The Enclosure

and

Partial Reclamation

of the

ZUYDER ZEE

Composed with collaboration
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and the Management of the
— Zuyderzee-Works —

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The Enclosure and Partial Reclamation of the Zuyder Zee.

PARTS OF THE WORKS.

THE execution of the Zuyderzeeworks consists of two parts, viz.:

The enclosing to prevent the water of the North Sea to penetrate the area of the Zuyderzee destined to be embanked; and

the reclamation, by which parts of the enclosed area after having been embanked, will be drained and the reclaimed seabottom made suitable for cultivation and for inhabitation.

GENERAL SCHEME.

According to the scheme projected by the late Dr. C. LELY. C.E., the Zuyderzee will be enclosed by a dam, running from Van Ewijckssluis, a village on the coast of the province of North Holland, to the isle of Wieringen, thereby crossing the channel of the Amsteldiep (length 1½ mile) and by another dam from the east point of Wieringen to the village of Zurig on the coast of the province of Friesland (length 18½ miles). South of the enclosing dam the reclamation of the Zuyderzee will take place by embanking and draining separately four parts or polders, with a total area of about 550.000 acres, leaving out in the centre a large area of water (about 270.000 acres) provisionally called the Yssel Lake; this lake is to collect the water of the rivers Yssel, Zwartewater and Vecht, and of some other small rivers and arterial drainage systems, besides the water pumped from the reclaimed polders.

The surplus water of the Yssel Lake is to be discharged into the open part of the Zuyderzee through 25 sluices (each wide 40 ft.) built in the enclosing dam, 15 sluices near Den Oever (Wieringen) and the remaining 10 sluices on the shoals of Kornwerderzand. In connection with each group of sluices ship-locks will be built, namely one at Den Oever, and two at Kornwerderzand, on behalf of inland navigation.

Eastward of Amsterdam, a small lake called the Y-lake (area 20.000 acres) will be left, separated from the Yssel Lake by locks. On behalf of inland navigation and the drai-

ning of the low lands behind the new polders a chain of channels will be left around the reclaimed areas.

IMPORTANCE OF THE ENCLOSING DAM.

The act of June 14th 1918, prescribing the execution of the Zuyderzeeworks is based on the consideration that the enclosing of the Zuyderzee and the reclaiming of certain parts within the enclosure ought to be undertaken in the interest of the country. Every one will readily understand that land reclaiming, in this case by drainage, is profitable to the country.

The importance of the enclosing, however, is not so evident, as it is quite possible to embank and reclaim the polders separately without enclosing the Zuyderzee. But the works, undertaken at present have another purpose besides the reclamation of land. In this they resemble some of the drainage schemes achieved in the 19th century (for instance the draining of the Haarlem lake), in which the reclaiming of land was made subservient to the improvement of the drainage conditions of the adjoining districts.

Likewise, by the execution of the Zuyderzeeworks, a solution is aimed at, by which the drainage interests of the country around the Zuyderzee will tell to full advantage as well as the reclaiming of land.

Besides, by embanking parts of the Zuyderzee, according to the scheme, but without constructing the enclosing dam, a funnel shaped area would remain between the embankments, in which during Northwesterly gales the storm tide would be driven and the seawater would accumulate to such a height, that the safety of the banks would be seriously endangered. The construction of the enclosing dam will prevent this, and moreover offer a number of other advantages, viz.:

1°. the establishment of the Yssel Lake, as a freshwater lake; this fact is of great importance especially for the provinces of Northholland and Friesland, where in the dry period from April to August fresh water is badly wanted (for agricultural, horticultural and industrial purposes; for drinking water for the cattle; for the interests of public health and of inland navigation on the canals of the province of Friesland);

2°. improved drainage of the districts around the enclosed area;

3°. less costs of maintenance of the existing banks along the coast of the Zuyderzee;

4°. prevention of periodical as well as of unlooked for inundations;

5°. protection of the built areas of some small towns on the sea coast from being flooded during stormtides;

6°. more regular and faster traffic (by railway and road along the enclosing dam) between the provinces of Northholland and Friesland;

7°. safer navigation upon the Yssel Lake.

