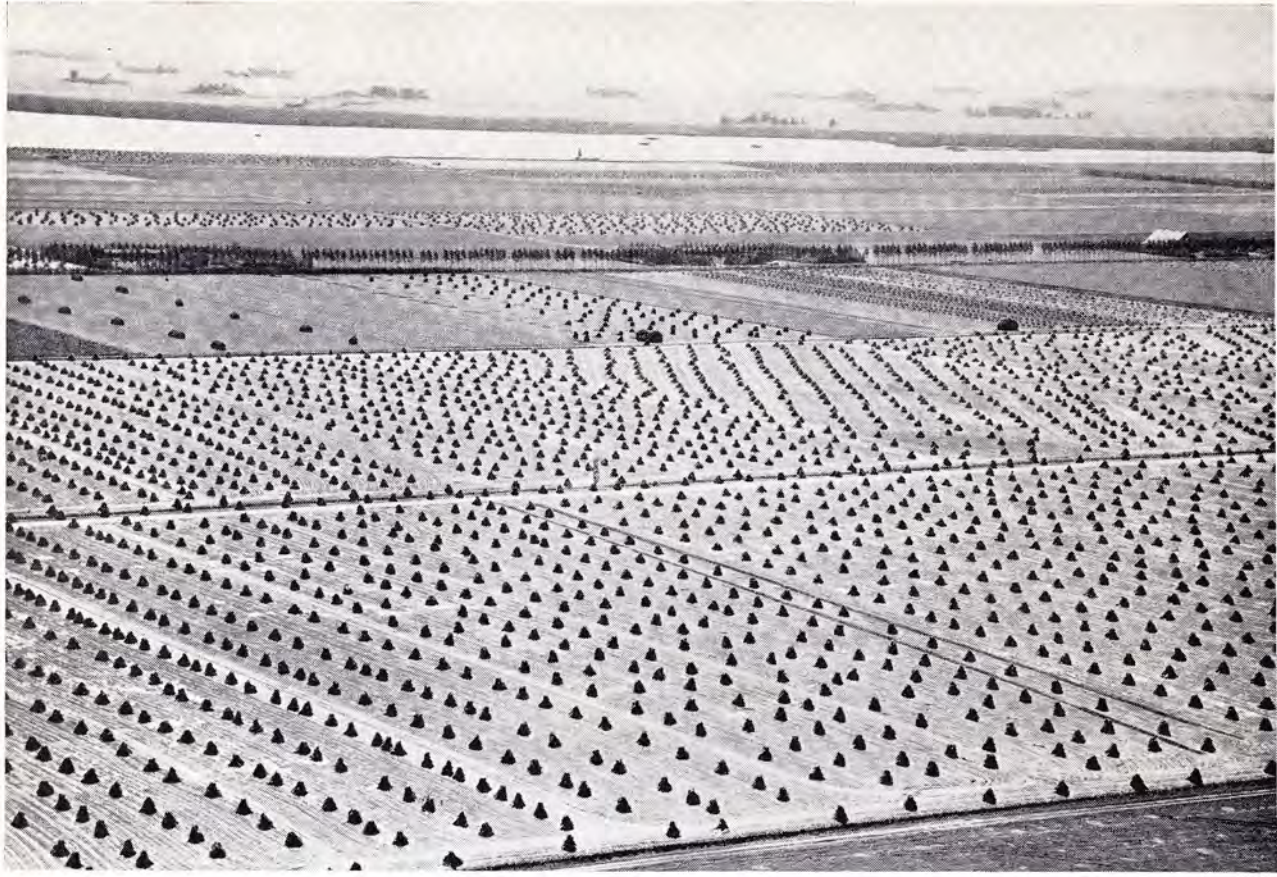
Shipping locks and sluices must be avoided too, as salt water penetrates through these structures. If a ship of say 10,000 tons enters the lock at IJmuiden (the world's largest lock) a 'phantom vessel' follows stealthily and dumps 3,000 tons of salt into the Dutch inland water system, equal to 200 carloads of salt. This is so because the sea water is heavier than fresh water.

Trees grow up quickly and the young land abounds with cattle and extremely good crops.

