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LIST OF DISCRETE DEPTH SAMPLES AND OPEN NET HAULS OF THE AMSTERDAM MID NORTH ATLANTIC PLANKTON EXPEDITION 1981 (PROJECT 101A) [1)]

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ABSTRACT

The technical details and hydrographical data of the hauls with open nets and opening-closing nets, made during the Amsterdam Mid North Atlantic Plankton Expedition, are given, together with the general conditions during the sampling period September 15 - October 6, 1981. Temperature and salinity profiles are given for the sampled area roughly between 55°N 30°W and 24°N 30°W and between 24°N 30°W and 27°N 20°W.

INTRODUCTION

The research programme 101A of the Department of Marine Invertebrates, University of Amsterdam, primarily aims at elucidating the patterns of latitudinal diversity, taxonomic variation below the species level, vertical variation and the interaction of climate, hydrographic features, ecology and morphological variation of marine plankton. In 1981, in addition to a north-south line, an east-west line was sampled to obtain information on neritic influences.

The present list comprises the data of all the net samples made in the period September 15 - October 6, 1981. The list of the cruise February 26 - March 3, 1979 has been given by Heyman (1981: 23), that of the cruise of April 11 - May 2, 1980 has been given by Van der Spoel (1981: 8) and by Van der Spoel & Goessens

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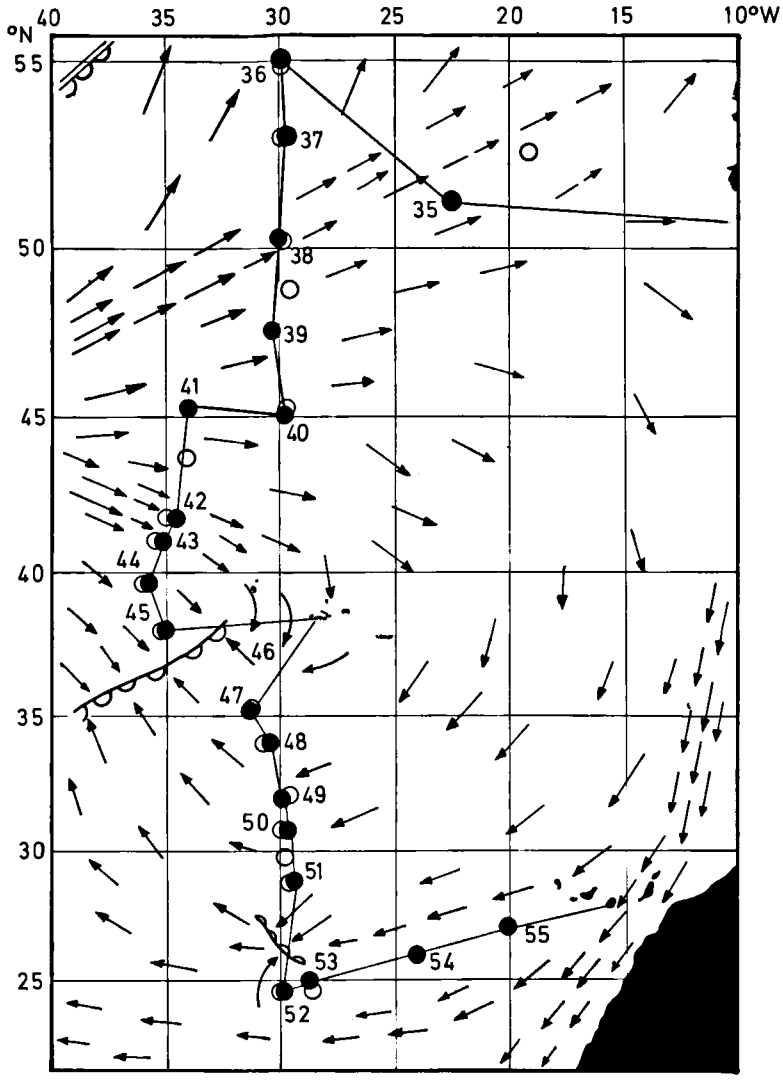


Fig. 1. Position of the stations with diagrammatic representation of surface currents (arrows) and fronts (double lines), stations of the 1981 cruise are given as solid dots, those of 1980 are open circles.

(in prep.) for the microplankton pump samples. For correction of some errors in the papers mentioned the reader is referred to the Appendix to this paper.

The discrete depth samples were made between 0 and 1170 m depth with the combined Rectangular Mid Water Trawl (RMT 1+8) developed by the Institute of Oceanographic Sciences, Wormley, Great Britain. The open hauls were made with an open one-square meter Rectangular Mid Water Trawl (RMT1) in the upper 350 m, with an open Ring-net in the upper 50 m and with open fine-meshed square nets in the upper 70 m.

In addition to these samples, microplankton pump samples were taken, salinity, daylight and DSL migration were measured. The pump samples and DSL measurements will be published elsewhere.

The discrete depth samples and open net hauls are given in figures 1 and 2. The samples were taken as much as possible at the same localities as the samples collected in 1980 to make comparison between the results of the two seasons as accurate as possible. The tropical storm "Irene", however, disturbed the regular sampling programme after September 27.

All samples were roughly sorted aboard ship, fixed and preserved in the most appropriate way according to the animal group concerned, formaline 4% or 2%, alcohol 70% and propylene-phenoxetol propylene-glycol were the most frequently used fixatives (Heyman, 1981). All material is preserved at the Institute of Taxonomic Zoology, Amsterdam.

The temperature measurements made with the CTD, XBTs and with the RMT net monitor system form the basis of the temperature profile in figure 3. Figure 4 gives sea-surface temperatures based on NOAA satellite data for three days during the expedition. In figure 5 the