8°. possibility of developing fresh water fishery upon the Yssel Lake.

Furthermore the enclosing dam allows to decrease the dimensions of the polder embankments, which will not be exposed to stormtides (except the embankment of the N.W. polder called the Wieringermeer, which has been constructed, simultaneously with the enclosing dam and therefore has been built with a heavier profile, thereby economizing considerably on the costs. And finally the construction of this vast work will have some significance in combating unemployment.
As far as possible, the different advantages have been valuated in money; the first mentioned advantage has been estimated at more than £ 8.000.000.— while the other advantages have been estimated to represent a capitalised value of about £ 1.500.000.—.
For this reason the government have taken the attitude, that the enclosure of the Zuyderzee is of such paramount importance to a large part of the country, and of such an eminent value, that, apart from the other works, it ought to be executed in the public interest.

CONSTRUCTION OF THE ENCLOSING DAM.

The dam is made of materials dredged from the bottom of the Zuyderzee; it consists of a core of boulder clay and behind this core a body of sand, covered with a layer of clay or boulder clay.
Boulder clay is a tough kind of loam mixed with boulders of different dimensions; it is found in the bottom of the Zuyderzee in different places, as well as on the isle of Wieringen and on the south coast of the province of Friesland. It has proved to be quite fit to resist the scouring action of flowing water. For that reason, when constructing a given part of the dam, the work is started by first dumping under water the core of boulder clay to as high a level as possible, and then the sand behind it. This dumping is done from hopper

barges having a hold with valves in the bottom: by opening the valves, the contents of the hold are discharged on the right spot.
After dumping has become impracticable by lack of depth, the remaining part of the boulder clay is discharged from the barges by floating grapple cranes. The remaining sand is conveyed by suction dredges discharging it from barges through pipes after having mixed it with a sufficient quantity of water; the water then flows sideways away and the sand is deposited.
The boulder clay used for covering the sandbody is generally deposited on the dam by conveying belts or by floating grapple cranes.
The required boulder clay and sand are drawn from the sea bottom: the boulder clay by bucket dredges, the sand by suction dredges and sometimes also by bucket dredges.
Finally the body of the dam is protected against wave-action, below the waterline by mattresses of brushwork weighted with riprap, and above the water, up to a certain level, by a stone facing of basalt from the Rhine or limestone from the Meuse, and above this level by turfing.

SEQUENCE OF THE DIFFERENT ENCLOSING WORKS.

When noticing the fact, that the construction of enclosing dam is started in several places simultaneously, and not from one point, for instance Wieringen towards the opposite coast, one is inclined to ask whether a special reason has led to this method of construction.
This reason exists indeed.
In the construction of the enclosing dam one of the principles observed is, that as large a part of the work must be made without notably disturbing the existing tidal currents. By strictly adhering to this principle, it becomes possible to build long stretches of the dam before the velocity of the currents has increased considerably. On that account it was necessary to start the construction in places, where the tidal movement is slow, i.e. on the shoals. Consequently in 1928 the section of the enclosing dam between the foundation pit on the Kornwerderzand and the coast of Friesland was built on the shallows of Makkummerwaard (length about 4000 yards). Likewise in 1929 a section of 2200 yards with two construction harbours on both sides of the dam, was finished on the shoals of Breezand, about half-way between Wieringen and Kornwerderzand; in this way a startingpoint was obtained, from which the construction will be continued in two direc-

tions. The harbours are made use of as salving harbours for the plant working on the North and the South sides of the dam and for the supply of materials. The south harbour is also destined for the large dredging plant working at sea; consequently it is more spacious than the other.

Moreover, it was found that it is possible to limit considerably the depth of the different channels at the point, where they are to be crossed by the enclosing dam, by building an artificial sill below the water level without restricting significantly the capacity of these channels. Consequently by constructing sill dams in the deeper channels, a large part of the work, can be achieved without disturbing the tidal movement. Increase of velocity of the currents in places, where at present they are slow, is not to be feared either; therefore the construction of the dam in these places will not be hindered. For this reason, the building of the sill damms is being executed in the first stage of the enclosure.