The shipping locks in the Zuiderzee dam also allow the sea salt to come into the interior and not less than ⅓ of the lowest discharge of the Rhine is necessary to expel some of that salt. This makes the Dutch civil engineers and farmers wince. Every gallon of fresh water can produce two pounds of dried wheat or other crop, and what an inexcusable shame it is to see all this fresh water flow unused into the sea ! Therefore the string of islands in the north must be connected by dams. Also the southern archipelago must be closed too and the sea must be wholly driven out. Hendrik Stevin wrote already in 1667 that this must be the great aim. That aim has become attainable now. The Dutch cannot afford to leave the sea inside the land, the damage is far too great, it runs into billions.

And what when the Dutch have 'finished' their land? Will they have fewer children? Will there be enough work in the future?

I see my 'mother country' smile. It has been called over-populated for 20 centuries. Moreover, though the Netherlands may be finished some day, not the world. There is the '*good Earth*' everywhere, the '*good Waters*' in the seas and also the '*good Air*' above the world, and all these elements wait to give of their infinite riches to him who works intelligently, soberly and faithfully. The world is great and beautiful and awaits development, the art in which the Dutchman has excelled from time immemorial. Today powerful machines extend his power a thousandfold – yet disasters like that of the year 1953 remind us, as of old, that we should not boast of what we have achieved, but that 'pride will have a fall'



In one of the new polders after about 10 years of preparatory work. Very little remembers of the dismal sea-mud-bottom.

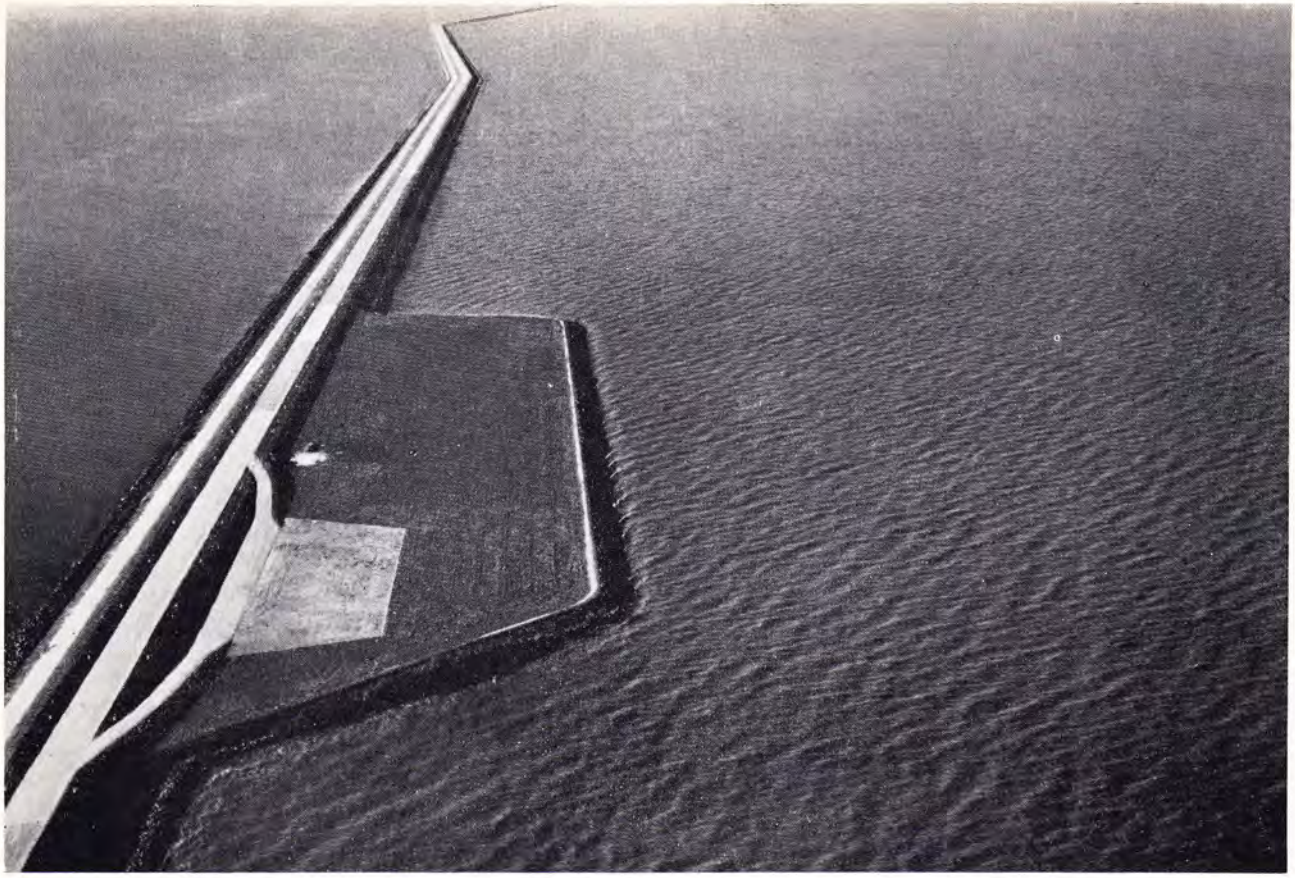
and that only the most assiduous work, study, organization and perseverance will enable us to remain victorious in the age-long struggle against the sea. All civilizations are vulnerable, but ours specially so.

