OBSERVATIONS ON THE ALGAL VEGETATION OF THE NORTHERN PIER AT HOEK VAN HOLLAND, MADE FROM OCTOBER 1953 TILL AUGUST 1954

by

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I. Introduction

The Netherlands' coast being sandy and muddy is not suitable for most algal growth. Dikes, piers and harbour-works replace the rocks elsewhere. The pier at Hoek van Holland is one of these artificial rocky coasts. It has been constructed with basalt blocks and other hard stones, viz. the so called "Nilvoordste steen" and "Doornikse steen", both from Belgium.

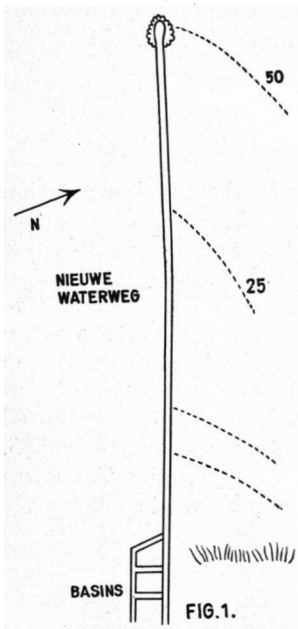


FIG. 1.
Depths in dm

The pier projects into the sea about 1350 m. On the southern side it is washed by the mouth of the Nieuwe Waterweg, on the northern side by the North Sea. A little more (fig. 1) up the Nieuwe Waterweg there are several basins enclosed by a dam parallel to the pier and a number of dams at right angles to it, thus replacing the rockpools of natural rocky shores.

The upper side of the pier is covered by big concrete slabs since 1948; before that time it was bearing a rail, under which a number of small artificial rockpools. Although the vegetation of these rockpools is not described they are sometimes referred to in the checklist.

The tide.

The medium high water level is situated 88 cm above N.A.P., and the medium low water level 70 cm below N.A.P., so that the mean difference between high and low tide amounts to 158 cm. See also table 1. The extreme low water during spring tide is as low as 103 cm below N.A.P.

TABLE 1

M.H.W.S. = 1.04 m + N.A.P.
H.H.W.N. = 0.76 m + N.A.P.
M.L.W.S. = 0.66 m — N.A.P.

During strong W. winds and especially N.W. winds, the tidal levels are raised considerably, during strong E. winds, especially S.E. winds they are lowered. The lowest level was reached on January 25th, when it was as low as 1.65 m below N.A.P.

The wind and the humidity of the air.[1])

The wind is blowing mostly from western directions and more especially from the S.W. (see table 2). The N. side of the pier is most exposed to the surf, also during S.W. winds. In that case the waves are coming from about N.W. because they change their direction on the shallows on the N. side of the pier (a phenomenon identical with light refraction, see P. Groen, p. 220—229).

The water of the Nieuwe Waterweg on the S. side of the pier is mostly quiet, it being sheltered by the N. and S. piers. Only when the winds are blowing from S. to S.S.W. the S. side too can be washed by a relatively strong surf.

TABLE 2

Percentage of hours, during which the winds blew from different directions during the years 1953 and 1954 (data furnished by the K.N.M.I.).

Year	S.	S.W.	W.	N.W.	N.	N.E.	E.	S.E.	no wind
1953	13	22	17	9	11	13	7	4	3
1954	15	23	16	9	9	10	10	7	2

Periods of strong E. winds are unfavourable for the algal vegetation as the latter dries up: 1. by the lowering of the tide, 2. while the relative humidity of the air is rather low during E. winds. The lowest Relative Humidity in winter was reached in the last decade of January; the mean R.H. amounted to 71 %, the minimum R.H. on January 27th amounted to 55 %. The lowest R.H. of the year was reached in May, when the mean R.H. for the second decade amounted to 59 %, the minimum R.H. on May 14th to 34 %. The maximum R.H. for the time of observation was reached in the first decade of December, when the mean R.H. amounted to 94 %, the maximum R.H. on December 5th and 6th amounted to 100 %. Also in the last decade of February the R.H. was very high; the mean R.H. was 92 %, the maximum R.H. 97 %. Moreover, in winter it mostly freezes during E. winds.

Temperature.[1])

An important factor for the littoral algae is not only the temperature of the water, but also that of the air. The minimum temperature of the air was reached in the first week of February 1954; the mean temperature of the first decade amounted to — 4.1° C., the minimum temperature in the night of February 2nd to — 12.7° C. The minimum temperature of

[1]) The meteorological data were furnished by the Royal Meteorological Institute (K.N.M.I.) and were collected at Naaldwijk, about 7 km E.N.E. wards. The data concerning the temperature of the seawater were collected on the light ship Goeree.

the water was reached a decade later; the mean temperature of the seawater during the second decade amounted to 1.4° C.

These two weeks of frost had a destructive influence on the algal vegetation. Most species did not survive, except several species of the lower littoral belt, like Pylaiella littoralis (midlittoral), Polysiphonia urceolata, P. nigrescens and Ceramium deslongchampsii. After this destructive period most of the littoral belt had to be recolonized.

The maximum temperature of the air and the water was reached in August, when the mean temperature of the air for the first decade amounted to 17.9° C.; the maximum temperature of the seawater was 16.5° C. at that time.

Light.

The vegetation on the N. side of the wooden poles on the pier differs remarkably from that on the S. side. Most probably this difference is connected with the difference in insolation on both sides, and therefore with the difference in humidity.

The difference in vegetation of the N. and S. side of the pier itself is perhaps also connected with a difference in insolation, although probably here other factors like surf, salinity and turbidity are more important.

Salinity.

The salinity on the S. side of the pier, in the mouth of the Nieuwe Waterweg, varies considerably. The concentration of Cl'-ions in the surface layer amounts to about 3000 mg Cl'/l at low water, and lowers to 12000 mg Cl'/l at high water.