In 1929 the sill of the channel — „de Middelgronden", westward of Kornwerderzand, has been finished, and the construction of the sill of the channel — „de Vlieter" (about 3 miles east of Wieringen) has been started.

The works have progressed favourably in 1929; accordingly it was possible to build another section of 1200 yards length on the shoals, east of Wieringen between the channels „het Gaatje" and „het Zwin".

The above mentioned sections of the enclosing dam are to be lengthened and extended over the shallows towards the deeper channels in which the sill dams have been made; finally, by building a boulder clay dam on top of these sills the last openings will be filled up and the final closing will be achieved.

For the whole winter season preceding the final closing the tidal currents from and towards the Zuyderzee will have only the sill dams left to run across. During storm tides the crests of these dams will evidently be exposed to the scouring action of very strong currents; they must be able to withstand this action, without suffering much damage until the moment of final closing, otherwise serious consequences might be involved.

The sill dams are being made of boulder clay, but as it was deemed that even this material will not stand the very strong currents expected during the last winter before closing, they are protected by a covering of strong mattresses of brushwork, weighted with heavy riprap. This protection is extended to cover the sea bottom over a certain length on both sides of the sills, to prevent scouring in these places.

FINISHING THE ENCLOSING DAM.

The enclosure was started in 1924 by building the enclosing dam across the Amsteldiep, while in 1927 the construction of the dam between Wieringen and Friesland began.
Though at first the complete finishing of the dam was expected during the year 1934, the expeditious execution will probably make it possible to have the work finished in 1932. To this end, of the still remaining length, of 12½ miles of the enclosing dam in the years 1930, 1931 and 1932, sections of about 5¼ m., 5 m. and 2¼ m. length will have to be built.

SLUICES AND LOCKS IN THE ENCLOSING DAM.

The locks and sluices designed in the enclosing dam on behalf of navigation and of the discharging of the surplus water of the Yssel Lake include:

a). at Den Oever, east of Wieringen: 3 sets of 5 sluices each, with a length of 165 ft. and a width of nearly 40 ft., consequently a total width of 600 ft. besides a ship-lock wide 46 ft. with an intermediate pair of gates and a maximum length of 465 ft., destined for ships of 2000 (metrical) tons with tug. Each set of five sluices bears upon a continuous foundation slab of reinforced concrete, measuring 290 by 165 ft. and thick 4 ft. 3 in., laid directly on the subsoil of the boulder clay. The construction was started in February 1927.

b). On the Kornwerderzand, about 2½ miles from the coast of Friesland: 2 sets of 5 sluices, similar to the above mentioned, with a total width of 400 ft., besides two ship locks, one of 46 ft. width and 465 ft. length (without intermediate gates), and one wide 29 ft. 6 in. and long 230 ft. intended for ships of 600 (metrical) tons.
Owing to the condition of the subsoil as revealed bij borings, it was resolved to make the continuous reinforced concrete slabs bear upon a foundation of wooden piles, of which 12.000 were required.
The construction was started March 1928.

On behalf of the traffic by railway and road along the enclosing dam, the approaches of the locks are to be crossed by swing-bridges. The different sets of sluices have a distance of about 295 ft., between the sets, smal sections of the enclosing dam are constructed.

The sluices and locks are being built upon the excavated sea bottom, which had first to be enclosed by a temporary banking and drained afterwards: small polders (of 75 acres) performing the duty of foundation pits. These temporary bankings will have to be removed again as far as necessary, when the sluices and locks will be put on the service. The locks have to be used already before the enclosing dam is quite finished, towards the end of 1930 or the beginning of 1931. The sluices will have to start working approximately one year later.
Each sluice is provided with one pair of steel tidal gates and with two steel sluice gates travelling up and down between reinforced concrete towers.

THE BALGZAND CANAL WITH BRIDGE.

