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Phytoplankton abundance and distribiution in the southern Drake Passage and the Bransfield Strait in February—March 1981 (BIOMASS-FIBEX) *)

ABSTRACT: Maximum values of the settling volume and dry weight of suspended particulate matter, were found in the open waters of the southern Drake Passage (between 60°8' S and 62°11' S), and west of the Anvers Island. Minimum respective values were observed in the Bransfield Strait. The distribution of phytoplankton cell numbers and of algal biomass expressed as total cell volumes closely followed the distribution of particulate matter. Diatoms were the major algae of the plankton. Several species of the genera *Chaetoceros, Nitzschia* and *Corethron* were dominant and characteristic of the phytoplankton assemblages in different parts of the study area.

Key words: Antarctic, FIBEX, phytoplankton, distribution

1. Introduction

During the BIOMASS-FIBEX investigations in February-March 1981, 151 stations were investigated by the Polish r/v "Profesor Siedlecki" working in the "A" area of the southern Drake Passage and the Bransfield Strait. Along with other biological and physicochemical data, net-phytoplankton samples were collected at 63 plankton stations Rakusa-Suszczewski 1982. The purpose of this report is to present the relative abundance, species composition and distribution of phytoplankton in the investigated area.

2. Materials and methods

126 phytoplankton samples, two at each of the 63 plankton stations, were obtained by means of a vertical net haul from 100 m depth to the

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surface. A Copenhagen-type net with an opening diameter of 50 cm (0.1963 m^2 opening mouth area) and a mesh size 60 μm was used for the collections. Each sample was split into two equal parts: one was fixed with 4% formaline for further microscopic examination, another part was concentrated by centrifuging to obtain the wet settling volume of the suspended particular matter. Subsequently the concentrated sample was filtered through a preweighed Millipore filter (1.2 microne pore size), dried 24 hr at 40–60°C and then weighed to obtain dry weight of particulate matter.