The salinity of the seawater on the N. side of the pier may be more constant. No data from exactly that place are available; the chlorinity of the sea about 4 kilometers from the mouth of the Nieuwe Waterweg amounts to 17000 till 18000 mg Cl'/l (data furnished by the "Rijkswaterstaat").

Turbidity.

The turbidity of the water in the Nieuwe Waterweg is considerable; the algae on the S. side are often covered with mud or muddy sand.

Sand.

Sand is an unfavourable factor for algal growth, probably by its scouring action, especially on coasts strongly exposed to the surf, and while it, often covering the stones, may prevent spores to get fixed. This is perhaps the reason why the vegetation is preponderantly characterized by a vegetation of Enteromorpha compressa often accompanied by Porphyra umbilicalis.

II. The algal vegetation

The littoral belt is not characterized here by the phaeophycean girdles so characteristic of the most European westcoasts, as only Fucus spiralis occurred on the places observed. Also on numerous other

FIG. 2.


Blidingia minima


Enteromorpha compressa


Fucus spiralis


Cyanophyta


Pylaiella littoralis


Callithamnion polyspermum


Bangia fuscopurpurea


Rhizoclonium sp.


Ceramium deslongschampsii


Polysiphonia sp.


Ulothrix sp.


Urospora sp.


Sphacelaria britannica


Ralfsia verrucosa


Porphyra umbilicalis


Acrosiphonia centralis


Diatomeae (epilithic)


mussels


barnacles

places exposed to the surf and the scouring action of the sand, like the "Delflandse hoofden" and other piers projecting into the sea, the big Phaeophyta are practically not found growing. Nevertheless several girdles can be recognized, chiefly of Chlorophyta, but also of Phaeophyta and Rhodophyta.

The vegetations on the N. side and the S. side of the pier differ considerably, and are treated separately. Also the vegetation on the wooden poles on the N. side as well as on the S. side of the pier have a different character. Therefore the poles are treated separately too.

The following scale was used to give an impression of the abundance of the species in the girdles: cc very abundant, c abundant, + moderate, r rare, rr very rare. The vegetation of several places, especially that of the wooden poles was mapped. For this purpose the symbols were used given in fig. 2.

1. The southside of the pier

A. *The vegetation on the stones.*

The following belts were distinguished, from the top downward:

1. A girdle consisting of a crust-like vegetation of Cyanophyta, chiefly Entophysalis deusta (Gloeocapsa crepidinum). This girdle is supralittoral (moistened by splash and spray), but the participating species occur as far as in the lower littoral belt under those species characteristic for that place.

This girdle can be seen during the whole year. During periods of calm and dry weather (no rain, little splash and spray) the crust dries out and peels off. When the moistening increases again, the vegetation spreads rapidly. On January 23rd the crust had disappeared almost entirely by the extreme and long low water (E. wind) and the calm dry weather during the frost. Also after a dry period in May 1954 the crust had disappeared.

The girdle occurred everywhere in the supralittoral belt, on the N. as well as on the S. side, on stones as well as on poles. It consisted of the following species: Entophysalis deusta (Gloeocapsa crepidinum) (cc), Calothrix scopulorum (+), Phormidium fragile (+), Ulothrix subflaccida (+), Urospora mirabilis (r), Bangia fuscopurpurea (r), Blidingia minima (r) (samples from 8-11-1953).

2. A girdle characterized by Blidingia minima. This girdle fills up the upper littoral belt and is found during the whole year. Most plants appeared to have died after the frost of January/February 1954. In April 1954 the species had not yet returned. Under Blidingia the following species were found growing: Entophysalis deusta (cc), Calothrix scopulorum (+), Phormidium fragile (r), Ulothrix flacca (r), Ulothrix subflaccida (rr), Porphyra umbilicalis (+) (samples from 8-11-1953).

3. A girdle characterized by Enteromorpha compressa and F. spiralis (see table 3). In many places Fucus spiralis was rather sparse, and Enteromorpha compressa dominating the vegetation. Neither Enteromorpha compressa nor Fucus spiralis survived the frost of January/February 1954: on January 23rd most plants had died. Not only the low temperature but also the low humidity of the air — the vegetation had entirely dried up and was very brittle at low tide — must have been a destructive factor. The area was recolonized by diatoms and Ulothrix. In April 1954 it was covered by a dense vegetation of very young plants of Enteromorpha compressa, only a few mm high, in August 1954 by fullgrown plants of the same species.

TABLE 3

Sample	8-11 -'53	24-1 -'54	28-3 -'54	10-4 -'54	2-8 -'54
Fucus spiralis	cc	c[1])	rr		r
Enteromorpha compressa	cc	c[1])	rr	cc[2])	cc
Porphyra umbilicalis	+	c	+		+
Ulothrix flacca		r	c	c	+
Ulothrix pseudoflacca			r	r	
diatoms		c	cc	c	

[1]) plants almost all dead.
[2]) very young plants.

4. A girdle, characterized by Cladophora glaucescens and Callithamnion roseum (see table 4). This girdle fills up the lowest part of the littoral belt and extends till into the sublittoral belt. Both species had disappeared on January 23rd together with the young mussels (Mytilus edulis) on which they were attached. At that time the stones were entirely bare with the exception of remainders of byssus threads and barnacles here and there. The area was recolonized by diatoms and Ulothrix. In August 1954 the original vegetation appeared to have returned.

TABLE 4

Sample	8-11 -'53	24-1 -'54	28-3 -'54	10-4 -'54	2-8 -'54
Cladophora glaucescens	cc[1])				cc
Callithamnion roseum	c[1])				c
diatoms		byssus	cc	+	
Enteromorpha compressa	+		r		+
Ulothrix flacca			c	+	
Ulothrix pseudoflacca			+	cc	
Ulothrix subflaccida			c	+	
Urospora mirabilis			+	r	
Porphyra umbilicalis				rr	

[1]) overgrown by epiphytic diatoms.