In the years 1924—1925 the enclosing dam accross the Amsteldiep between the coast of North Holland and Wieringen has been built. It was to be expected, that the closing of this channel would cause an extensive accretion of the coast near the point where the enclosing dam meets it, and that, consequently, the level of low water was to rise, and the drainage by gravitation of the Anna Paulownapolder (a district in the neighbourhood) through the sluice, called Van Ewijckssluis, south of the junction, would be hindered.
To meet this deficiency the Balgzand canal was dredged in the years 1923 to 1925 along the coast on the sea-side of the existing bank from Van Ewijckssluis to Oostoever. By means of this discharge canal, the evacuation of the Anna Paulownapolder was transferred to the Nieuwe Diep, the harbour channel of Helder.
Besides serving as a discharge for the above mentioned polder, the Balgzand canal constitutes a part of the canal, required as a consequence of the reclamation of the Wieringermeer, to receive the discharge water of the polders along the adjacent coast between Aartswoud and Van Ewijckssluis, which formerly was evacuated into that part of the Zuyderzee.
At the same time the canal will serve inland navigation to and from the small harbours on that coast; otherwise by the closing of the Amsteldiep and the embanking of the Wieringermeer they would have been cut off.
As long as the Wieringermeer had not yet been embanked, the canal between Van Ewijckssluis and Oostoever was closed by a temporary dam near the former locality, in order to pre-

vent the storm-tides in the Wieringermeer to penetrate into and damage the canal. This dam was also made use of to make a communication between the isle of Wieringen and the continent, in anticipation of the construction of a bridge across the canal for railway and road traffic. The bridge was built in 1929 and opened to traffic in September of the same year; then the temporary dam was dredged away within a week, and the Wieringermeer was brought into communication with the Balgzand canal; through the pass of Kolhorn (then still kept open) the canal from Kolhorn to Oostpunt and the Amstel Lake. This communication at the same time offered an opportunity to evacuate part of the water in the Wieringermeer before the pumping was started.

Embanking and draining the Wieringermeer.

THOUGH the benefit of land-reclamation is evident, it may be of some interest to consider the significance of the undertaking to the country.

It has been mentioned that the reclamation of the Zuyderzee includes four polders, viz.,

a north-west polder, area	50.000	acres
a north-east polder, area	135.000	acres
a south-east polder, area	230.000	acres
a south-west polder, area	135.000	acres
total area	550.000	acres

i.e. approximately 7% of the total and about 10% of the arable area of the Netherlands, a surfice corresponding to that of the province of Groningen.

INCREASE AND DECREASE OF ARABLE LAND.

According to the statistics published in 1924, the increase of territory in the Netherlands by embanking and reclamation has been about 250.000 acres since 1846; the following of waste land has yielded an increase of arable land of about 800.000 acres; consequently during the last century the total increase of cultivable land has been more than 1.000.000 acres, giving an average of 10.000 acres per year.

On the other hand there has been a serious loss.

During the years 1833—1922 the increase of built areas in the Netherlands has been about 80.000 acres, proving that the growth of the population leads to a notable decrease of the cultivable area, a decrease still progressing.

By extension of towns, construction of roads, canals and harbours, in the 10 year period 1912—1921 a surface of more than 60.000 acres has been withdrawn from cultivation, giving a loss of 6000 acres per year; this leaves a balance of only 4000 acres for the increase, while the population is growing fast.

SHORTAGE OF ARABLE LAND.

Anyhow, there are many indications of a shortage of arable land in the Netherlands, and the increase of the rural population accentuates this shortage more and more.
These indications are given by the high prices of the land (both in purchase and lease); by the large members of persons interested in public sales and locations of land; by the deserting of the land by young farmers, tired of waiting for their opportunity; by the exploitation in community by the children of the parents estate, because the opportunity of separate establishment is wanting; by the unnatural extension of horticulture; by the ever progressing splitting up of holdings for want of arable land, which in the long run will affect seriously the economic strength of agriculture. Evidently this look-out is rather alarming for this country, obliged to lean on its rural industry for a large part.

CULTIVATING OF WASTE LANDS A RELIEF?