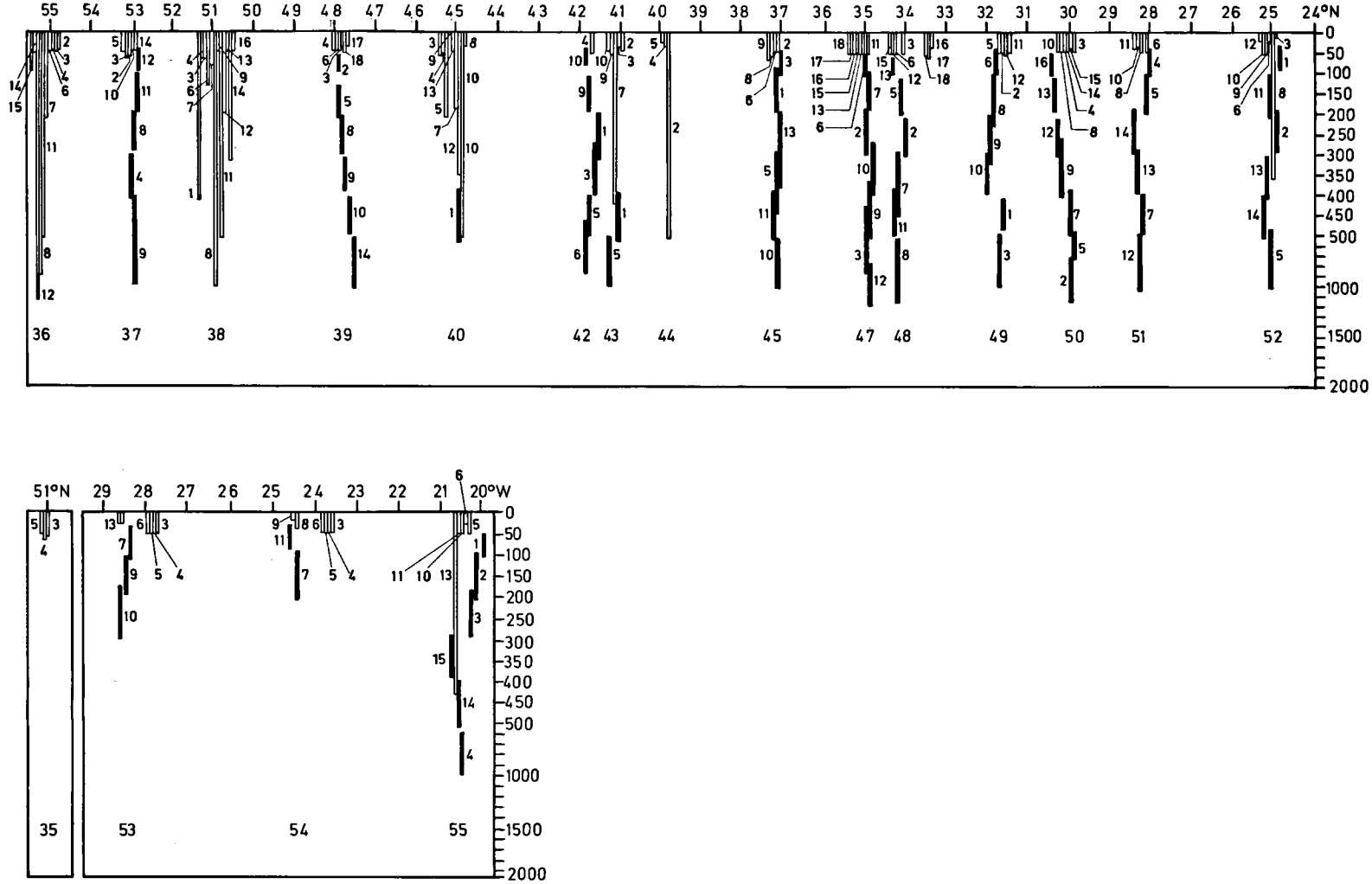


Fig. 2. Position of the stations and hauls in a vertical profile, giving the openin-closing sa ples (solid) and open net hauls (open), 2a: for the N-S transect; 2b: for the E-W transect.

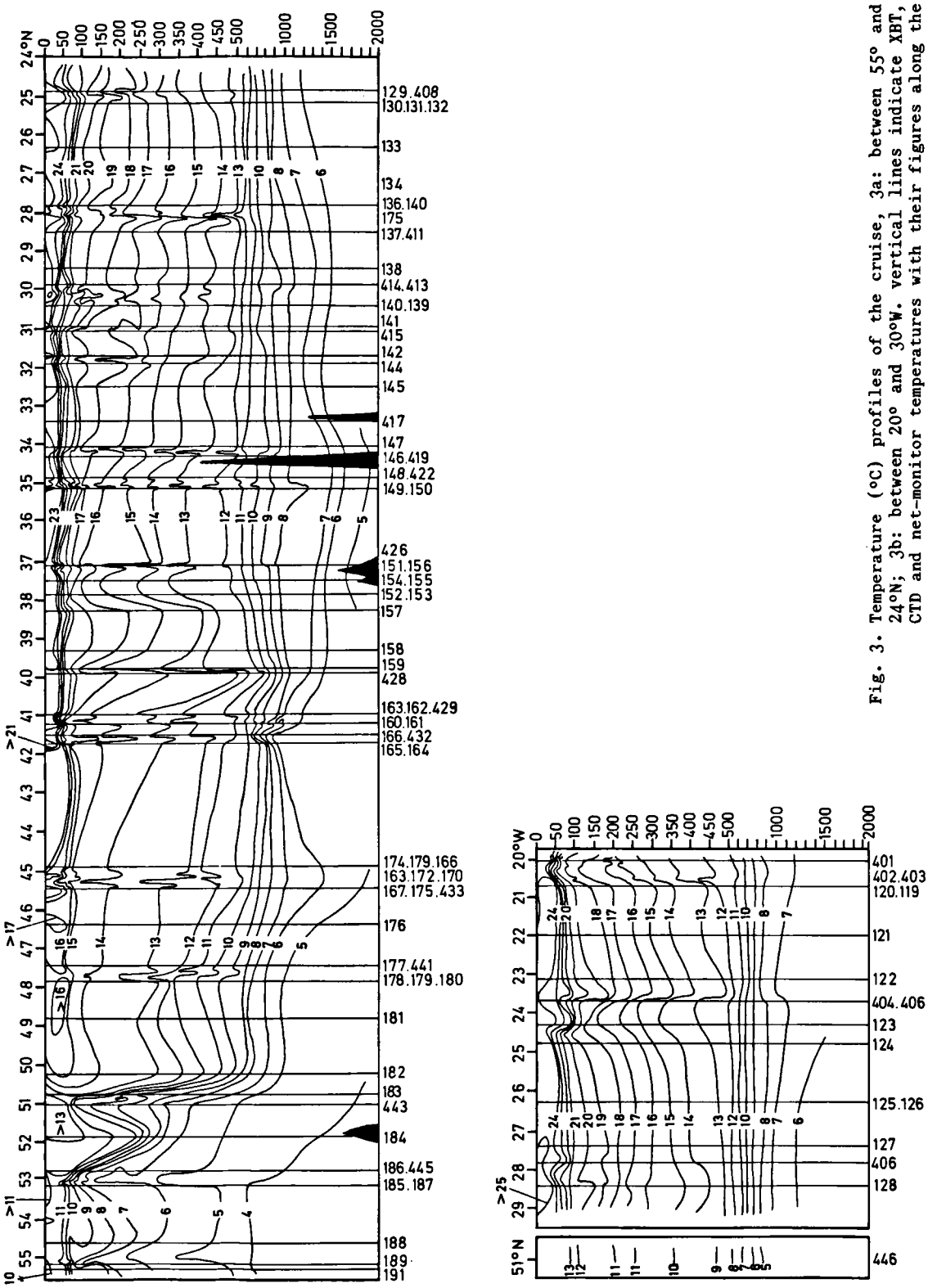


Fig. 3. Temperature (°C) profiles of the cruise, 3a: between 55° and 24°N; 3b: between 20° and 30°W. vertical lines indicate XBT, CTD and net-monitor temperatures with their figures along the y-axis, depth in meters along the x-axis.

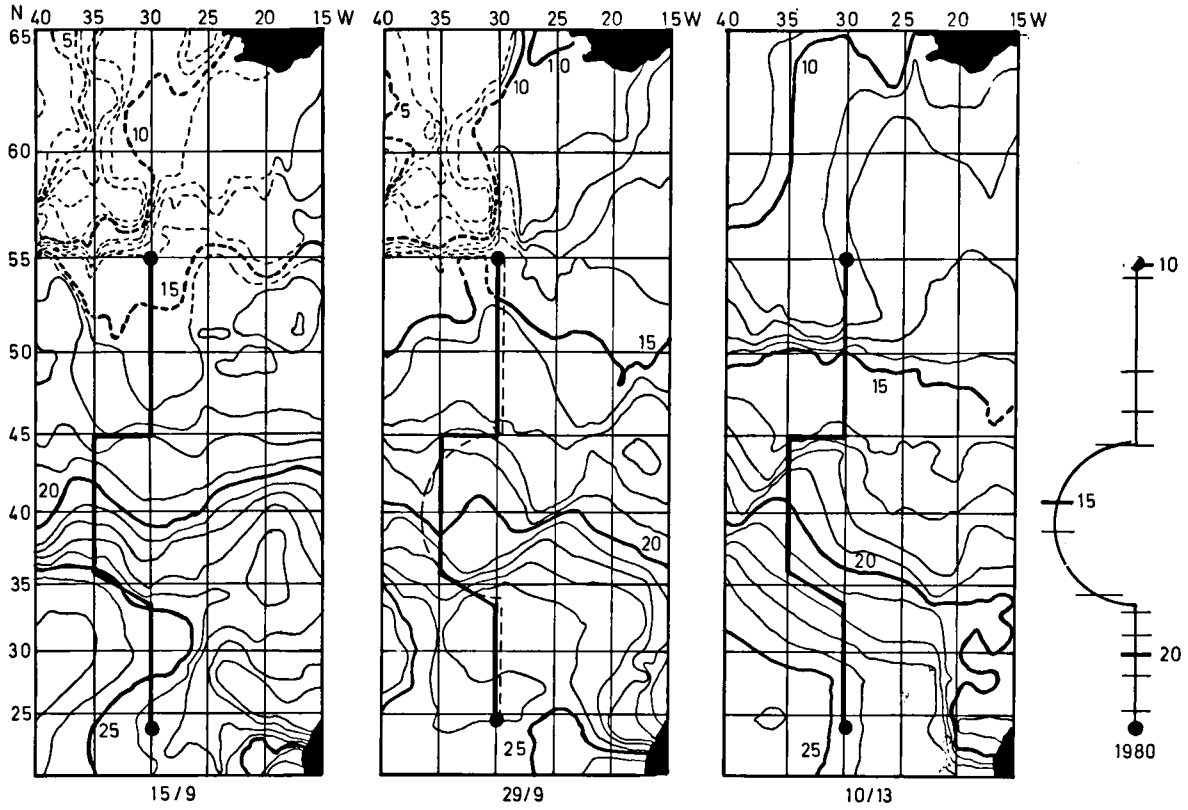


Fig. 4. Sea surface temperatures (1°C intervals) in the area investigated; from left to right: on 15 and 29 September and on 13 October 1981, based on NOAA satellite measurements (courtesy of the U.S. dept. Commerce, National Oceanographic and Atmospheric Administration).

salinity profile is given based on CTD measurements.