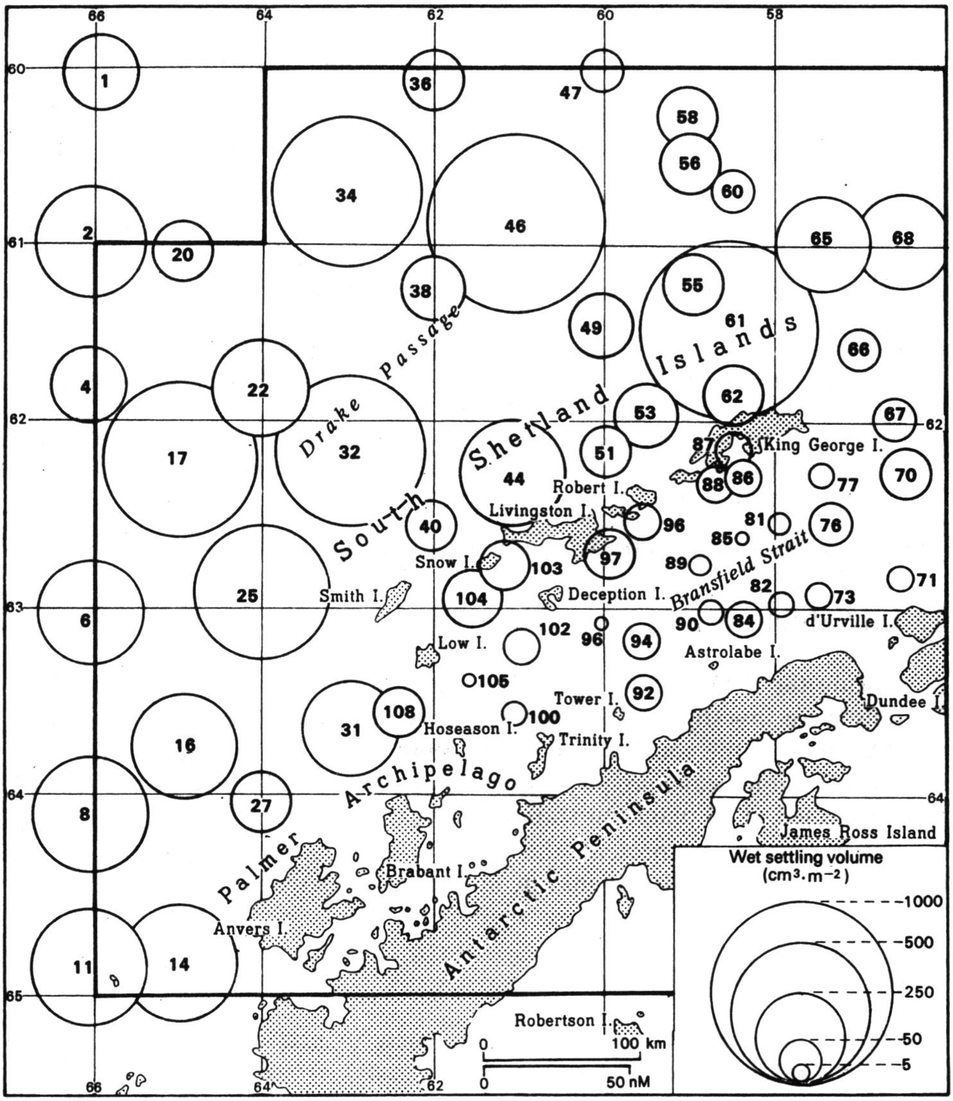

Fig. 1. Wet settling volume of suspended particulate matter expressed as cm^3 under 1 m^2 sea surface, in 100 m water column, 14 February—14 March, 1981

Phytoplankton samples were examined under Biolar P I microscope and cells were counted in a water drop of known constant volume according to the method described by Kopczyńska (1980).

Cell volume calculations were based on average length and width measurements of about 20 cells of the dominant species; the values were used to obtain a rough estimate of the total phytoplankton cell volumes at the stations studied.

In phytoplankton counting, the species of *Nitzschia*, of the groups *Pseudonitzschia* and *Fragilariopsis,* were usually included collectively within their groups, since identification to species of the water-mounted algae presented much difficulties.

3. Results

3.1. Distribution of suspended particulate matter

Table I and Figures 1 and 2 show the results pertaining to the wet settling volumes and dry weights of suspended particulate matter. High settling volumes (Fig. 1) were observed in the open waters of the Drake Passage, particularly between 60°8' S and 62°11' S. Maxima ranging between 580 and 950 $cm^3 \cdot m^{-2}$ (Table I) occurred at stations 25, 32, 34, 17, 46, 61 arranged here in order of increasing values. Rather high values (340–460 cm^3 under 1 m^2) were also found west of the Anvers Island at stations 11, 14, 8 and 16. Generally low settling volumes were characteristic of the Bransfield Strait, with minima (4–14 $cm^3 \cdot m^{-2}$) along the central NE- SW line of the Strait, at stations 77, 81, 85, 89, 98, and 105. Medium values (100–330 $cm^3 \cdot m^{-2}$) were scattered between the highest values over the entire investigated area of the Drake Passage, especially in the NE part of the sector "A", such as at stations 65 and 68 close to the Elephant Island, or at stations 62, 53, 44 and 49 north of the South Shetland Islands.

The distribution of dry weight of particulate matter (Fig. 2) was virtually the same as the distribution of wet settling volumes, with maxima (9.5 $g \cdot m^{-2}$ at st. 8 to 19.6 $g \cdot m^{-2}$ at st. 61), occurring generally at the same stations in the open area of the Drake Passage and west of the Anvers Island, and with minima (0.06—0.40 $g \cdot m^{-2}$) in the Bransfield Strait.