Many times the question has been asked, why cultivation of waste lands is not undertaken on a larger scale than heretofore. It must be borne in mind, however that the avalable area of waste lands, fit for cultivation, has already been reduced considerably. The total area of waste lands in the Netherlands amounts to 1.150.000 acres; a large part of these is totally unfit for cultivation, and will have to be afforestated; and even an intensive fallowing of the remaining lands could never meet the demand of arable land of the farmers on the lighter soils.
It has been pointed out moreover, that especially in the districts of the heavy clay and the pasture-grounds, resembling most the soils to be reclaimed from the Zuyderzee, the shortage of arable land is stronger felt, and it is quite unavoidable to take measures to remedy this situation.
Though originally it was intended to enclose the Zuyderzee first and to start the reclamation works afterwards, in view of the shortage of land, it has been resolved to undertake the reclamation of the Wieringermeer at the same time with the enclosing.
It is expected that the realization of the whole reclamation scheme will supply about 6000 holdings with an economical area, giving prosperity to a financially strong rural population.

EMBANKMENT WIERINGEN—MEDEMBLIK.

In 1929 the construction of the embankment of the Wieringermeer, begun in 1927, had progressed so favourably, that only two openings remained, one at 2¾ miles north of Medemblik and wide 1600 yards, and the other between Wieringen and the shoals of De Oude Zeug, wide 3 miles. Though because of the severe frost in 1929 the works started late in spring, — the contractors managed to close the gap near Medemblik on July 3rd. 1929. In agreement with the previous calculations, no trouble of any significance was experienced from increased velocity of the tidal currents, either by scouring out of the boulder clay and the sea bottom, or in the use of the plant.

The closing of the northern gap was achieved on July 29th. 1929, by rising the boulder clay core till above the water level; after this the dam body was finished regularly.

CANAL AARTSWOUD—KOLHORN—AMSTEL-LAKE.

It has been mentioned that along the North Holland coast of the Wieringermeer a canal is required to serve as a collecting drain for the polders, the water of which formerly was evacuated in the Wieringermeer, and that consequently this canal is to be considered as an extension of the Balgzandkanaal.

Between De Kooi and Kolhorn the canal is destined for ships of 600 metrical tons.

The sluice near Oostpunt, delivered up to navigation on September 16 th. 1929, will remain open in normal circumstances; it is destined to be closed, in case a breach might occur in the enclosing dam through the Amsteldiep, to prevent the Wieringermeer from being inundated.

Near Oostpunt the canal joins the Amstel Lake, a storage lake of 1650 acres south of the enclosing dam, destined to accomodate the drainage water supplied by the canal in periods when the discharge at Oostoever is blocked by high stormtides. The storage lake has been left south of the dam, because in this part of the Amsteldiep some passes are to be found, the bottom of which is too deep to be drained. The lake is bordered on its south side by an embankment, the „Amstelmeerdijk" between Oostpunt and Haukes, where it joins the existing bank along the south coast of Wieringen. This junction has been performed in such a way, that the existing fishingharbour remains open, and that a second basin of 280 by 110 yards is established with a depth 12 ft. at the same time serving as an access to a ship-lock, giving admission to the Wieringermeer.

DREDGING OF CANALS AND MAIN DRAINS IN THE WIERINGERMEER.

The dredging of the required canals and main drains has already been started during the construction of the embankment between Wieringen and Medemblik; not only to facilitate the flow of the water towards the pumping stations, during the pumping and the gradual emerging of the former sea bottom, but also because dredging is the best and cheapest method of constructing these canals.
On behalf of the formation of the canals, about 12.000.000 cu. yd. was to be dredged, and for the main drains about 8.000.000 cu. yd., these huge quantities necessitated the beginning of the works in 1928 to secure on early completion.

PARCELLING.

It is evident, that the above mentioned dredging operations could not be started before a general drainage scheme of the polder, establishing the trend of the canals, main drains and roads, the emplacement of the pumping stations and of the locks between the different sections of the polder, had been drawn up. This scheme was worked out in 1927.
According to the plan, the polder is subdivided into four sections, owing to the divergence of level in the different parts of the Wieringermeer; each section has its own water level, 4 ft. 8 in. below the surface of the lowest land in that section. Provisionally the water level in the four sections has been fixed respectively at 15 ft. 2 in., 17 ft. 5 in., 19 ft. 8 in., and 22 ft. 0 in. below normal Amsterdam Level.

Communication in and with the new polder.