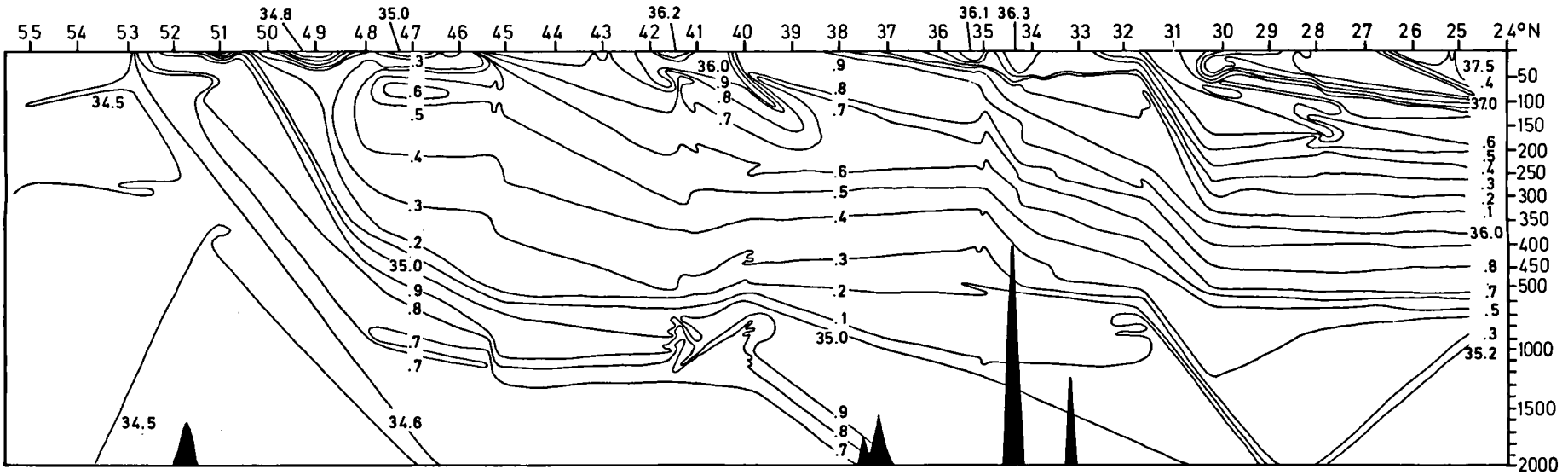
COLLECTING METHODS

For a description of the collecting gears RMT1+8 and RMT1 the reader is referred to Van der Spoel (1981), Roe et al. (1980) and Baker et al. (1973), for a description of the Ring-net the reader is also referred to Van der Spoel (1981). The RMT1+8, the RMT1 and the Ring-net were lowered from the stern of the ship. In a few cases the opening-closing mechanism failed to work, and open or completely closed hauls were made with the RMT1+8 as indicated in table I. Besides these gears, two small $1/4m^2$ rectangular nets were used, one with a mesh size of 76 µm and one with a mesh size of 202 µm. These nets were lowered quickly and pulled up vertically with stationary ship to make the haul from about 60 m to the surface. These nets are pyramidally shaped, 2.5 m long and end in a blind plastic bucket. These two fine-meshed nets were lowered from starboard deck only.

In total 76 hauls were made with functioning opening-closing system and 104 hauls with open nets. All small, fine-meshed rectangular net hauls were made in the day-time, from the RMT1+8 hauls 41% was made in the day-time and 40% at night; for the open nets these percentages were 42% and 34%.

In table I the sequences of station numbers and dates run contrary as the numbering of stations runs north-south regardless of the cruise direction. Some station numbers (41, 46) and many haul numbers are not given in the table as they only concern pump-samples. The distance sampled given in table I is, for the RMT1+8 and for the small rectangular nets, the actual distance the net was towed through the water, for all the other nets it is only the horizontal distance covered by the ship during the haul.

A few simple Secchi-disc readings were made with a white disc of 91 cm diameter, the results are given together with the times of



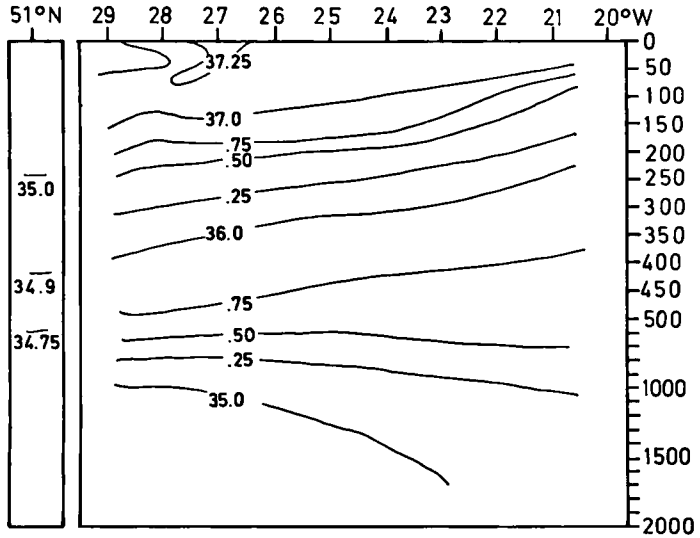


Fig. 5. Salinity (°/ooS) profiles, after CTD measurements, depth in meters along x-axis, 5a: for the transect between 55° and 24°N; 5b: for the transect between 30° and 20°W.

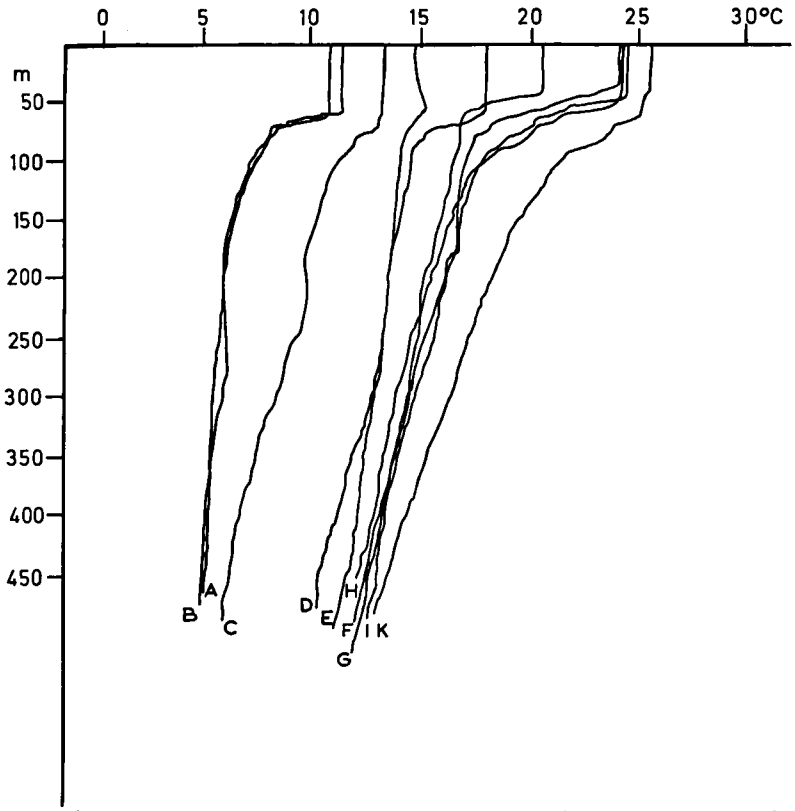


Fig. 6. Ten temperature curves from XBTs taken in approx. the same water masses as the curves given by Van der Spoel (1981, fig. 5).

a) 55°03'N 30°03'W, 8-X-1981, 11.20 h., near stat. 36; b) 53°01'N 29°36'W, 7-X-1981, 23.20 h., near stat. 37; c) 50°48'N 29°31'W, 6-X-1981, 23.15 h., near stat. 38; d) 50°12'N 30°00'W, 6-X-1981, 06.15 h., near stat. 38; e) 45°27'N 30°58'W, 2-X-1981, 11.15 h., near stat. 40; f) 32°30'N 29°41'W, 22-IX-1981, 11.30 h., near stat. 50; g) 34°09'N 31°21'W, 22-IX-1981, 23.30 h., near stat. 48; h) 35°08'N 31°23'W, 23-IX-1981, 23.45 h., near stat. 47; i) 41°12'N 35°46'W, 29-IX-1981, 23.15 h., near stat. 43; k) 25°02'N 29°58'W, 18-IX-1981, 17.25 h., near stat. 53.

sunset and sunrise in table II.