B. *The vegetation on the poles.*

The vegetation on the S. side and that on the N. side of the poles show remarkable differences. On the S. side of the poles as well as on the stones of the S. side of the pier about the same girdles were seen on corresponding levels. Rhizoclonium riparium and Rhizoclonium implexum were abundant in the Blidingia minima and Enteromorpha compressa girdles, but they were not found on the stones. The following girdles were distinguished from the top downward:

1. A supralittoral girdle of Cyanophyta, composed of Entophysalis deusta (Gloeocapsa crepidinum) (cc), Calothrix scopulorum (+), Phormidium fragile (r), Plectonema battersii (r), Porphyra umbilicalis (+) (samples of 8-11-1953). What is said about this belt on page 175 is also valid here. However, here the crust survives during dry periods in little fissures.

2. A girdle, characterized by Blidingia minima (see table 5). See also what is mentioned about this belt on page 176.

TABLE 5

Sample	18-10 -'53	25-10 -'53	8-11 '-53	24-1 -'54	2-8 -'54
Blidingia minima	cc	cc	cc	cc[1])	cc
Rhizoclonium implexum			c		
Rhizoclonium riparium	cc	cc	c	cc[1])	+
Urospora mirabilis					r
Entophysalis deusta	+	+	+		cc
Phormidium fragile	+	+			c
Plectonema battersii					r
Ulothrix pseudoflacca		+			rr

[1]) plants practically all dead.

3. A girdle, characterized by Enteromorpha compressa (see table 6). See also what is said about this belt on page 176.

TABLE 6

Sample	18-10-'53	25-10-'53	8-11-'53	24-1-'54	2-8-'54
Enteromorpha compressa	cc	cc	cc	cc[1])	c
Blidinga minima	r	r	r		
Rhizoclonium riparium	cc	c	+	cc[1])	
Urospora mirabilis					cc
Entophysalis deusta					r
Plectonema battersii					r
Phormidium fragile					r

[1]) plants practically all dead.

In August 1954 on many places Urospora mirabilis appeared to be very abundant in the Enteromorpha compressa girdle.

The N. side of the poles was characterized by two sciophilous species, namely Pylaiella littoralis and Callithamnion polyspermum, which species form two distinct girdles mostly, of which Pylaiella the upper one, Callithamnion the lower one. The area they cover corresponds more or less with the lower part of the Enteromorpha compressa girdle on the stones and on the S. side of the poles. Callithamnion had disappeared in January 1954, and was not seen again in August 1954. Pylaiella was found growing during the whole year (see pl. I, and table 7; A in the fig. corresponds with A in the table, etc.).

PL. I.

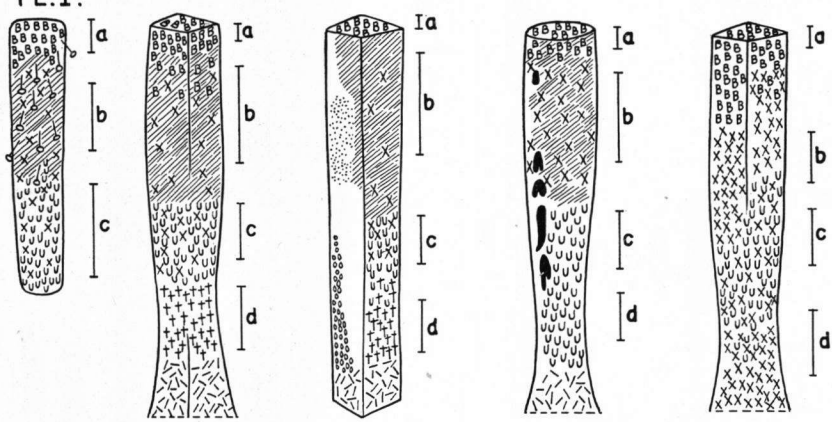


FIG. 1 8-11-'53 FIG. 2 18-10-'53 FIG. 3 25-10-'53 FIG. 4 24-1-'54 FIG. 5 2-8-'54

VEGETATION OF THE N. SIDE OF THE POLES ON THE S. SIDE OF THE PIER (SEE TABLE 7).

TABLE 7

	Sample	18-10 -'53	25-10 -'53	8-11 -'53	24-1 -'54	2-8 -'54
A	Blidingia minima	cc	cc	cc	cc[1])	cc
	Rhiziclonium riparium				cc[1])	
B	Enteromorpha compressa	+	r	c	c[1])	cc
	Rhizoclonium riparium	cc	cc	cc	cc[1])	+
	Fucus spiralis			c		
	Blidingia minima	+	r	c		rr
	Porphyra umbilicalis			r		
	Entophysalis deusta		c			
	Ralfsia verrucosa				c	
	Urospora mirabilis					r
C	Pylaiella littoralis	cc	cc	cc	cc	cc
	Enteromorpha compressa	+	c	+		c
	Rhizoclonium implexum			+		
	Callithamnion polyspermum	r	r			
	Callithamnion roseum			rr		
	Cladophora glaucescens			rr		
	Ceramium deslongschampsii			rr		
	Acrochaetium virgatulum			+		
	Entophysalis conferta	+	+	+	+	+
	Phormidium molle			r		
	Entophysalis deusta					r
	Ralfsia verrucosa				c	
	Phormidium fragile					r
	Plectonema battersii					r
D	Callithamnion polyspermum	cc	cc			
	Enteromorpha compressa		+	Base of pole not low enough in littoral belt	+	cc
	Pylaiella littoralis				cc	+
	Entophysalis conferta				+	
	Entophysalis deusta					r
	Plectonema battersii					r
	Phormidium fragile					r

[1]) most plants dead.