3.2. Phytoplankton abundances and distribution

Total counts

High numbers of algae (Table I, Fig. 3) were generally found in the Drake Passage, at all the about ten stations characterized by the highest values of settling volume and dry weight. Three maximal counts were noted at stations: 11 (379×10^8 cells under 1 m^2 of sea surface) and st. 14 (207×10^8) located west of the Anvers Island, and at station 61 (282×10^8), Species composition and relative abundance of phytoplankton at BIOMASS-FIBEX stations, area "A", February—March, 1981

Station No.	1	2	4	6	8	11	14	16	17	20	22	25	27	31	32	34	36	38	40	44	46	47	49	51	53	55	56	58	60	61	62
Suspended particulate matter																															
wet settling volume (cm · m⁻² sea surface)	151.0	376.0	189.5	340.0	410.0	460.0	420.0	377.0	810.0	87.0	310.0	580.0	90.1	250.0	710.0	750.0	94.8	119.0	61.9	327.0	940.9	51.9	148.2	78.8	152.3	82.5	85.6	103.1	72.0	951.0	112.9
dry weight ($g \cdot m^{-2}$ sea surface)	2.90	6.77	2.20	5.35	9.46	—	12.60	6.08	16.21	3.39	11.30	4.20	0.42	5.18	6.83	12.35	0.89	3.11	0.57	9.47	17.89	2.17	6.88	1.20	3.41	2.00	2.20	1.82	0.91	19.60	2.11
Total phytoplankton																															
Total cell volume ($mm^3 \cdot m^{-2}$ sea surface)	340	3073	882	1925	11666	8725	4742	7142	37360	703	1274	15820	839	2693	16378	21291	36	120	125	18439	9570	377	5718	1808	5828	15	107	77	693	37650	5490
Cells under 1 m^2 sea surface ($N \times 10^8$)	1.3	5.5	2.4	8.5	2.1	379.4	206.7	3.7	56.4	1.2	5.8	46.6	0.2	0.6	41.5	59.1	0.1	0.3	0.8	67.3	9.5	0.1	6.2	1.2	2.7	0.1	0.2	0.3	0.6	281.6	7.5
Bacillariophyceae (percent in total phytoplankton cell numbers)	99.9	100.0	99.5	99.8	95.8	0.6	3.4	99.0	99.8	99.2	99.7	99.9	99.4	99.5	99.8	99.6	99.1	99.8	100.0	99.8	98.9	99.7	98.5	100.0	99.9	99.5	99.7	98.8	100.0	68.2	93.2
Centrales																															
Actinocyclus sp.																		p			p					p					
Asteromphalus hookeri Ehr.	p*)	p	p						p	p											p					8.7	p				
A. hyalinus Karst.		p	p																									p			
A. parvulus Karst.			p					p	p								p	p			p										
Asteromphalus sp.				p							p	p			p	p				p											
Biddulphia striata Karst.				p	1.5	p	p	1.1		p				4.7						p	p				p					p	2.4
Chaetoceros atlanticus Cl.	28.3	47.6	47.7	60.0	p			2.3	11.3	11.4	59.7	49.8			61.0	66.0	78.1	46.7	1.0	p	11.5		44.0		p	19.6	41.5	33.5	59.0	p	p
C. atlanticus v. *skeleton* (Schütt). Hust.			9.1						p	p																					
C. bulbosum (Ehr.) Heiden		p		p		p	p	p	p	p					p	p					p		p	1.5						p	p
C. concavicornis Mangin	7.5	2.2																								p	p	p			
C. concavicornis f. *volans* (Schütt.) Hust									p												p					p					
C. convolutus Castr.	2.9														p			p			p		1.1	4.6	1.2				14.0	p	p
C. criophilum Castr.	2.0	2.1	1.6	1.2	15.2	p		1.3	1.3	3.0	1.2	p	9.1	2.9	p	p	p	p		p	p		p				p	4.1	8.0	p	
C. densus Cl.							p		p					p	p	p							2.4					4.1		p	
C. debilis Cl.		p										p								p				15.3							
C. dichaeta Ehr.	6.8	28.9	3.6	p	2.6	p		p	49.8	44.3	3.0	15.2	2.7	4.1	19.0	15.2	14.6	17.6	p	p	69.8		22.0	4.0	4.9	6.5	4.9	8.8	6.1	1.1	2.3
C. flexuosus Mangin				p				1.8				p																		p	
C. neglectus Karst.				3.6	3.3		p	1.4						5.9	p			2.4	25.5	5.0	p	6.2		1.5						2.4	1.6
C. peruvianus Brightw.							p	13.0				p				p							p		p				3.6		p
C. peruvianus f. *gracilis* (Schröd.) Hust.												p																			
C. schimperianum Karst.																				p			p								
C. socialis Lauder							1.5	4.8			p	p			p	p														p	
C. tetrastichon Cl.																p							1.1							2.4	
C. tortissimum Gran.				p			p	5.5				p		14.7					36.4	90.0				52.0	35.6						
Chaetoceros spp.	1.6	1.4	6.2		5.5	p	p	p	2.8	1.0	p	p					p	3.0				6.2								54.6	47.7
Charcotia actinochilus (Ehr.) Hust.			p		p																										
Corethron criophilum Castr.	p	p	1.1	2.5	50.5	p	p	14.4		2.0	p	1.6	50.0	34.7	p	1.1	p	p	2.9	1.2	2.8	28.1	6.0	14.0	21.2	p	4.9	2.9	8.0	p	6.6
Coscinodiscus bouvet Karst.											p								p	p				p						p	
C. furcatus Karst.																															
C. gyratus Jan.									p																						
C. inflatus Karst.																															
C. lentiginosus Jan.		p	p						p													p				p					
C. oculoides Karst.																	p	p				p									
C. tabularis Grun.		p	p						p	p											p										
Coscinodiscus spp.	1.0	p				p			p	p	p	p	1.8	p		p	p		p			p			p	p	p	p	p	p	p
Coscinosira antarctica Kozlova		p															p														
Dactyliosolen antarcticus Castr.	3.6	p	p	p	p	p		p	p	1.0	p	p	p		p		p	p			p	p	p			p	p	p		p	