CONDITIONS

The differences in conditions between this autumn expedition and the spring cruise in 1980 are manifold, but most typical are: the absence of a polar front and of Subarctic water in the northern section; higher surface temperatures, more pronounced thermoclines in the upper 100 m, and the more vague delimitation of the branches of the North Atlantic Current, which also results in a less sharp boundary between cold and warm waters near 42°N. At about 27°N and 37°N two fronts were distinguished, based on abrupt changes in water colour and surface temperature (fig. 1); in the temperature profile these fronts are not clear, however. Between 40°N and 46°N the North Atlantic Current influences the temperature profile, this is in all probability the southern branch of the current. Warm Temperate waters are found in the entire section north of 42°N. The Sargasso Sea influences are found at the same localities as in 1980, viz. between 27°N and 40°N. South-east of 27°N 30°W influences of the Canary Curent are found. Real indications for the presence of Intermediate Antarctic water could not be found, below 800 m Arctic water penetrates southwards and near 45°N at a depth of 1200 m the CTD measurements indicated the presence of Mediterranean outflow.

Most remarkable in the temperature profile is the uplift of the isotherms between 35°N and 37°N. This same uplift over roughly 100 m is also found in the temperature profile for the 1980 cruise (Van der Spoel, 1981). In the salinity profiles this phenomenon is much less marked but still visible. The uplift coincides with

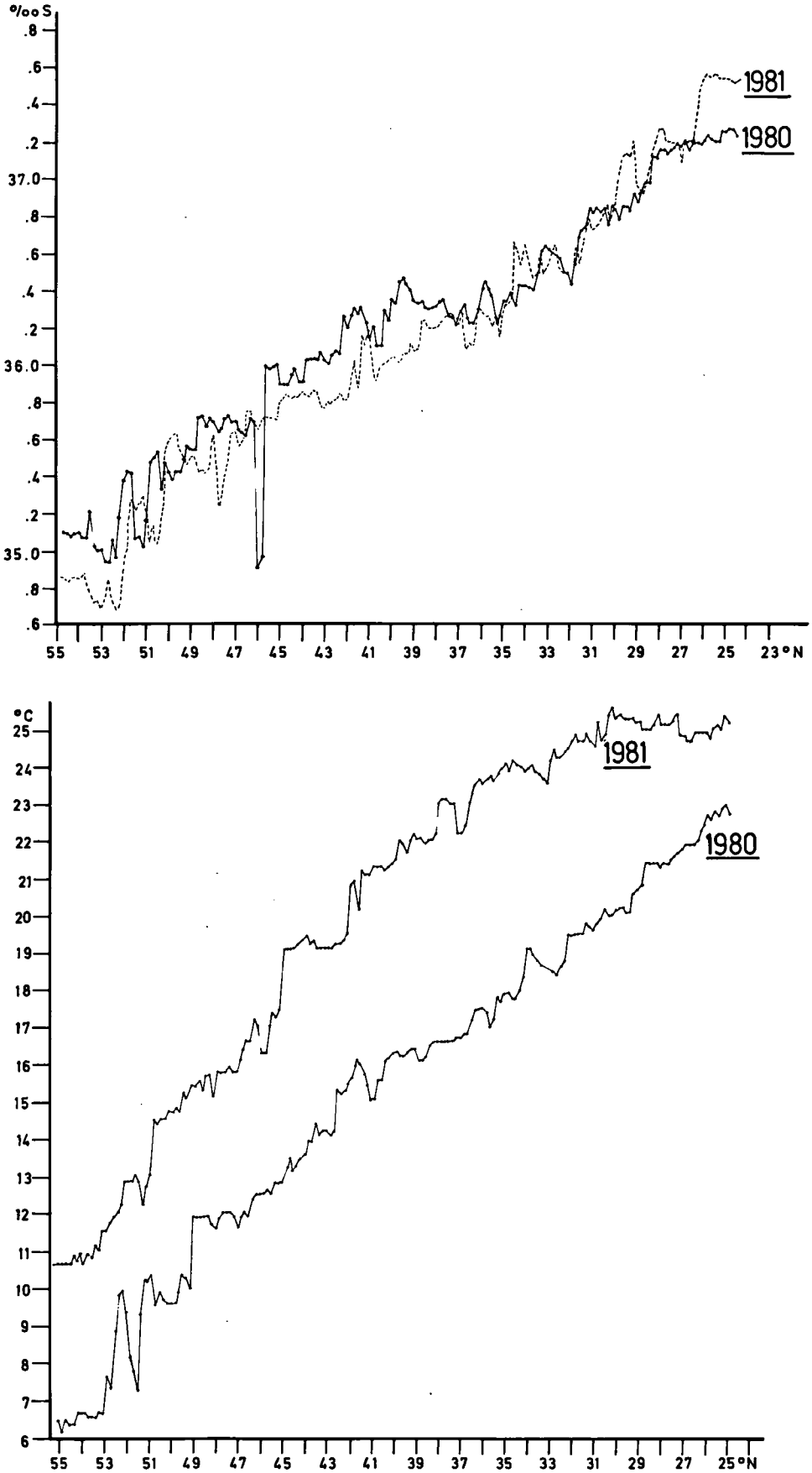


Fig. 7. Sea-surface salinities (corrected after a gauging in 1981) for 1980 and 1981 against latitudes (top) and sea-surface temperatures for 1980 and 1981 against latitudes (bottom).