Vegetation on the N. side of the poles on the S. side of the pier (see pl. I).

2. The northside of the pier

A. *The vegetation on the stones.*

The following girdles were distinguished from the top downward (see pl. II), of which the upper three are identical with the upper three on the S. side:

1. A belt of Cyanophyta, mainly Entophysalis deusta (cc), further Calothrix scopulorum (+), Phormidium fragile (+), Plectonema battersii (+) (sample from 8-11-1953). See also what is mentioned about this girdle on pag. 175.

2. A girdle, characterized by Blidingia minima. Under Blidingia the following species were found: Entophysalis deusta (c), Calothrix scopulorum (c), Phormidium fragile (r), Ulothrix flacca (r) (samples of 8-11-1953). See also page 176, Blidingia girdle.

3. A girdle characterized by Enteromorpha compressa (see pl. II, table 8). Only very sparse Fucus spiralis plants were found growing in this girdle. On January 23rd the greater part of the Enteromorpha compressa plants were frozen to death or had disappeared (pl. II, fig. 1). The area was not recolonized by Ulothrix and diatoms only, but partly by Pylaiella littoralis too, which species was very abundant on April 9th (pl. II, fig. 2). At the same time many very young Enteromorpha plants, a few mm high, were found growing in this belt. In August 1954 the area was covered again with a dense vegetation of full-grown Enteromorpha plants (pl. II, fig. 3).

TABLE 8

Sample	11-10 -'53	25-10 -'53	18-11 -'53	23-1 -'54	28-3 -'54	9-4 -'54	2-8 -'54
Enteromorpha compressa	cc	cc	cc	+[1]	r[1]	c[2]	cc
Ulva lactuca	cc	c	c	+[1]	r[1]		c
Ulothrix flacca	r	r	r	c	cc	c	r
Ulothrix pseudoflacca		r		r	c	c	r
Ulothrix subflaccida					c	c	
diatoms				+	cc	c	
Urospora mirabilis	r	r				+	
Pylaiella littoralis						cc	c
Fucus spiralis			r				
Acrosiphonia centralis						+	
Porphyra umbilicalis	+	r			r		c

[1]) plants almost all dead.
[2]) very young plants.

4. A girdle, characterized by Polysiphonia urceolata and Polysiphonia nigrescens (table 9, pl. II). Polysiphonia appeared to maintain its position during the whole year. In winter a growth of young mussels (Mytilus edulis) disappeared, which previously occupied a large part of the girdle. The area was recolonized mainly by epilithic diatoms which at their turn disappeared and were replaced by the spring-species Acrosiphonia centralis, which was accompanied by two other spring-species, Petalonia fascia and Petalonia zosterifolia. In August the stones were covered again by a dense carpet of young mussels, with here and there a mat of Polysiphonia.

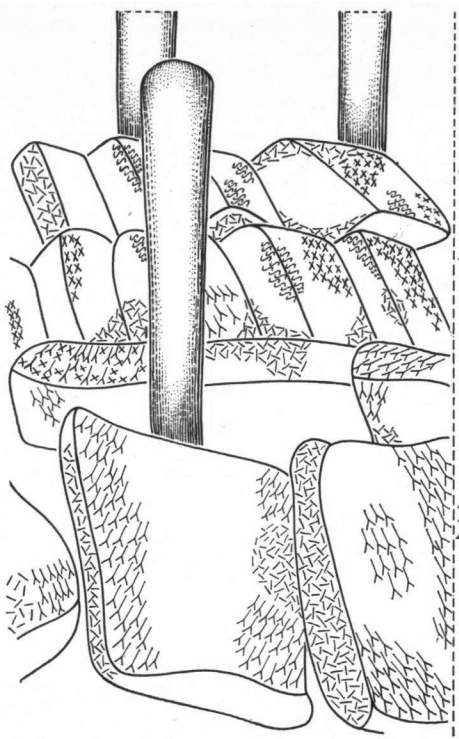


Fig. 1. 23-1-1954.

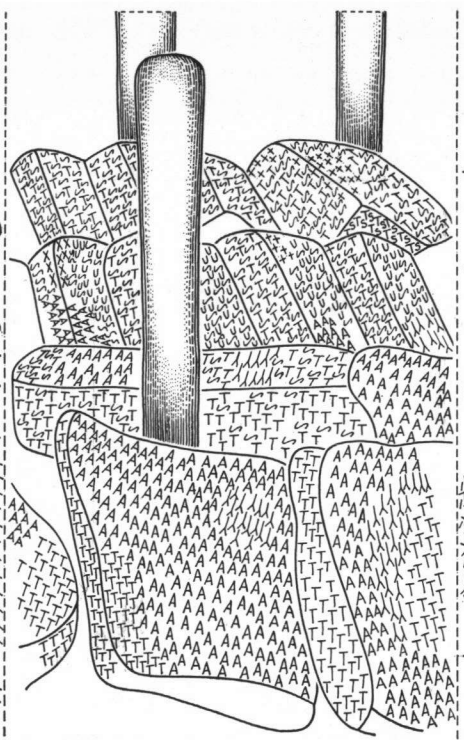


Fig. 2. 9-4-1954.