The great offensive called Delta Plan

As already reported in a few earlier words, in the night of 31st January-1st February 1953, the group of islands located in the south-west of the Netherlands was struck by a flood of severity. Over eighteen hundred people lost their lives, more than 20,000 head of cattle were drowned, the dikes were damaged in more than 600 places, at 67 points the tides had made very deep holes, scouring deeper daily. About 9,000 farm buildings and houses were totally destroyed and 38,000 were seriously damaged. The total loss was estimated at nearly two billion guilders.

After this initial victory which the water had gained over man, a large-scale counter-offensive was launched. The first phase was a short-term offensive, whereby all the scouring holes were closed within a period of twelve months, followed by a long-term offensive involving a vast hydraulic engineering project to give the threatened areas greater security and safety.

This project is known by the name 'Delta Plan'. The object of this plan is to close off a number of sea arms. The lower part of the Netherlands in the south-west largely consisting of islands, will then be protected by a short uninterrupted coastline. This will cost less to maintain and be easier to defend. Thus, a far greater



The dike around the third Zuiderzee polder, called Flevoland, measuring 140,000 acres, had to be founded deeply, because the mud-layers underneath had to be removed first. The total length of this dike of Flevoland is about 60 miles. The sea to the right has been pumped dry now, the sea to the left will be pumped dry later.

measure of safety will be achieved and this must be regarded as the primary aim of this enormous project.

It may be stated here that the author of the foregoing chapters has had a large share in the preparation of the Delta Plan. This long period of studies lasted almost twenty-five years. The terrible stormflood of 1st February, 1953 proved the correctness of the maxim proclaimed by the author and his staff of scientific workers to shorten the coast wherever it would be possible, to achieve a far greater safety for the people living below sea level.

The project will have an additional advantage of considerable importance, namely the formation of a number of extensive fresh-water basins. The availability of an adequate supply of fresh water at the right times can be regarded as a primary necessity of life and this applies in particular to the agrarian sector, thus to the interests of agriculture and horticulture. Nowadays, even sandy soils can be made to yield good harvests and thanks to modern agricultural science the yields of good soils can be raised even further. Fresh water is a mighty weapon in the struggle against salting up of the soil. Salt is the other deadly weapon of the sea, which slowly but surely strives to poison the arable polderland.

It need hardly be pointed out that the river Wester Scheldt and the Rotterdam Waterway were not incorporated in the plan, as the closing of these waterways

When the Zuiderzee-bottom is pumped dry a weird desert of soft mud appears on which nobody can walk, no machine can run. The first act to make land of this mud is to sow reed-seed by planes. These reeds, 10 to 15 ft high, bring the right structure of the soil and bacterial life, necessary for crops. The reeds themselves have value for several purposes.

by dams with locks would have adversely affected the shipping interests of Antwerp and Rotterdam. Moreover, the closing of the Rotterdam Waterway would have created vast problems in connection with inland shipping over the river Rhine. Apart from this the hydraulic engineering projects involved would have been so ernormous that the preliminary study and the preparatory work alone would have taken years and years, thus making a short-term realization of the plan impossible.