Dactyliosen sp.		p	p						p		p		1.8					p			p							p			
Eucampia balaustium Castr.		p	p		p	p	p		p			p	4.7	p			p			p	p				5.4	p				1.0	2.3
Melosira sol (Ehr.) Kütz.																															
Porosira pseudodenticulata (Hust.) Zhuse					p				p	p								p													
Rhizosolenia alata Brightw.	2.3	p	p	p	3.5	p			p	p	p	p	1.8	p	p		p	p	p		p		p		1.0	p	p			p	p
R. alata f. *curvirostris* Gran.		p								p							p				p										
R. alata f. *gracillima* (Cl.) Grun.		p		p				p				p			p	p			1.1	p			p	p						p	
R. alata f. *indica* (Perag.) Osten.															p									1.5							
R. alata f. *inermis* (Castr.) Hust.	1.6		p		p				p	p							p	p			p										
R. bidens Karst.																					p										
R. delicatula Cl.	2.6	2.8	p			p			p	p	1.3		p	p	p	p		7.9			p										
R. hebetata f. *semispina* (Hensen) Gran.	p			p				p							p			p			p										
R. rhombus Karst.																p															
R. setigera Brightw.																p	p									p		p			
R. simplex Karst.	p	p	p						p	p			p																		
R. styliformis Brightw.										p																					
R. styliformis v. *longispina* Hüst.															p												p				
R. truncata Karst.								p								p															
Rhizosolenia spp.												p																			
Schimperiella antarctica Karst.		p							p	p				p			p	p													
Thalassiosira delicatula Hust.												p																			
T. gracilis (Karst.) Hust.	p	p	p						1.4	3.2								p			1.2					p	p				
Thalassiosira spp.		p		p		p			p	p	p	p			1.0	p			1.1	p			p			p				p	
Pennales																															
Achnanthes sp.																															
Amphora sp.																															
Cocconeis costata Greg.																															
C. imperatrix A. Schm.																															
Cocconeis sp.																															
Gomphonema sp.																															
Navicula criophila (Castr.) *DeToni*					p				p												p										
Navicula sp.															p						p										
Nitzschia angulata Hasle			p	p					p	p		p						p			p					p					
N. curta (V. Heurck) Hasle		p	p	p	1.5	p	p		2.8	2.2	2.2	p	1.8	3.5		p		p			4.4	p				6.5	p	10.0			
N. cylindrus (Grun.) Hasle			p	1.2			p	14.0				1.6			2.0	p			18.6	p	p				3.3					p	p
N. kerguelensis (O'Meara) Hasle	3.2	3.4	12.4	3.5	p				18.7	18.3	9.7	5.9	9.1	p	6.2	7.8		9.1		p	2.8	18.8	6.5			10.9	p	8.2	p	p	
N. obliquecostata (V. Heurck) Hasle		p							p																						
N. sublineata Hasle		p			2.3	p			p																1.7					p	7.0
N. heimii Manguin**)											5.4	1.4			1.7	p			2.6	1.5			4.3		5.6						6.6
N. longissima (Brèb.) Ralfs															p																
Nitzschia "delicatissima" complex***)	35.1	8.2	10.9	22.2	5.0	p	p	33.7	5.1	12.2	18.5	11.4	7.3	17.1	4.8	4.9	7.3	13.3	8.2	p	3.9	15.6	6.7	4.6	16.3	26.1	46.5	21.8	p		2.4
N. lineola Cl.											7.0	p			p																
N. prolongatoides Hasle								p			1.1	p			p										p				p		
N. turgidula Hust.											4.6	p			p										p						
N. turgiduloides Hasle											p	p												p							
Nitzschia ssp.				p																											
Pleurosigma sp.			p						p							p	p				p						p				
Synedra reinboldii V. Heurck								p			p	p				p				p			p		p						
Synedra sp.															p	p			p												
Thalasionema elegans Hust.												p			p																
Thalassiothrix antarctica Schimper et Karsten	p	1.4	1.0	p	3.5	p	p	3.1	1.0	1.0	p	p	14.6	6.5	p	p	p	p	p	p	p	6.2	p	p	2.1	p		p	p	p	1.6
Triceratium arcticum Bright																															
Triceratium sp.																															
Tropidoneis sp.			p	p					p		p				p						p										
Dinophyceae																															
Ceratium sp.	1.6		p						p	p			p				p	p				p						p			
Dinophysis tuberculata Mangin																															
Dinophysis spp.			p			p												p		p	p				p						
Gymnodinium spp.											p																				
Gyrodinium spp.												p			p	p							p								
Oxytoxum criophilum Balech				p								p																			
Peridinium antarcticum Schimper																															p
P. curtum Balech				p																											
P. pseudoantarcticum Balech							p																								
Peridinium spp.				p		p		p		p			p	p		p	p	p								p	p				
Silicoflagellatae																															
Dictyocha speculum Lemm.			p	p	p				p		p	p			p	p	p				p		1.3		p	p				p	
Haptophyta																															
Phaeocystis antarctica Karst.					4.2	99.4	97.0	p					p	p						p	p									31.8	6.7
Unidentified flagellates																															p