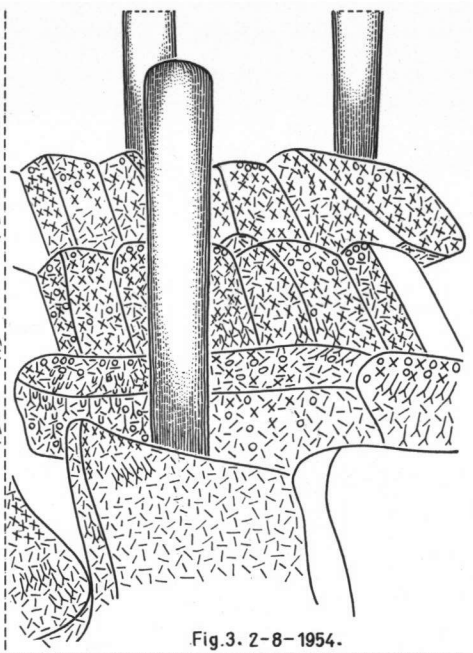
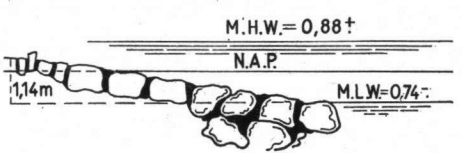


Fig. 3. 2-8-1954.

Fig. 4.



VEGETATION ON THE N. SIDE OF THE PIER, THREE TIMES ON THE SAME PLACE (TABLE 8,9).

PL. II.

TABLE 9

Sample	11-10 -'53	18-10 -'53	25-10 -'53	23-1 -'54	28-3 -'54	9-4 -'54	2-8 -'54
Polysiphonia urceolata	cc	cc	cc	cc	cc	c	cc
Polysiphonia nigrescens	c	c	c	c	c	+	c
Enteromorpha compressa	+	+	+	+			+
Ceramium rubrum	c						
Ceramium deslongschampsii		r	rr		r		
Chaetomorpha aerea [1]			+				
diatoms				cc	cc	c	
Ulothrix flacca				+	c	+	
Ulothrix pseudoflacca						+	
Ulothrix subflaccida						+	
Acrosiphonia centralis						cc	
Urospora mirabilis						r	
Petalonia fascia						r	
Petalonia zosterifolia						r	
Ep: Lyngbya infixa			+	+			
Ep: Acrochaetium secundatum			+	+			
Porphyra umbilicalis	r	r	r	r			r

[1]) in the summer of 1953 much Chaetomorpha aerea was found in the Polysiphonia belt.

B. *The vegetation on the poles.*

The aspect of the N. side and that of the S. side is different here too. Apart from the fact that the vegetation on the S. side is much sparser, the composition of the species shows also an important disparity.

The vegetation on the poles on the N. side of the pier much resembles that of the poles on the S. side. The most important differences are:

1. The vegetation on the S. side of the poles, on the N. side of the pier, is much sparser than that on the S. side of the poles, on the S. side of the pier, probably while the S. side is moistened by the splash water from the Nieuwe Waterweg during low tide, which is not the case on the N. side.

2. The lowest part of the N. side of the poles on the N. side of the pier is characterized by a girdle of Polysiphonia urceolata and Ceramium deslongschampsii. This belt was not found an the N. side of the poles on the S. side of the pier.

On the S. side of the poles on the N. side of the pier the following girdles were distinguished (see pl. III and table 10).

1. A girdle characterized by Blidingia minima. This species was often accompanied or replaced by Entophysalis deusta. Usually Bangia fuscopurpurea was found growing on the S.W. sides of the poles.

TABLE 10

Sample	11-10 -'53	11-10 -'53	11-10 -'53	25-10 -'53	23-1 -'54	10-4 -'54	2-8 -'54
pl., fig.	II, 1	II, 2	II, 3	II, 4	II, 5	II, 6	II, 7
A							
Blidingia minima		cc		c	c[1])		cc
Entophysalis deusta ...			cc	cc	c	c	cc
Calothrix scopulorum .			r	r		cc	
Bangia fuscopurpurea.			c		c		c
Phormidium fragile ...			r		r		cc
Spirulina major					rr		
Enteromorpha compressa						r	
Plectonema battersii...			r				+
Ulothrix flacca							r
Ralfsia verrucosa						c	
B							
Enteromorpha compressa		c		c	r[1])		cc
Ralfsia verrucosa	cc	cc			c	c	
Phormidium fragile ...	r				r		c
Fucus spiralis		r					
diatoms					cc		
Lyngbya semiplena ...					+		
Pylaiella littoralis						+	
Urospora mirabilis ...							cc
Plectonema battersii...							+
Entophysalis deusta....							c
Ulothrix flacca							c
Bangia fuscopurpurea.							c
Calothrix scopulorum .							+
Rhizoclonium riparium							+
Blidingia minima							rr

[1]) most plants dead.

Vegetation on the S. side of the poles on the N. side of the pier.

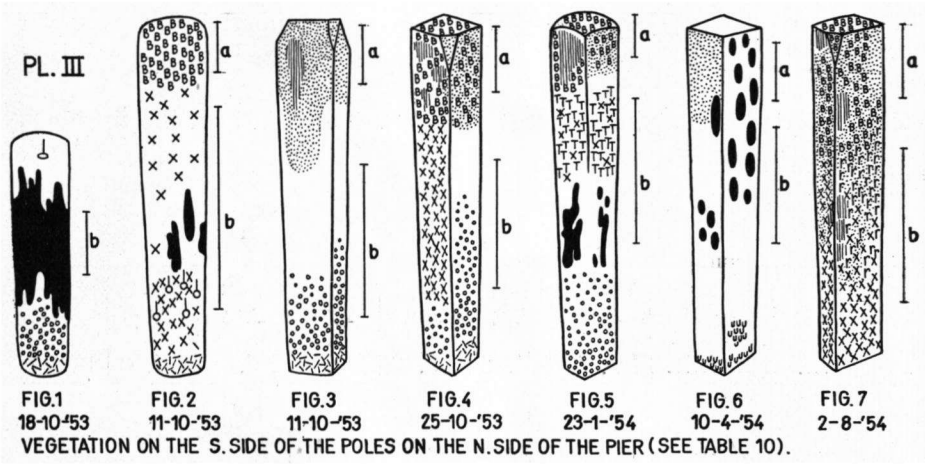
2. A girdle characterized by Enteromorpha compressa. This species was often accompanied or replaced by Ralfsia verrucosa. In August 1954 much Urospora mirabilis grew in this belt.