The main drainage canals, at the same time destined for navigation, have been traced generally along the borders of the sections, and are to be connected by locks (total number 6). By other shiplocks near De Haukes, Den Oever, Medemblik and Kolhorn (all of them finished already) these canals will be in communication with the surrounding waterways. The two first mentioned locks give admission to normal canals, the dimensions of which are calculated for ships of 80 to 100 metrical tons and 40-tons motorbarges, while the locks near Kolhorn and Medemblik give admission to a canal between these two places, adopted to ships of 200 to 300 tons and 80-tons motorbarges.
For communication by land a main road, connected with the arterial road from North Holland along the enclosing dam

to Friesland, is projected from Den Oever to the planned central locality of the polder, and from there to different localities at the periphery, like Medemblik, Lambertschaag, Aartswoud, Kolhorn; also to De Haukes, in connection with the arterial road over Van Ewijckssluis southwestward. This network of roads is projected chiefly along the canals, and consequently along the borders of the polder sections, and will provide the polder with adequate means of communication within its boundary as well as with the surrounding districts.

Mound in the polder.

The planned central locality is projected in section III, on the border of section IV; in that place a mound has been built with a crest, measuring 110 by 220 yards, at a height of 6 ft. 6 in. above normal Amsterdam Level. Upon this mound several public buildings will be erected; in case of an unlooked for rupture of the polder embankment, it can be used as a temporary refuge for the population, dwelling in the neighbourhood with their cattle.

Dimensions of parcels.

The polder has been parcelled chiefly in accordance with the system, recommended by a Royal Commission under presidency of Mr. L o v i n k: each parcel will have a surface of about 40 acres, with a length of 880 yards and a width of 275 yards. The short ends are bordered by a metalled road on one side and by a collecting drain accessible to scows on the other side.
In consequence of the desirability, expressed by certain specialists, of trying another system, in some parts of the polder, this system has been projected, the parcels of which have a length varying from 550 to 1650 yards, and a width in some cases differing also from that of the parcels, according to the general system. In this system ample opportunity is offered to transport the agricultural products from the land to the factories with ships of 80 to 100 metrical tons.

Free space underneath bridges.

Originally the free space between the water level and the lower part of the bridges was projected at $8\frac{1}{2}$ ft.; afterwards it was increased to 13 ft.; in view of the encumbrance of road traffic to be caused by the rather long slopes, the number of bridges has been limited as much as possible.

Residences.

The centres of habitation of the future population, the exact emplacements of which cannot be decided on yet, are planned along the main roads at distances of about 2½ miles.

DRAINAGE OF THE POLDER.

The initial draining of the sea water, entrapped by closing the embankment, is done by two pumpingstations near Medemblik and Den Oever; afterwards they will be used to keep the polder dry.
In order to meet the far reaching requirements of modern agriculture in relation to the capacity of the pumping stations, this capacity must be able to maintain the above mentioned water levels within a fluctuation of less than 10 in. As a consequence of this exigency, the pumping stations will be capable of emptying the polder within 8 months, provided that they will function continuously and the polder is expected to be dry in the autumn of 1930.
The drainage of the polder has been distributed over two stations, in order to obtain more safety in case of trouble. And since the pumping plant of the station near Medemblik is driven by electricity and near Den Oever by gasoil (Diesel-engines), the drainage will not be dependent on one kind of fuel: an advantage of much interest in case of a stagnation in the supply of one of these fuels.

The „L e l y", the pumping station near Medemblik, has 3 centrifugal pumps with vertical shafts, driven by regulable electro motors with a normal speed of 107 rounds per minute; the capacity of each pump is 86.000 gallons per minute with an average head of 20 ft.
Under normal circumstances each of the three pumps will drain one section of the polder, viz. the sections II, III (partially) and IV while the complex of intake passages has been planned in such a way, that in case of trouble with one of the pumps any section can be drained by any one of the other pumps.