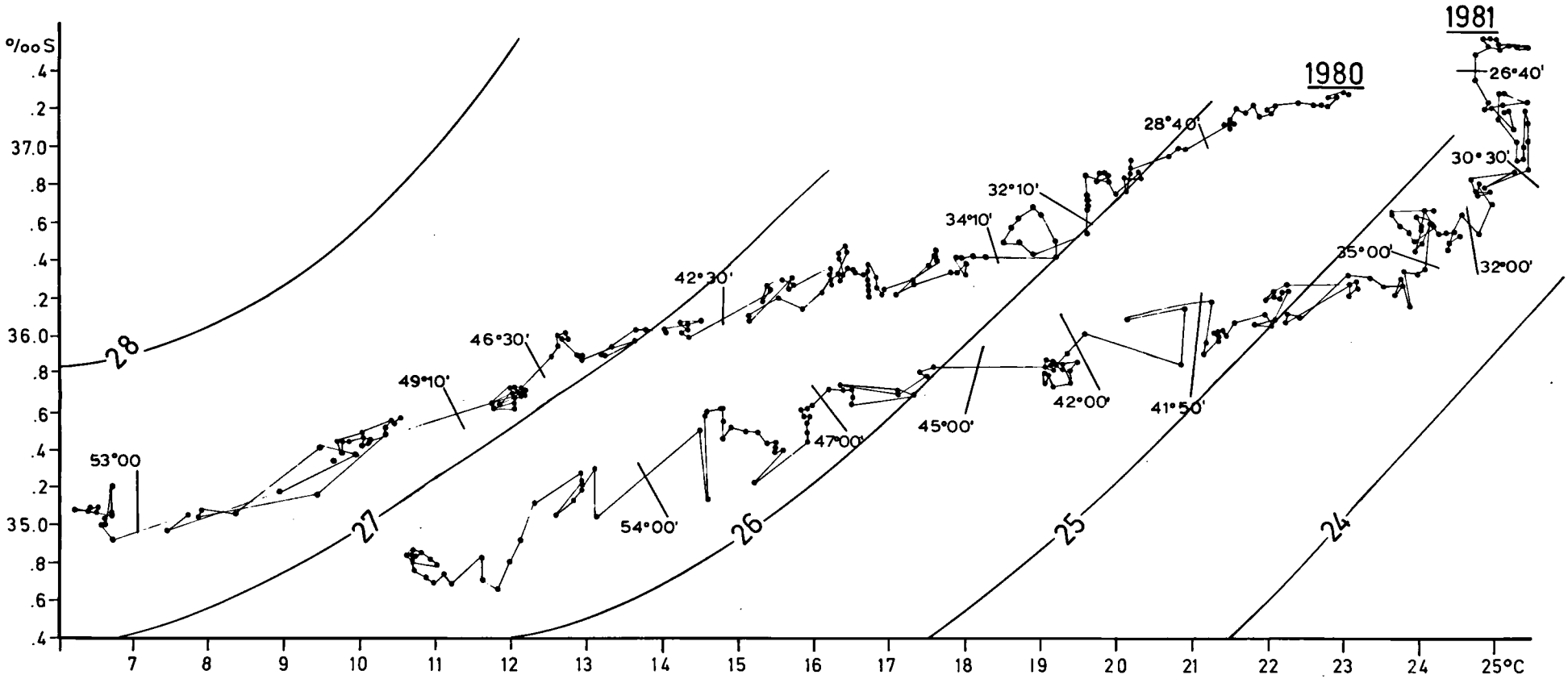


Fig. 8. T/S diagram for sea-surface salinities (corrected after a gauging in 1981) and temperatures for 1980 and 1981 with latitudes and water densities indicated.

the presence of seamounts and crests of the Mid Atlantic Ridge in the cruise transect. It is probably deep water flowing over the ridge from west to east which is responsible for this phenomenon. It is also in this area that animals of deep water are found in rather shallow hauls (cf. Van Utrecht, in press). The sharp ascending of isotherms near approx. 51°N was also found for the 1980 cruise, the only difference is that in the autumn of 1981 the 13°C isotherm and in spring 1980 the 10°C isotherm reached the surface.

The temperature curves given in figure 6 show isothermal layers, minimally 30 m thick, near 41°N and maximally 70 m thick, near 50°N. A great difference of the waters north and south of 50°30'N is marked by the great distance between the XBT curves c and d in figure 6.

The difference in sea-surface temperature and salinity between the 1980 and 1981 cruises are given in figure 7. The T/S diagram of the cruises (fig. 8) shows also the shift in density which is most pronounced in the north, while in the tropical area, south of 30°N, the character of the T/S diagram changes strongly.

ACKNOWLEDGEMENTS

The authors express their sincere thanks to the Royal Dutch Navy for help during the organisation of the cruise and more specifically to commander and crew of the oceanographic vessel H.M.S. "Tydeman" for their various efforts to make the expedition successful. A deep-felt gratitude is expressed to the staff of the Institute of Oceanographic Sciences for advice and supplying of equipment. The Royal Dutch Meteorological Institute made the CTD probes for which we are very thankful.

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received : 2.IX.1982
distributed : 11.III.1983

Table I

Station list

A: Station number

B: haul

C: day, month, 1981

D, E: the geographic position at the beginning of each haul: N (D), W (E)

F: the average course of the ship during the haul

G: depth in m

H, I: haul in min/km: the duration in minutes (H) and the distance towed in kilometers (I) see p.)

J: time start

K, L: the temperature (in °C, K) and the salinity (in °/oo S, L) at the start of the haul at the sea surface

M, N: the average temperature (in °C, M) and the average salinity (in °/oo S, N) over the depth sampled

O: gear: R18=Rectangular Midwater Trawl RMT1+8; RCT=closed haul because of malfunctioning of RMT1+8; ROT=open haul because of malfunctioning of RMT 1+8; RO1=open Rectangular Midwater Trawl RMT1; RNO=open Ring-net; 2VU=1/4m^2 net with 202 µm meshes; 7VU=1/4m^2 net with 76 µm meshes

P: period: D=day; D-N=dusk; N=night; N-D=dawn

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
35	3	10.10	51 08.6	23 55.9	307	0- 57	4	0.07	00.46	13.20	35.40	13.15	*****	7VU	N
35	4	10.10	51 08.5	23 56.3	300	0- 61	3	0.07	00.57	13.20	35.42	13.15	*****	2VU	N
35	5	10.10	51 08.4	23 56.7	301	0- 54	4	0.07	01.06	13.20	35.43	13.15	*****	7VU	N
36	2	08.10	55 01.4	29 58.2	288	0- 46	4	0.06	09.01	10.80	34.85	11.00	34.62	2VU	N-D
36	3	08.10	55 01.3	29 58.3	294	0- 49	3	0.06	09.09	10.80	34.85	10 90	34.62	7VU	N-D
36	4	08.10	55 01.2	29 58.7	292	0- 49	5	0.06	09.26	10.70	34.85	10.85	34.62	7VU	D
36	6	08.10	55 01.1	29 59.3	325	0- 50	60	3.15	09.55	10.70	34.85	10.85	34.62	RO1	D
36	8	08.10	55 07.0	30 10.3	325	0-1000	84	4.93	13.37	10.60	34.93	7.25	34.61	ROT	D
36	11	08.10	55 09.5	30 13.4	86	0- 390	111	5.48	15.24	10.50	34.77	8.25	34.62	ROT	D
36	12	08.10	55 07.4	30 05.4	350	0-1140	153	8.51	17.45	10.70	34.83	7.25	34.63	ROT	D-N
36	14	08.10	55 12.2	30 08.4	351	0- 50	33	1.94	20.25	10.60	34.86	10.30	34.63	RO1	N
36	15	08.10	55 13.5	30 08.8	350	0- 100	72	4.22	21.03	10.50	34.83	9.75	34.61	ROT	N
37	2	07.10	53 00.4	29 58.6	315	0- 63	5	0.07	12.59	11.50	34.72	10.50	34.56	7VU	D
37	3	07.10	53 00.4	29 58.9	324	0- 68	6	0.07	13.08	11.60	34.73	10.05	34.56	2VU	D
37	4	07.10	53 00.2	29 57.5	87	300- 410	60	3.91	14.32	11.60	34.75	4.75	34.41	R18	D
37	5	07.10	53 00.2	29 58.0	87	0- 50	65	3.81	14.25	11.60	34.76	11.30	34.58	RO1	D
37	8	07.10	52 59.2	29 51.1	90	195- 280	30	1.87	16.15	11.50	34.70	5.50	34.39	R18	D
37	9	07.10	52 58.5	29 47.4	91	400-1000	60	3.19	17.21	11.50	34.73	4.15	34.42	R18	D
37	10	07.10	52 58.6	29 48.0	90	0- 50	60	2.78	17.10	11.50	34.73	11.25	34.56	RNO	D
37	11	07.10	52 56.9	29 40.7	91	100- 200	30	1.87	19.30	11.50	34.72	6.50	34.40	R18	D-N
37	12	07.10	52 56.1	29 37.7	84	45- 100	30	1.87	20.37	11.40	34.72	9.50	34.50	R18	N
37	14	07.10	52 55.7	29 35.6	84	0- 50	25	1.54	21.38	11.70	34.86	11 45	34.70	RO1	N
38	1	06.10	50 59.8	29 58.2	117	0- 415	76	4.46	11.01	12.90	34.87	9.50	34.75	ROT	D
38	3	06.10	50 59.6	29 58.8	328	0- 60	5	0.05	10.21	12.90	34.89	12.95	34.95	7VU	D
38	4	06.10	50 59.6	29 58.6	314	0- 61	7	0.06	10.29	12.90	34.91	12.95	34.95	2VU	D
38	6	06.10	50 58.9	29 54.8	109	0- 130	67	3.72	12.38	13.00	34.86	11.95	34.97	ROT	D
38	7	06.10	50 58.1	29 50.9	101	0- 90	2	0.07	14.01	13.40	35.01	12.95	34.97	ROT	D
38	8	06.10	50 57.8	29 50.0	126	0-1005	185	8.00	14.35	13.50	35.02	9.35	34.81	ROT	D
38	9	06.10	50 57.6	29 49.7	124	0- 50	150	6.49	14.45	13.50	35.02	13.20	35.00	RO1	D
38	11	06.10	50 53.8	29 43.9	119	0- 520	104	5.78	17.45	13.90	35.16	9.65	34.82	ROT	D-N
38	12	06.10	50 50.4	29 38.6	105	0- 205	71	3.51	19.41	14.10	35.16	11 90	34.97	ROT	D-N
38	13	06.10	50 49.9	29 38.1	102	0- 50	65	3.01	19.53	14.10	35.16	13.55	35.02	RNO	D-N
38	14	06.10	50 48.4	29 35.3	86	0- 315	102	5.50	21.03	14.10	35.19	11.25	34.89	R18	N
38	16	06.10	50 47.7	29 31.1	82	0- 50	9	0.33	22.36	13.30	35.03	13.40	34.95	ROT	N
39	2	05.10	47 56.3	30 38.3	125	55- 100	60	3.91	05.29	14.70	35.02	15.15	35.42	R18	N
39	3	05.10	47 57.6	30 40.3	125	0- 50	15	0.74	04.38	14.80	35.02	15.45	35.18	RNO	N
39	4	05.10	47 56.1	30 37.9	125	0- 50	56	3.29	05.39	14.70	35.02	15.40	35.23	RNO	N
39	5	05.10	47 53.6	30 33.0	125	130- 210	61	4.45	07.23	15.20	35.15	13.65	35.40	R18	N-D
39	6	05.10	47 53.5	30 33.9	125	0- 50	60	3.52	07.05	15.00	35.14	15.95	35.41	RO1	N-D
39	8	05.10	47 49.7	30 28.5	125	205- 300	60	3.64	09.06	16.10	35.44	12.75	35.35	R18	D
39	9	05.10	47 46.5	30 23.5	125	310- 390	60	3.82	11.04	15.70	35.37	11.15	35.19	R18	D
39	10	05.10	47 43.4	30 18.8	125	405- 500	61	3.55	12.58	15.60	35.31	10.00	34.95	R18	D
39	14	05.10	47 39.1	30 13.8	126	500-1020	60	2.92	15.59	15.90	35.65	6.90	34.76	R18	D
39	17	05.10	47 40.7	30 15.5	265	0- 48	2	0.06	14.44	15.90	35.51	15.95	35.45	7VU	D
39	18	05.10	47 40.6	30 15.5	245	0- 52	4	0.06	14.49	15.90	35.53	15.95	35.46	2VU	D
40	1	02.10	45 09.4	29 57.1	54	385- 570	60	4.63	15.59	17.70	35.80	11.75	35.23	R18	D
40	3	02.10	45 10.0	30 41.5	103	0- 60	3	0.06	14.44	17.70	35.80	16.35	35.65	2VU	D
40	4	02.10	45 10.1	30 00.3	82	0- 58	6	0.06	14.50	17.70	35.77	16.30	35.64	7VU	D
40	5	02.10	45 02.2	29 54.3	240	0- 212	61	3.39	19.41	17.70	35.81	15.75	35.61	RO1	D-N
40	7	02.10	45 00.3	29 57.2	241	0- 190	59	2.92	20.54	17.70	35.80	15.90	35.62	RO1	N