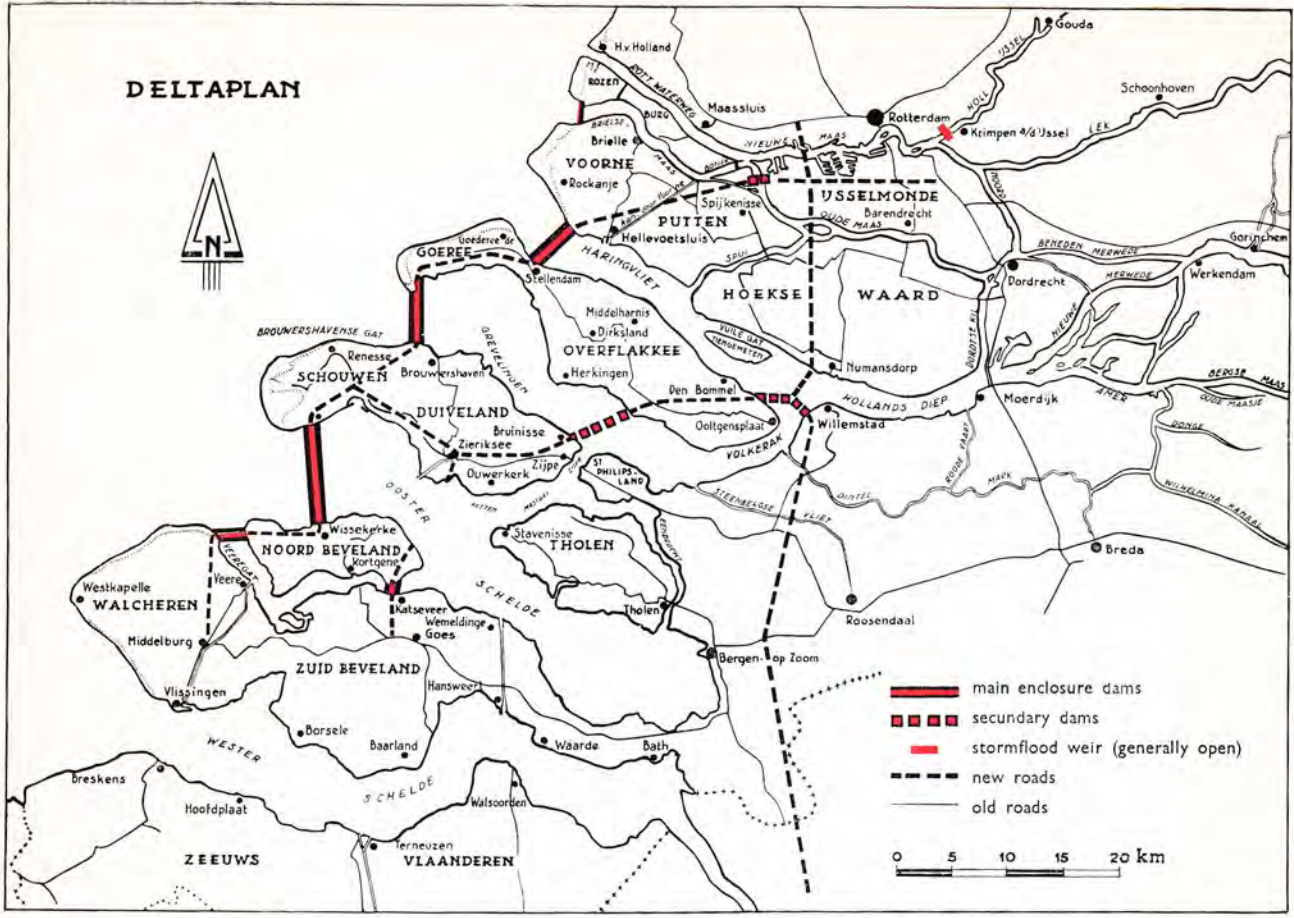
There were two possible solutions in this great hydraulic project:

a. raising all the dikes along all the coasts and sea arms;
b. sealing off a number of sea arms by means of new dikes, thus creating a much shorter coastline and subsequently reinforcing the dunes and the dikes along this shortened coast line.

The two methods would each involve a total expenditure of nearly two billion guilders and would roughly take twenty-five years to carry out.

The Delta Commission strongly recommended the second solution: the closing of three large sea arms, viz. the Haringvliet, the Brouwershavense Gat and the Easter Scheldt, as well as the smaller Veerse Gat. In addition, a number of secondary and supplementary works will have to be carried out.