Also here Blidingia and Enteromorpha appeared to be frozen to death for the greater part on January 23rd.

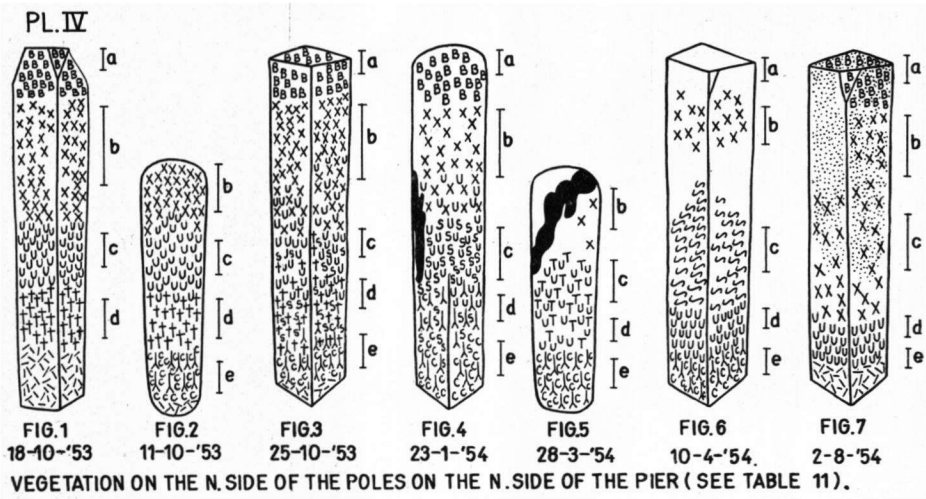
On the N. side of the poles, on the N. side of the pier (see pl. IV, table 11), a number of sciophilous species were found growing, viz. Pylaiella littoralis, Sphacelaria britannica, Callithamnion polyspermum, Polysiphonia

urceolata, Ceramium deslongschampsii. The following girdles were distinguished:

1. A girdle characterized by Blidingia minima. This species was often accompanied or sometimes replaced by Cyanophyta, of which Entophysalis deusta was the most abundant one. Rhizoclonium riparum often occurred



VEGETATION ON THE S. SIDE OF THE POLES ON THE N. SIDE OF THE PIER (SEE TABLE 10).



VEGETATION ON THE N. SIDE OF THE POLES ON THE N. SIDE OF THE PIER (SEE TABLE 11).

in the Blidingia belt. Blidingia and Rhizoclonium were killed by the frost for the greater part on January 23rd.

2. A girdle characterized by Enteromorpha compressa. Also in this girdle Rhizoclonium riparium was very abundant. Both species did not survive the frost of January/February 1954.

3. A girdle characterized by Pylaiella littoralis. This species was found growing during the whole year. In autumn and in winter Sphacelaria britannica was very abundant.

4. A girdle characterized by Callithamnion polyspermum. This species was found in autumn only. During winter and later this area appeared to be occupied by Pylaiella littoralis, Ceramium deslongschampsii and Polysiphonia urceolata or by the two last mentioned species only. In August 1954 Callithamnion polyspermum had not reappeared.

5. A girdle characterized by Ceramium deslongschampsii and Polysiphonia urceolata. This girdle was seen during the whole year. In August 1954 the vegetation appeared to be pushed away by a new settlement of young mussels.

The differences between the vegetations on the N. and on the S. side

Most important is the difference in the combination of species in the lower littoral belt. There, on the S. side of the pier chiefly Cladophora

TABLE 11

Sample	18-10 -'53	11-10 -'53	25-10 -'53	23-1 -'54	28-3 -'54	10-4 -'54	2-8 -'54
pl., fig.	IV, 1	IV, 2	IV, 3	IV, 4	IV, 5	IV, 6	IV, 7
A	pole				pole		
Blidingia minima	not	cc	c	cc[1])	not		cc
Rhizoclonium riparium	high	c	cc	cc[1])	high		+
Enteromorpha compressa	enough		+		enough		+
Entophysalis deusta ...							cc
Phormidium fragile ...			+				cc
Calothrix scopulorum .			r				c
B							
Enteromorpha compressa	cc	cc	+	c[1])	+[1])	+[2])	cc
Enteromorpha ahlneriana			cc				
Rhizoclonium riparium		c		c[1])			+
Ralfsia verrucosa				+	c		
Blidingia minima			+				+
Pylaiella littoralis			+				
Rhizoclonium implexum				+			
Phormidium fragile ...							cc
Entophysalis deusta ...							cc
Calothrix scopulorum .							c
Ulothrix flacca							r
Urospora mirabilis							r
C							
Pylaiella littoralis	cc	cc	cc	cc	cc		
Enteromorpha ahlneriana			c				

TABLE 11 (continued)

Sample	18-10 -'53	11-10 -'53	25-10 -'53	23-1 -'54	28-3 -'50	10-4 -'54	2-8 -'55
pl., fig.	IV, 1	IV, 2	IV, 3	IV, 4	IV, 5	IV, 6	IV, 7
Enteromorpha compressa			+	+			cc
Callithamnion polyspermum			+				
Ulothrix flacca					c	cc	+
Sphacelaria britannica.			⊥	cc			
diatoms					cc	c	c
Blidingia minima				rr			
Ralfsia verrucosa				c			
Cladophora utriculosa.				rr			
Entophysalis deusta							cc
Phormidium fragile							cc
Calothrix scopulorum.							c
Urospora mirabilis							r
D							
Callithamnion polyspermum	cc	cc	cc				
Pylaiella littoralis			+	r	cc	cc	cc
Enteromorpha compressa							+
Sphacelaria britannica.			c	+			
Polysiphonia urceolata			+	cc			
Ceramium deslongschampsii				c			
diatoms					cc	c	c
Entophysalis deusta							+
Ulothrix flacca					+		
Calothrix scopulorum.							r
Ectocarpus confervoides							rr
E							
Ceramium deslongschampsii	cc	not	cc	cc	c	c	
Polysiphonia urceolata	cc	low	cc	cc	c	c	
mussels	cc	enough	cc	cc	c		cc
Pylaiella littoralis			r	r		r	
Cladophora utriculosa.				rr			
Sphacelaria britannica.				r			
Ulothrix flacca					+		

[1]) plants almost all dead.
[2]) very young plants, a few mm high.