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
40	8	02.10	44 59.3	30 00.6	265	0- 40	62	2.69	22.00	17.60	35.76	17.50	35.69	R01	N
40	10	02.10	44 59.1	30 03.8	293	0- 520	90	4.17	23.10	17.60	35.77	14.30	35.48	R01	N
40	12	03.10	45 01.3	30 08.5	291	0- 350	90	4.17	00.55	17.60	35.81	15.35	35.57	R01	N
40	13	03.10	45 03.6	30 11.6	288	0- 50	60	2.78	02.30	17.60	35.80	17.40	35.65	RNO	N
42	1	30.09	41 37.8	34 32.2	46	200- 315	60	3.82	07.35	20.30	36.10	14.30	35.55	R18	N-D
42	3	30.09	41 39.9	34 28.0	50	270- 400	60	3.64	09.15	20.90	36.16	13.75	35.46	R18	D
42	4	30.09	41 40.0	34 27.8	50	0- 50	60	3.34	09.20	21.00	36.17	19.55	35.99	RNO	D
42	5	30.09	41 42.5	34 23.4	50	405- 500	60	3.37	11.04	21.20	36.18	12.65	35.33	R18	D
42	6	30.09	41 44.4	34 20.5	246	460- 870	61	3.73	12.53	21.00	36.17	10.25	35.26	R18	D
42	9	30.09	41 44.7	34 25.0	58	110- 200	60	4.00	15.01	21.10	36.17	15.00	35.68	R18	D
42	10	30.09	41 48.3	34 23.2	46	45- 80	30	1.96	15.31	21.10	36.16	16.80	35.84	R18	D
43	1	29.09	41 05.6	35 40.4	311	385- 565	59	4.09	11.46	21.20	35.88	12.25	35.29	R18	D
43	2	29.09	41 01.7	35 41.3	199	0- 48	3	0.08	09.03	21.20	35.90	21.10	35.90	2VU	N-D
43	3	29.09	41 01.8	35 41.0	200	0- 38	5	0.08	09.15	21.20	35.91	21.10	35.85	7VU	N-D
43	5	29.09	41 10.3	35 42.4	300	500- 995	121	7.64	14.28	21.20	35.96	9.70	35.02	R18	D
43	7	29.09	41 11.1	35 42.5	288	0- 421	105	4.86	21.15	21.10	36.07	16.95	35.71	R01	N
43	9	29.09	41 13.5	35 47.0	204	0- 57	3	0.07	18.15	21.20	35.10	19.10	35.95	7VU	D
43	10	29.09	41 13.4	35 46.8	202	0- 50	3	0.07	18.21	21.20	36.10	21.10	35.95	2VU	D
44	2	28.09	39 48.2	35 44.8	180	0- 530	74	3.89	15.05	21.90	35.06	17.20	35.58	R01	D
44	4	28.09	39 48.3	35 45.7	176	0- 35	7	0.07	14.20	21.90	36.06	21.70	35.94	2VU	D
44	5	28.09	39 48.3	35 45.2	173	0- 26	9	0.08	14.48	21.90	36.05	21.70	35.96	7VU	D
45	1	27.09	37 09.0	34 48.6	250	80- 195	60	3.46	10.21	22.90	36.19	15.80	35.75	R18	D
45	2	27.09	37 09.3	34 48.1	246	0- 50	61	3.20	10.14	22.90	36.20	21.45	36.02	RNO	D
45	3	27.09	37 08.9	34 52.0	267	40- 105	61	3.37	11.50	22.90	36.20	17.75	35.85	R18	D
45	5	27.09	37 08.9	34 55.8	261	290- 430	66	3.82	15.00	22.90	36.18	13.35	35.41	R18	D
45	6	27.09	37 08.9	34 55.5	261	0- 50	60	2.59	14.53	22.90	36.16	21.05	36.01	R01	D
45	8	27.09	37 08.5	34 54.5	143	0- 57	7	0.08	13.19	22.90	36.18	20.70	36.01	2VU	D
45	9	27.09	37 08.6	34 54.6	140	0- 64	10	0.07	13.34	22.90	36.17	20.45	36.01	7VU	D
45	10	27.09	37 08.8	35 01.0	230	505-1010	90	4.88	17.09	23.30	36.17	9.80	35.09	R18	D
45	11	27.09	37 05.7	35 06.5	230	385- 530	59	2.65	19.52	23.10	36.26	12.50	35.27	R18	D-N
45	13	27.09	37 03.8	35 09.4	235	195- 380	56	3.37	21.41	23.10	36.27	14.65	35.50	R18	N
47	1	23.09	35 07.4	31 34.7	90	0- 50	60	3.34	19.10	24.20	36.30	23.10	36.40	R01	D-N
47	2	23.09	35 07.3	31 34.4	90	180- 300	58	3.55	19.17	24.20	36.29	14.55	35.60	R18	D-N
47	3	23.09	35 07.7	31 29.0	90	425- 855	57	3.10	21.24	24.00	36.32	10.70	35.22	R18	N
47	4	23.09	35 07.6	31 30.6	90	0- 50	60	2.78	20.50	24.10	36.32	23.30	36.31	RNO	N
47	6	23.09	35 07.6	31 22.7	90	50- 105	60	3.55	23.22	23.90	36.32	19.35	35.94	R18	N
47	7	24.09	35 07.1	31 19.5	90	95- 190	59	2.74	00.49	23.90	36.35	16.25	35.80	R18	N
47	9	24.09	35 06.7	31 16.4	90	360- 520	60	2.83	02.36	23.90	36.33	12.20	35.28	R18	N
47	10	24.09	35 07.1	31 12.6	90	270- 395	60	3.10	04.35	23.90	36.34	13.25	35.40	R18	N
47	11	24.09	35 07.0	31 13.4	90	0- 50	60	3.52	04.15	23.90	36.36	23.45	36.18	RNO	N
47	12	24.09	35 07.4	31 07.3	87	750-1170	60	2.56	06.57	23.90	36.33	8.65	35.13	R18	N-D
47	13	24.09	35 07.4	31 08.5	90	0- 50	60	3.15	06.29	23.90	36.33	23.50	36.16	R01	N-D
47	15	24.09	35 08.0	31 04.1	313	0- 50	3	0.05	08.40	23.90	36.33	23.50	36.17	7VU	N-D
47	16	24.09	35 08.0	31 04.1	320	0- 50	2	0.05	08.45	23.90	36.34	23.50	36.17	2VU	N-D
47	17	24.09	35 08.0	31 04.0	342	0- 50	2	0.05	08.50	23.90	36.34	23.50	36.17	7VU	N-D
47	18	24.09	35 08.1	31 04.0	1	0- 50	2	0.05	09.04	23.90	36.33	23.50	36.16	2VU	D
48	2	22.09	34 09.0	31 20.8	75	210- 300	60	3.37	23.53	24.00	36.57	15.40	35.77	R18	N
48	3	22.09	34 09.0	31 20.9	75	0- 50	65	3.01	23.50	24.00	36.56	22.55	36.49	RNO	N
48	5	23.09	34 11.9	31 16.2	70	110- 200	60	3.46	01.34	24.20	36.65	16.80	36.20	R18	N
48	6	23.09	34 11.9	31 16.1	70	0- 50	62	3.06	01.35	24.20	36.65	21.85	36.48	R01	N
48	7	23.09	34 12.4	31 05.6	90	290- 440	48	2.66	06.36	24.10	36.54	14.00	35.52	R18	N-D
48	8	23.09	34 12.9	31 11.9	90	500-1150	53	2.48	03.48	24.20	36.62	9.90	35.20	R18	N
48	11	23.09	34 12.7	31 05.8	237	390- 495	56	3.64	08.54	24.00	36.62	12.85	35.37	R18	D
48	12	23.09	34 12.8	31 04.4	258	0- 50	60	3.15	08.25	24.00	36.65	21.95	36.47	RNO	D
48	13	23.09	34 11.4	31 11.3	87	60- 100	60	1.93	11.47	24.00	36.66	18.70	36.38	R18	D
48	15	23.09	34 11.5	31 11.2	87	0- 50	65	4.62	11.53	24.00	36.66	21.95	36.48	R01	D
49	1	21.09	31 40.4	29 49.4	50	410- 490	60	3.46	17.30	25.00	36.70	14.10	35.51	R18	D
49	2	21.09	31 40.3	29 49.6	50	0- 50	60	3.15	17.25	25.00	36.71	23.00	36.60	RNO	D
49	3	21.09	31 43.1	29 42.6	59	515-1000	120	7.10	20.13	24.90	36.60	10.60	35.25	R18	N
49	5	21.09	31 42.9	29 43.4	58	0- 50	79	4.15	19.54	24.90	36.63	22.85	36.46	R01	D-N
49	6	21.09	31 44.5	29 35.3	46	45- 107	60	3.28	23.29	24.90	36.59	19.80	36.37	R18	N
49	8	22.09	31 45.6	29 32.9	48	105- 230	59	3.19	00.58	24.80	36.51	17.45	36.07	R18	N
49	9	22.09	31 47.4	29 30.0	48	200- 325	60	3.01	02.47	24.80	36.54	16.27	36.13	R18	N
49	10	22.09	31 51.2	29 25.2	47	290- 395	60	3.28	05.46	24.80	36.58	14.65	35.72	R18	N
49	11	21.09	31 39.9	29 50.3	308	0- 51	5	0.05	16.08	25.00	36.71	22.45	36.60	7VU	D
49	12	21.09	31 39.9	29 50.3	311	0- 53	3	0.05	16.15	25.00	36.71	22.40	36.60	2VU	D
49	16	22.09	33 26.5	30 21.8	5	0- 39	5	0.06	16.53	23.80	36.51	23.50	36.42	7VU	D
49	17	22.09	33 26.5	30 21.9	17	0- 59	6	0.06	17.01	23.80	36.50	22.15	36.34	2VU	D
49	18	22.09	33 26.4	30 22.2	11	0- 54	4	0.06	17.14	23.80	36.56	22.30	36.37	7VU	D
50	2	20.09	30 05.3	29 46.7	19	730-1200	95	4.60	19.24	25.30	37.16	9.15	35.45	R18	D-N
50	3	20.09	29 56.2	29 49.5	185	0- 49	2	0.05	13.06	25.50	37.13	24.20	36.96	7VU	D
50	4	20.09	29 56.2	29 49.4	163	0- 50	2	0.05	13.10	25.50	37.13	24 25	37.01	2VU	D
50	5	20.09	29 58.4	29 48.2	355	490- 745	90	4.70	15.30	25.60	37.16	11.75	35.60	R18	D
50	7	20.09	30 09.1	29 42.3	21	385- 508	60	3.19	22.39	25.50	37.15	14.00	35.82	R18	N
50	8	20.09	30 08.9	29 42.5	20	0- 50	60	3.71	22.30	25.50	37.14	24.30	37.05	RNO	N
50	9	21.09	30 12.0	29 40.0	351	260- 410	56	3.19	00.44	25.50	37.16	15.30	36.11	R18	N
50	10	21.09	30 11.9	29 40.0	351	0- 50	68	4.20	00.42	25.50	37.16	24.20	37.03	R01	N
50	12	21.09	30 14.5	29 39.8	352	210- 305	60	3.01	02.40	25.30	37.00	16.30	36.35	R18	N
50	13	21.09	30 18.5	29 39.3	352	110- 195	72	3.99	04.27	25.10	36.83	19.70	36.60	R18	N
50	14	20.09	30 03.7	29 47.5	190	0- 50	6	0.05	17.57	25.40	37.16	24.20	37.03	7VU	D
50	15	20.09	30 03.8	29 47.4	185	0- 50	6	0.05	18.07	25.40	37.15	24.20	37.02	2VU	D
50	16	21.09	30 22.4	29 39.9	***	55- 105	62	3.37	06.23	24.90	36.80	20.75	36.75	R18	N-D
51	4	19.09	27 56.6	29 51.2	2	35- 110	57	3.19	15.09	25.50	37.21	21.60	36.97	R18	D
51	5	19.09	27 59.2	29 51.2	2	105- 200	60	3.73	16.40	25.40	37.21	18.75	36.62	R18	D
51	6	19.09	27 59.0	29 51.2	2	0- 50	75	4.40	16.35	25.40	37.21	24.70	37.20	RNO	D
51	7	19.09	28 03.3	29 51.9	2	395- 500	60	2.65	18.55	25.30	37.23	13.75	35.82	R18	D-N
51	8	19.09	28 03.0	29 51.8	2	0- 50	60	2.96	18.40	25.30	37.23	24.70	37.21	R01	D-N
51	10	19.09	28 05.7	29 52.4	18	0- 47	7	0.05	20.42	25.10	37.22	25.05	37.22	7VU	D-N
51	11	19.09	28 05.8	29 52.5	32	0- 48	5	0.05	20.55	25.10	37.23	25.05	37.21	2VU	D-N
51	12	19.09	28 07.0	29 52.8	359	500-1050	120	6.38	22.10	25.10	37.26	10.45	35.54	R18	N
51	13	20.09	28 13.4	29 53.4	3	285- 400	60	3.10	01.35	25.30	37.26	15.60	36.07	R18	N
51	14	20.09	28 17.2	29 53.4	2	190- 300	60	3.19	03.33	25.10	37.26	17.40	36.34	R18	N
52	1	18.09	24 49.8	30 00.3	360	30- 90	63	4.09	05.28	25.30	37.54	22.95	37.35	R18	N
52	2	18.09	24 54.1	30 01.5	5	200- 290	62	3.91	07.44	25.20	37.53	17.35	36.42	R18	N-D
52	3	18.09	24 53.8	30 01.4	4	0- 1	60	3.15	07.35	25.20	37.53	25.20	37.52	RNO	N-D
52	5	18.09	24 57.5	30 01.2	84	490-1005	120	6.38	10.16	25.20	37.53	9.85	35.42	R18	D
52	6	18.09	24 57.5	30 01.4	84	0- 25	60	3.89	10.10	25.20	37.53	25.15	37.53	R01	D
52	8	18.09	24 59.8	29 55.8	323	0- 320	60	3.34	15.42	25.50	37.53	20 55	36.81	RCT	D
52	9	18.09	24 57.6	29 54.2	344	0- 62	9	0.09	13.23	25.30	37.54	25.15	37.49	7VU	D