In the past seven years after the stormflood disaster the Rijkswaterstaat has success-



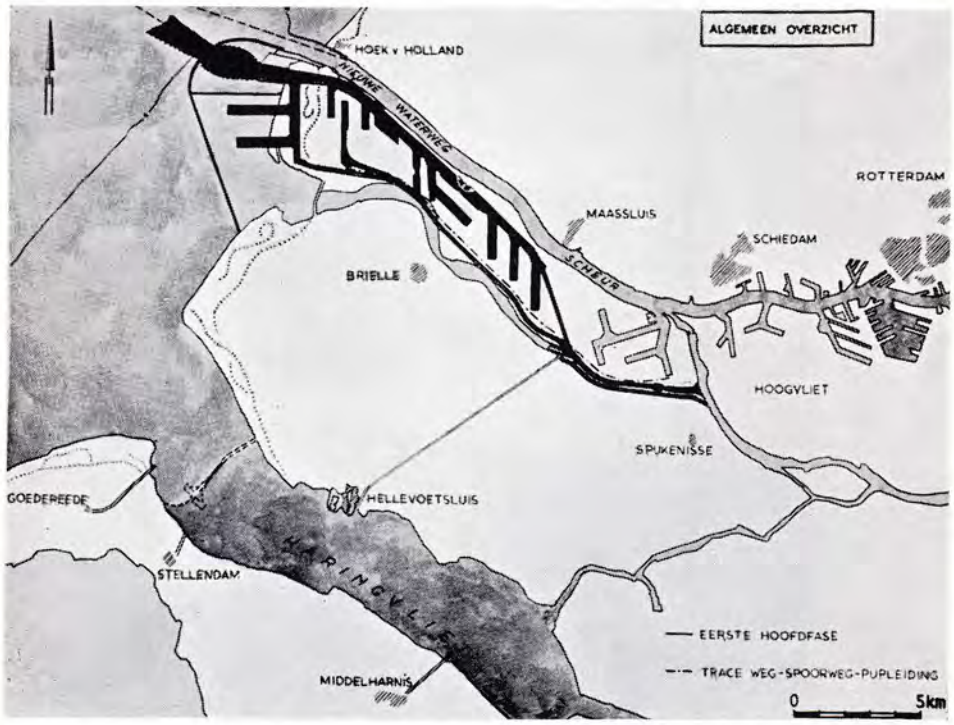
The so-called Delta Plan started after the flood of 1953, when much of the area shown here inundated. This work, greater in size than the Zuiderzee-plan, is intended to give safety to the 'Delta' and will be ready after about 25 years of intensive work. New roads over the dams will open up the archipelago. A fresh water lake will serve for agricultural purposes.

fully worked on a series of projects; the services of numerous scientific institutes and laboratories have been enlisted for a wide range of detail investigations and several parts of the vast plan are under construction or have already been realized. A number of problems remains to be solved. For example, it is quite certain that the classical methods of dike building, based on centuries of experience, will have to undergo a process of evolution.

To illustrate the vastness of the project, we need only mention the closing of the gulleys which the sea has scoured in the sandy bottom down to a depth of 33 yards below mean sea level, the strong tides in the sea arms, the gigantic quantities of material which have to be worked up into the dams. At some points these Delta dams will be approximately 450 yards wide at the base. The closing operations which – in view of the large tidal volume of these sea arms – will have to be carried out with caissons of an entirely new type.

A very important aspect of these operations is the preparation of the sea-bed to take the foundation and to prevent the sand from being washed away during the closing operations. The classical methods, involving the use of mattresses made of brushwood, will prove inadequate, as the large number of workers and quantities of material required to cover the millions of square metres for only a single sea arm are not available, even in the Netherlands.

Experiments are now being carried out to ascertain whether plastics can be used to keep the sand in position. In addition enormous quantities of stone will be required and in this case too efforts are being made to find a substitute. To this end experiments were started immediately after the disaster with mine slag – a waste product of the collieries – and much to everybody's surprise this slag proved to have promising properties for application in hydraulic engineering. Should it



Rotterdam Europoort at the mouth of the Rotterdam Waterway, made about 1880, is now being constructed. It will be able to receive superships of 50 ft depth. The whole former island of Rozenburg will be swallowed up by harbors to provide room for the trade and industries of the world's second largest harbor.

be decided to use this slag in large quantities, there will be yet another problem to solve, viz. its transportation from the collieries in the southeast to the Delta area.

Furthermore, it is certain that a lot of new equipment of greater capacity than has hitherto been available will have to be built for these projects. In addition, entirely new equipment adapted to the special requirements of the work will have to be developed and in this connection it should be mentioned as an example that the preparatory work for a floating dumping installation of large capacity is in an advanced stage.