The „L e e m a n s", the pumping station near Den Oever, contains two centrifugal pumps with horizontal shaft directly coupled to six cylinder Diesel engines; the pumps have each a normal capacity of 61.100 gallons per minute with an average head of 17 ft. 5 in., while the speed is regulable between 125 and 175 r.p.m. Under normal circumstances each pump is to drain one section viz. the sections I and III

(partially). In this station too the intake passages allow to drain any section with any pump. Part of the building has been reserved for an eventually needed third pump. According to the description above, section III, by far the largest, is to be drained in both places.
When functioning together, the two pumpingstations can remove 380.000 gallons of water per minute under normal circumstances, or 5.500.000 gallons each day.
During the initial draining, however, a much higher capacity is obtained, as the head is much lower; and besides especially constructed impellers are used in the pumps; consequently during the first months of this period the capacity is increased to nearly 9.000.000 gallons per day.

WORKS IN THE POLDER.

It is evident that, after the entrapped water has been removed and the sea bottom in the embanked area has emerged, much work will have to be done to make the soil suitable for cultivation and for habitation.
Besides the construction of roads, this work includes the excavation of feeding drains with a total length of about 750 miles, and of ditches with a total length of about 25.000 miles (i.e. equal to the circumference of the earth) if the distance of the ditches is to be 16½ ft. and a length of about 12.500 miles, if that distance is to be 33 ft.
These figures in some degree give an idea of the task waiting.

DISPOSAL OF THE LAND.

It has not yet been decided, in what way the land is to be disposed of, after it has been made cultivable. With reference to this question the government have requested an advice from a Royal Commission under presidency of Mr. V i s s e r i n g.

The experimental polder near Andijk.

IN the first album issued, it has been mentioned, that in 1927 an experimental polder of 100 acres has been embanked near Andijk, on the coast, between Medemblik and Enkhuizen, destined to research in relation to removing the sea salt from the soil and in relation to preparing the soil for cultivation.

The first requirement in behalf of an economical development of the reclaimed parts is, that agriculture ought to be carried on under conditions as favourable as possible. To this end care must be taken from the start, that the soil is treated according to such methods as will ensure the best output.

The land to be reclaimed has been covered by the seawater for centuries, and is heavily charged with salt. The grounds of the northwestpolder (Wieringermeer) have a mean salinity of 2%, those of the S.W., S.E. and N.E. polder have a salinity respectively of $1\frac{1}{2}$%, $\frac{3}{4}$% and $\frac{1}{2}$%. These percentages show clearly the influence of the fresh water, carried to the Zuyderzee from the surrounding districts and by the rivers Vecht, Eem, Yssel, Zwarte Water, etc.

The Royal Commission under presidency of Mr. L o v i n k, in their report, dated 1924, advocated strongly the desirability to try the practical application of the different recommended methods of preparation of the soil in an experimental polder, before applying them on a large scale in the first reclaimed polder.

The Government agreed with this proposal, and in 1926 the embanking was started of a small part of the Zuyderzee, outside the areas to be reclaimed, but with a bottom, the character of which resembled that of the future polders, and therefore very suitable to the purpose.

The outlay of the experimental polder has been approximately £ 83.000. This amount is rather large in comparison to the gain of 100 acres of land, but the purpose of the enterprise lay elsewhere. By applying the outcome of the research, it will probably be possible to raise the output of the reclaimed soil of the Wieringermeer to its normal value a few years sooner than would have been the case without an

experimental polder. Moreover, expert cultivation will show in the output, and consequently the selling value of the land need not be influenced unfavourably by contrarieties caused by cultivation without expert information. When criticizing the outlay of the experimental polder, it must be measured by its general economical value, and not by the cost per acre of the land.
The cultivation of the experimental polder could not begin before it had been pumped dry (in August 1927) and various operations in relation to drainage had been performed. After this, a few wooden buildings have been erected, viz. a farm and laboratories for agricultural, microscopic and soil research.

Research in the experimental polder is threefold:

a). physico-chemical soil research to collect data in relation to the leaching out of the soil, the transmutation of natron-clay into lime-clay, and the properties important to soil-structure;

b). micro-biological research, to obtain insight into the gradual transition of sea bottom to cultivated soil, as far as lower organisms act a part in this change;

c). laying-out of experimental plots to collect evidence about the possibilities of cultivation during the different stages of evolution of these young soils.
Obviously this evidence cannot serve as a fixed measure, as circumstances will often be quite different in the Wieringermeer, but the outlook will be enlarged and the rational cultivation of the reclaimed land in the Zuyderzee will profit by it.