Vegetation on the N. side of the poles on the N. side of the pier (see pl. IV).

glaucescens and Callithamnion roseum are growing, species, which disappear in winter and are replaced by epilithic diatoms and Ulothrix. The lowest girdle on the N. side consists of Polysiphonia urceolata and Polysiphonia nigrescens, in spring accompanied by Acrosiphonia centralis. Also in the occurrence of the more rare species the N. and S. side show considerable differences. Generally speaking several species which were found growing on the N. side do not occur on the S. side (see table 12).

TABLE 12

On the N. side, but not on the S. side	*On the S. side, but not on the N. side*
In the Enteromorpha compressa and Pylaiella belt on the N. side of a pole:	In basins and on the more eastward banks more up the Nieuwe Waterweg:
Enteromorpha ahlneriana	*Fucus ceranoides*
In the Pylaiella belt on the N. side of a pole:	In the Cladophora glaucescens-Callithamnion roseum belt on the stones:
Sphacelaria britannica	*Cladophora glaucescens*
In the Ceramium deslongschampsii-Polysiphonia urceolata belt on the N. side of a pole:	*Callithamnion roseum*
Polysiphonia urceolata	
Ceramium deslongschampsii [1])	
Sphacelaria britannica	
Cladophora utriculosa	
In the Polysiphonia belt on stones:	
Polysiphonia urceolata	
Polysiphonia nigrescens	
Ceramium rubrum	
Chaetomorpha aerea	
Acrosiphonia centralis	
Petalonia fascia	
Petalonia zosterifolia	

[1]) This species was found growing once on the N. side of a pole on the S. side of the pier. It was seen also several times on the N. side of the pier on stones.

Further, Fucus spiralis was much more abundant on the S. side than on the N. side, probably because the N. side is much more exposed to the surf, so to the scouring action of the sand too.

List of algae, collected in Hoek van Holland

The following abbreviations are used to design the localities where the species were found growing: S.s. = south side of pier, N.s. = north side of pier, S.s.po = south side of poles, N.s.po = north side of poles, l.l. = lower littoral belt, m.l. = midlittoral belt, u.l. = upper littoral belt, ba = basin, ro = "rockpool" on top of pier.

Cyanophyta

Calothrix scopulorum (Web. et Mohr) Ag. ex Bornet et Flahault. N.s., S.s., N.s.po, S.s.po; in a supralittoral girdle of Cyanophyta, also lower.

Entophysalis deusta (Menegh.) Drouet & Daily (Gloeocapsa crepidium Thuret). N.s., S.s., N.s.po, S.s.po; in a supralittoral girdle of Cyanophyta and also lower down.

Entophysalis conferta (Kütz.) Drouet & Daily. Epiphytic on several species: Pylaiella littoralis, Enteromorpha compressa, Chaetomorpha aerea, Polysiphonia urceolata. N.s. and S.s.

Lyngbya infixa Frémy. Epiphytic on several species in the l.l.; Ceramium rubrum, Polysiphonia.

Lyngbya semiplena (Ag.) J. Ag. ex Gom. Forms blue-green slippery patches on the bitumen on the top of the pier, about in the Enteromorpha compressa girdle, where the pier is relatively low.

Phormidium fragile (Menegh.) ex Gom. In a supralittoral girdle of Cyanophyta and also lower down.

Plectonema battersii Gom. In a supralittoral girdle of Cyanophyta and also lower down.

Spirulina major Kütz. ex Gom. S.s.po on N.s. (Van den Hoek, 23-1-1954).

Chlorophyta

Acrosiphonia centralis (Lyngb.) Kjellm. N.s., l.l., abundant in Polysiphonia girdle; spring-species.

Blidingia minima (Naeg. in Kütz.) Kylin. S.s., N.s., S.s.po, N.s.po, abundant during the whole year, but nearly all killed by the frost.

Chaetomorpha aerea (Dillw.) Kütz. N.s., l.l., in Polysiphonia girdle. Also on poles.

Cladophora albida (Huds.) Kütz. var. refracta Thur. S.s. (Schlittler, 24-6-1947).

Cladophora flexuosa (Griff.) Harv. ba (Lucas, Koster, 1-6-1948).

Cladophora glaucescens (Griff.) Harv. S.s., l.l. and sublittoral, in a girdle of Cladophora glaucescens and Callithamnion roseum (Van den Hoek, Oct. 1953 and Aug. 1954).

Cladophora refracta (Roth) Kütz. ba (Koster, 4-7-1947).

Cladophora rupestris (L.) Kütz. ba (Koster, 4-7-1947).

Cladophora utriculosa Kütz. N.s.po on N.s., in the Enteromorpha compressa and Pylaiella girdle. Rare. (Van den Hoek, 25-10-1953).

Enteromorpha ahlneriana Bliding N.s.po on N.s., in the Enteromorpha compressa and Pylaiella girdle (Van den Hoek, 25-10-1953).

Enteromorpha compressa (L.) Grev. N.s., S.s., N.s.po, S.s.po. Forms a girdle in the upper littoral belt. Also m.l. and l.l. Also in ba abundant.

Enteromorpha intestinalis (L.) Link. S.s., H.l. (Van den Hoek, 9-11-1952, det. Bliding) ba (Koster, 16-4-1954).