Yet engineering alone is not enough to bring the execution of the Delta Plan to a satisfactory end and it is evident that the assistance of science will be required in many forms. Lots of work, for example, have to be done by the mathematicians

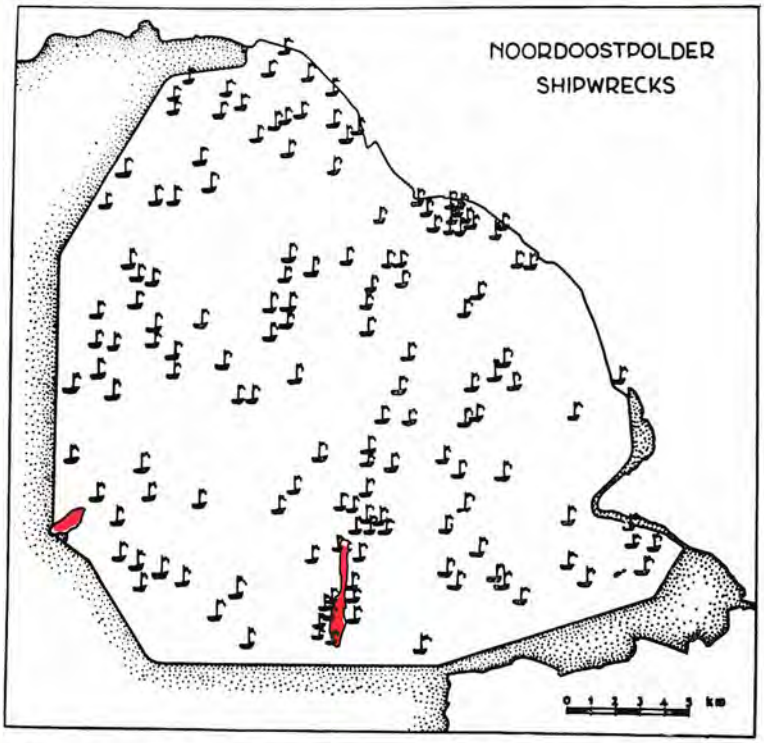
(Photo Stuvel.) The Delta works started in 1955 by closing off the main mouth of the Rhine, called Haringvliet. A sluice will be built in the central part of the tidal mouth, where a dike has been made encircling a building pit of about 250 acres. The sluice will be wide about 3500 ft. Dams to shut the remaining openings of the Haringvliet will be made after the sluice has been constructed.

of Rijkswaterstaat. They are able to derive exact figures from the results of measurements and soundings carried out in the open. In this way it has been possible to form an impression of the tidal mechanism and of the sand transports, to mention only two important points. By the application of methods, originally developed in the Netherlands by Professor Lorentz and others, it is now possible to predict on the strength of calculations the consequences of any artificial interference in an

Long wooden groynes catch silt in the delta areas, so that land of sufficient height and great fertility is being gained.

existing natural hydraulic situation. These results can be tested and checked – and, where necessary, supplemented – with the aid of hydraulic experiments with models. This type of research is carried out at the Hydraulic Laboratory in Delft by Professor Thijsse and his collaborators to solve problems of the most divergent nature. A third method of studying the behaviour of hydraulic engineering works in the tidal current areas involves the use of an electric model of the Delta, which is based on the analogy between tidal currents in a system of gulleys on the one hand and electrical currents in suitable circuits in the other. The tidal currents are imitated by means of alternating electric currents and the varying discharges of the upper rivers by varying direct currents. In this way it is possible to assess all kinds of situations in a very short time. The three methods are used to supplement and check each other.

Yet, the foregoing constitutes only a small part of the scientific research involved. The Laboratory for Soil Mechanics at Delft, has already carried out a large number of drilling and sounding operations with a view to establishing, inter alia, the load-bearing capacity of the soil at those points where closing dams and other hydraulic engineering works have been planned. In addition, a large number of hydrological experiments are being carried out.



During the drainage works, made in the extensive reed fields on the former bottom of the Zuiderzee-polders, many wrecks are found. In the North-East Polder there were 125 of them, witnesses of the once dangerous inland sea during many centuries. In the left corner and in the middle of the drawing the former islands of Urk and Schokland are indicated.