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
52	10	18.09	24 57.6	29 54.3	344	0- 66	9	0.09	13.39	25.30	37.53	25.15	37.49	2VU	D
52	11	18.09	25 02.3	29 58.2	342	100- 205	61	3.37	17.32	25.50	37.55	19.35	36.82	R18	D
52	12	18.09	25 02.4	29 58.2	341	0- 25	60	2.22	17.37	25.50	37.55	25.30	37.54	RNO	D
52	13	18.09	25 04.2	29 59.5	82	310- 410	61	2.92	19.30	25.40	37.55	15.10	36.05	R18	D-N
52	14	18.09	25 04.1	29 55.1	80	400- 510	59	2.83	21.42	25.20	37.52	13.50	35.82	R18	N
53	3	17.09	25 21.2	27 47.9	341	0- 50	9	0.06	13.01	25.20	37.22	24.90	37.25	2VU	D
53	4	17.09	25 21.2	27 48.3	340	0- 50	9	0.06	13.16	25.20	37.20	24.90	37.25	7VU	D
53	5	17.09	25 21.1	27 48.7	337	0- 50	10	0.06	13.45	25.20	37.19	24.90	37.34	2VU	D
53	6	17.09	25 21.1	27 48.5	338	0- 50	11	0.06	13.29	25.10	37.29	24.85	37.35	7VU	D
53	7	17.09	25 10.4	28 25.1	255	35- 125	60	3.82	17.05	25.20	37.45	22.00	37.25	R18	D
53	8	17.09	25 10.0	28 30.1	255	0- 25	60	3.34	19.04	25.10	37.49	25.07	37.56	RO1	D-N
53	9	17.09	25 10.0	28 30.3	255	100- 200	60	3.01	19.08	25.10	37.62	19.05	36.90	R18	D-N
53	10	17.09	25 09.4	28 34.3	255	170- 300	60	3.64	21.05	25.10	37.60	17.25	36.55	R18	N
53	13	17.09	25 09.4	28 34.4	255	0- 25	60	4.08	21.10	25.10	37.60	25.07	37.60	RNO	N
54	3	16.09	26 21.0	23 32.9	352	0- 50	10	0.06	13.15	24.60	36.97	23.90	37.23	7VU	D
54	4	16.09	26 21.0	23 33.2	346	0- 50	10	0.06	13.25	24.60	36.97	23.90	37.21	2VU	D
54	5	16.09	26 21.1	23 33.5	331	0- 50	10	0.06	13.35	24.60	36.93	23.90	37.21	7VU	D
54	6	16.09	26 21.2	23 33.9	329	0- 50	10	0.06	13.45	24.60	36.92	23.90	37.21	2VU	D
54	7	16.09	26 10.5	24 22.8	253	90- 210	55	3.37	18.08	24.50	37.26	18 00	36.77	R18	D
54	8	16.09	26 10.5	24 22.6	253	0- 40	55	3.57	18.05	24.50	37.26	24.25	37.38	RO1	D
54	9	16.09	26 09.6	24 26.4	253	0- 20	62	5.17	19.28	24.40	37.25	24.30	37.27	RNO	D-N
54	11	16.09	26 08.2	24 31.0	254	30- 92	60	3.55	20.54	24.30	37.26	21.05	37.30	R18	N
55	1	15.09	27 10.1	19 54.6	260	40- 105	60	4.09	04.10	23.50	36.83	19.30	36.55	R18	N
55	2	15.09	27 08.3	20 02.0	257	95- 205	61	3.82	05.34	23.60	36.88	16.70	36.25	R18	N-D
55	3	15.09	27 05.7	20 09.4	250	190- 288	63	4.72	09.14	23.50	36.83	14.90	36.05	R18	D
55	4	15.09	27 02.5	20 17.7	256	570-1000	120	6.83	11.57	23.60	36.85	9.15	35.40	R18	D
55	5	15.09	27 02.9	20 16.4	256	0- 50	84	4.41	11.30	23.60	36.80	21.80	36.30	RO1	D
55	6	15.09	27 01.7	20 19.8	258	0- 20	60	2.04	13.00	23.70	36.83	23.45	36.91	RNO	D
55	10	15.09	27 00.0	20 24.7	289	0- 50	9	0.06	15.25	23.70	36.84	21.50	36.92	7VU	D
55	11	15.09	26 60.0	20 24.8	293	0- 50	9	0.06	15.35	23.70	36.84	21.85	36.92	2VU	D
55	13	15.09	26 59.3	20 26.7	270	0- 430	50	3.40	17.12	23.70	36.85	18.10	36.27	RCT	D
55	14	15.09	26 57.5	20 32.9	270	400- 550	55	3.10	19.39	23.70	36.85	11.90	35.65	R18	D-N
55	15	15.09	26 55.9	20 38.6	275	290- 395	60	3.10	22.10	23.70	36.79	13.55	35.75	R18	N