One of the most important problems dealt with in the experimental polder concerns the ditching. Formerly in new soils open ditches were considered, indispensable though they were an encumbrance and demanded much care; hence the question has been raised whether the required efficiency can be obtained by a more economical drainage system.
In the experimental polder open ditches deep from 24 to 36 in. at distances of 27 ft. are being compared systematically with open ditches deep from 12 to 18 in. at distances of 13½ ft. and with series of under-drains at depths from 36 to 44 in. at distances of 27 ft.
The results obtained in the polder with different crops are very satisfactory as yet.

In 1928 already, the mixtures of grasses and clover gave an excellent crop with a large output; the clovers too gave a good yield; the development of the pigeonbeans was moderate and the other crops flourished well.
As a consequence of the rigorous winter, the soil structure was remarkably good in spring 1929.
By contrast with the preceding year, in 1929 nearly the whole polder could be cultivated; in consequence, an opportunity was created to study the development of the crops with the different drainage systems.
By the laying-out of experimental plots for fertilizers sown with oats, peas, beetroot and mustard, the need of nitrogen, phosphor and potassium of the new soil has been investigated.
The condition of different crops sown in plots without any manure and the exceptional luxuriant growth of herbs, led to the presumption, that manuring will not be necessary provisionally for this young and heavy clay with an excellent structure. Stableding was also experimented with.
In another part of the polder experiments were undertaken with horticultural crops, and trees, of interest to young polders, were planted.
In general the crops showed a tendency to short straw (or leaves); relatively the output of grain (or roots and bulbs) has been higher than the output of straw (or leaves). The weights of volume-unities were normal. The results of the laying-out of pastures were satisfactory in general.

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Persons desiring to visit the experimental polder under guidance have an opportunity of doing so every Tuesday and Friday afternoon at 2 o'clock. For visits at other times a written application should be made to the agricultural agent, ir. W. A. BOSMA, Andijk (West) near Medemblik.

Costs of the works.

THE question of the costs of the undertaking is of too much interest to overlook it.

In 1924 the costs and profits have been evaluated as follows:

Works to be executed	Costs	Total outlay	Evaluated profits
A. Enclosing dam.	£ 7.500.000.-	£ 7.500.000.-	£ 10.000.000.-
B. Reclamations:			
N.W. polder.....	„ 3.100.000.-		„ 3.600.000.-
S.W. polder.....	„ 8.400.000.-		„ 10.000.000.-
S.E. polder.....	„ 11.900.000.-		„ 18.300.000.-
N.E. polder.....	„ 7.000.000.-		„ 10.100.000.-
Total costs till the land has reached its normal value	£ 30.400.000.-		
Output of the land till then	„ 7.900.000.-	„ 22.500.000.-	
	Total.....	£ 30.000.000.-	
Interest (5 %) till then		„ 15.300.000.-	
		£ 45.300.000.-	£ 52.000.000.-
C. Requirements of national defence and fisheries.....		Memorial	

According to a later communication of the Government, however, the construction of the enclosing dam, calculated with the prices of 1928, will require a total amount of £ 10.700.000, or £ 3.600.000 more than the evaluation of 1924; while the reclamation of the Wieringermeer (N.W.-polder) c.a. will cost £ 5.000.000 or £ 1.900.000 more.

This rise of costs is caused by three factors, viz.:

1st The rise of the level of the prices of public works, in particular of dredging;

2nd higher demands made to the works during the construction;

3rd more expensive execution of the works in the open sea than could have been foreseen.

The first factor is the most important, as respectively £ 1.900.000 and £ 1.100.000 of the above mentioned differences are due to its influence.

Meanwhile it is evident now, that the costs of the enclosing works have been 8½% lower in 1929 than they should have been according to 1928-prices. If this situation remains, the enclosing dam will cost £ 10.000.000, or £ 700.000 less.

The other works have not yet been evaluated, in anticipation of the data to be collected from the works at present in course of construction.