Further, the Royal Meteorological Institute at De Bilt has been called in with a view to gaining better insight into stormfloods which are likely to occur in the future. This information is important to determine the height of the main water defenses. In addition, a study is being made of the phenomenon of soil subsidence, inter alia, by determining the age of objects found in the soil, which can be done fairly accurately by measuring the radio-activity of the carbon.

Of the projects which had to be carried out, the movable stormflood defense in the mouth of the Hollandse IJssel, some miles east of Rotterdam, is now completed. A belt dike has been built within a year in the middle of the Haringvliet (page 32). The water enclosed by this circular dike was pumped out. So, a building pit in the open sea was made. It will take six years to construct the seven-

teen discharging sluices, each 62 yards wide and with a total length of 0.62 mile. A start has been made with the secondary dams in the Volkerak and Grevelingen. The so-called Three Island-Plan in the south is in full swing. There, between Walcheren and North Beveland, the first main dam will be closed in 1961. The construction of this dam may be regarded as an experimental project, as a general rehearsal for the greatest offensive, ever undertaken against the sea: the Delta Plan.

Because of religious tolerance many foreigners came to Holland and thus had their share in the general development of the country. This tablet in the Pieterskerk at Leiden is a remembrance of the Pilgrim Fathers of whom the Magistrate of Leiden wrote in 1625: 'These English have lived among us now these 12 years and yet we never had any suit or accusation come against any of them'.

Conclusion

Having had to struggle for centuries against the constant assault of salt and water, it is no wonder that hydraulic engineering has become second nature to the Dutch and the 'art of the nation'.*

As far back as the 17th century many foreign countries, including England, France, Scandinavia, Belgium, Italy, Germany and Russia invoked the aid of Dutch hydraulic engineers to build their harbors, construct their dikes, drain their marshes and dig their canals. The art and tradition of these old workers in mud and water live on in the present generation.

The principal hydraulic contractors originated and are still established in the districts which have a long history of unremitting war against the water. Nowadays, however, they are equipped with a mighty fleet of dredgers, barges, cranes, hoppers, tugs and all the most up-to-date material required for the largest hydraulic projects.

Their engineers and workers can be found in all parts of the world, in the Near East, South America, Africa, Australia and Canada.

In their own country they can call on the services of one of the best equipped hydraulic laboratories, in Delft, and for the past few years of the open air laboratory in the North-East Polder

* 'Dredge, Drain, Reclaim, The Art of a Nation' by Dr. Johan van Veen. Published by Martinus Nijhoff, The Hague. This copiously illustrated book vividly describes the feats of Netherlands hydraulic engineers all over the world, in the past and present. (Editor)

near the picturesque old town of Vollenhove. There, local conditions can be reproduced on a small scale, enabling conclusions to be reached concerning currents and deposits which may result from the construction of harbors, new dams, the shifting of river mouths and the many other problems confronting the modern engineer.

As the disaster of February 1953 has shown, the struggle of the Netherlands against the water is unending. Terrible though this catastrophe was for the victims, it has evoked fresh forces in the people of the Lowlands; it will stimulate our engineers to still greater efforts, backed by fuller knowledge and experience, to tackle hydraulic problems in this country and all over the world.

Advisable tours in Holland

1. The Rembrandt country is typical polder, the 'bosoms' are higher than the land itself.
2. River dikes with roads on top of them. Alblasserwaard and Krimpenerwaard is old marshy country. Ancient farms with 'water-stones'.
3. Country of Leeghwater. Pettemer Dike, many drained lakes, quaint old towns like Hoorn, Enkhuizen, Medemblik (King Redbad's place).
4. Frisian marshes, wealthy farmlands.
5. Isle of Schouwen, in 1953 under water. Zierikzee was (and will perhaps remain) the best preserved old town. Tholen, the place where the Roosevelt family came from, also Vermuyden.

Water Tours

6. Water tour through Zeeland. Good hydrographic charts are available. Well-buoyed gullies, fast streams.
7. Biesbos delta. Wild natural area, creeks with sand bottoms largely dry at L.W.; at H.W. about 3 ft of draught. Maps available.
8. River tours. Main rivers are excellent for motor launches.
9. The old inner dune canals.
10. The Frisian lake district. Yachting.
11. The South Holland lake district. Yachting.
12. The Wadden Sea. Dangerous primeval area of sand and water. Guides in Harlingen, Terschelling, Oostmahorn, Zoutkamp, Noordpolderzijl.

Commendable routes for typical scenery
in
HOLLAND