Table II

Times of sunrise and sunset, and depth op Secchi readings

date	Julian day	start of twilight	sunrise	sunset	end of twilight	depth of Secchi disc	station
15-IX	258	06.15	07.06	19.27	20.17	32 m	55
16-IX	259	06.26	07.16	19.41	20.31	45 m	54
17-IX	260	06.51	07.41	19.56	20.46	44 m	53
18-IX	261	06.58	07.47	20.01	20.50	41 m	52
19-IX	262	06.56	07.47	20.00	20.51	49 m	51
20-IX	263	06.56	07.47	19.58	20.50	60 m	50
21-IX	264	06.54	07.47	19.57	20.50	-	49
23-IX	266	06.59	07.53	20.02	20.57	51 m	48
24-IX	267	06.59	07.54	19.54	20.50	-	47
25-IX	268	06.48	07.45	19.47	20.45	-	46
26-IX	269	07.00	07.57	19.57	20.53	-	46
27-IX	270	07.13	08.09	20.10	21.06	39 m	45
28-IX	271	07.18	08.16	20.10	21.09	-	44
29-IX	272	07.18	08.18	20.09	21.08	-	43
30-IX	273	07.14	08.14	20.01	21.02	-	42
1-X	274	07.17	08.20	19.58	21.03	-	41
2-X	275	07.02	08.07	19.38	20.42	30 m	40
5-X	278	06.58	08.05	19.32	29.39	23 m	39
6-X	279	06.56	08.07	19.26	20.37	17 m	38
7-X	280	06.57	08.10	19.22	20.36	18 m	37
8-X	281	06.57	08.16	19.18	20.36	16 m	36

APPENDIX

Corrections Van der Spoel, 1981

The sea surface temperatures are all 0.2°C too low. The temperature profiles and temperatures at depth are correct.

p. 7, line 24 read for Fig. 1b: Fig. 2.

Table I should be corrected as follows:

St. 9 Haul 1 position 52°22.9' 17°49.6'	read: 50°51.9' 11°25.6'
St. 10 Haul 2 in km 2.09	read: 2.41
St. 14 Haul 2 haul in min 60; temp. depth 12.70	read: 70; 7.75
St. 18 Haul 1 haul in min 94	read: 83
St. 20 Haul 4 haul in min 81	read: 90
St. 21 Haul 1 haul in min 106	read: 120
St. 21 Haul 6 in min 112	read: 127
St. 24 Haul 4 at surface Sal. 3694	read: 36.64
St. 25 Haul 8 time start 01.50	read: 01.05
St. 26 Haul 8 haul in min 236	read: 226
St. 27 Haul 23 haul in min 102	read: 120