Enteromorpha prolifera J. Ag. emend. Bliding. ba (Lucas, 28-11-1948). On pole (Lucas 12-2-1950). Epiphytic on Fucus (Vervoort, Jan. 1938).

Gomontia polyrhiza (Lagerheim) Bornet et Flahault. Abundant in barnacles (Van den Hoek).

Rhizoclonium implexum (Dillw.) Kütz. S.s.po on S.s. Abundant in Bli-

dingia girdle, rare in Pylaiella girdle (Van den Hoek, 8-11-1928).
Rhizoclonium riparium (Roth) Harv. S.s. and N.s., on poles, abundant in the Enteromorpha compressa and Blidingia minima girdles.
Ulothrix flacca (Dillw.) Thur. S.s., N.s., H.l., l.l. Abundant after the frost of January 1954, recolonizing the area previously occupied by Enteromorpha.
Ulothrix pseudoflacca Wille. S.s., N.s., on poles and stones. Often in little quantities between other algae, together with the more abundant U. flacca.
Ulothrix subflaccida Wille. Often together with Ulothrix flacca and U. pseudoflacca, but in much smaller quantities. One time it was found growing in the supralittoral girdle of Cyanophyta (Van den Hoek, 8-11-1953).
Ulva lactuca L. S.s., N.s., abundant in the lower part of the Enteromorpha compressa girdle. Also l.l., ba, ro.
Urospora penicilliformis (Roth) Aresch. N.s., S.s., l.l., h.l., on poles and stones.

Phaeophyta

Ectocarpus confervoides (Roth) le Jolis. N.s.po on N.s., among Pylaiella littoralis (Van den Hoek, 2-8-1954) ba, abundant. S.s., on dam of ba.
Elachista fucicola (Velley) Aresch. S.s., on Fucus (Koster, 1-6-1948, Lucas, 18-10-1949).
Fucus ceranoides L. On dams of ba and still more up the Nieuwe Waterweg. Dioecious as well as monoecious plants. Also in ba.
Fucus spiralis L. Forms a girdle on the S.s., together with Enteromorpha compressa. Had disappeared entirely after the frost of January 1954. Also on the N.s., but very sparse. Also in ba.
Fucus vesiculosus L. Was found here and there in the littoral belt by several collectors. Forms never a distinct, closed belt (Lucas, 30-12-1947, Koster, 4-7-1947, Van den Hoek, 15-3-1953).
Petalonia fascia (Müller) O. Kuntze. N.s., l.l., common in Polysiphonia girdle. Spring-species. Also in ro on top of pier (Lucas, Koster, 1-6-1948).
Petalonia zosterifolia (Reinke) O. Kuntze. N.s., l.l., common in Polysiphonia girdle. Spring-species.
Pylaiella littoralis (L.) Kjellm. N.s.po, h.l.; forms a distinct girdle. Also on the N.s., on stones, in Enteromorpha compressa girdle. Abundant in ba.
Ralfsia verrucosa (Aresch.) J.Ag. Abundant on S.s.po and N.s.po on the N.s. Less common on poles on the S.s., scarce on the stones.
Sphacelaria britannica Sauv. N.s.po on N.s., in Pylaiella and Callithamnion polyspermum girdles in autumn and January (Van den Hoek, 1953/1954).

Rhodophyta

Acrochaetium secundatum (Lyngb.) Näg. Epiphytic on Porphyra umbilicalis (Den Hartog, 10-4-1954).

Acrochaetium virgatulum (Harv.) J. Ag. Epiphytic on Ceramium rubrum, Polysiphonia, Chaetomorpha aerea (Van den Hoek, 1-3-1953, 15-3-1953).

Bangia fuscopurpurea (Dillw.) Lyngb. On poles on N.s., in Blidingia girdle. Always on S.W. sides. Once very scarce in the supralittoral Cyanophyta girdle on the S.s. (Van den Hoek, 8-11-1953).

Callithamnion polyspermum Ag. N.s.po, on N.s. and S.s. Forms a distinct belt. Only seen in autumn; not found back in August 1954 (det. R. Boddeke).

Callithamnion roseum Harv. S.s., l.l. and sublittoral. Forms a girdle together with Cladophora glaucescens. Had disappeared in January 1954. Found again in August 1954. Also epiphytic on Fucus ceranoides; abundant in ba; in ro.

Ceramium deslongschampsii Chauvin. N.s.po on N.s. Forms a girdle together with Polysiphonia urceolata. N.s. on stones, in Polysiphonia girdle. Also in ba (Koster, 1-6-1948). S.s. on stones (Schlittler, 24-7-1947, Koster, 10-6-1948).

Ceramium rubrum (Huds.) Ag. N.s., l.l. in Polysiphonia girdle. Ba (Lucas, 10-10-1949, Van den Hoek, 16-11-1952).

Polysiphonia nigrescens (Dillw.) Grev. N.s., l.l.; in a girdle of P. urceolata and P. nigrescens. Ro (Koster, 4-7-1947).

Polysiphonia urceolata (Dillw.) Grev. N.s., l.l., on stones in a girdle of P. urceolata and P. nigrescens. N.s.po on N.s., in a girdle of Ceramium deslongschampsii and Polysiphonia urceolata. Ro on top of pier (Koster, 1-6-1948). Ba (Lucas, 1-6-1948). On the dam of a basin, sublittoral (Koster, 1-6-1948).

Porphyra leucosticta Thur. Ba (Den Hartog, 10-9-1954).

Porphyra umbilicalis (L.) Kütz. N.s., S.s., h.l., l.l., ba. Very common on all places, most abundant in Enteromorpha compressa girdle.

Rhodochorton purpureum (Lightf.) Rosenv. On the dam of a basin (Den Hartog, 10-4-1954).

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