p*) — less than 1%
**) — often included in *Nitzschia "delicatissima"* complex
***) — includes: *N. lineola* Cl., *N. prolongatoides* Hasle, *N. turgidula* Hust., *N. turgiduloides* Hasle

Station No.	65	66	67	68	69	70	72	73	76	77	79	81	82	84	85	86	87	88	89	90	92	94	96	97	98	100	102	103	104	105	108
Suspended particulate matter																															
wet settling volume ($cm \cdot m^{-2}$ sea surface)	282.5	44.7	57.5	288.0	—	62.0	—	13.2	59.1	13.7	—	13.2	16.0	36.0		36.2	42.8	37.5	10.7	20.6	45.5	32.1	31.0	73.1	5.0	12.0	36.2	64.7	103.9	74.0	78.5
dry weight ($g \cdot m^{-2}$ sea surface)	5.00	0.23	0.92	3.89	—	0.45	—	0.10	0.29	0.16	—	0.04	0.08	0.15	0.08	0.34	0.39	0.12	0.08	0.06	0.14	0.15	0.23	0.44	0.03	0.05	0.18	0.24	1.40	—	0.39
Total phytoplankton																															
Total cell volume ($mm^3 \cdot m^{-2}$ sea surface)	30522	464	250	4559	6	27	536	156	78	4	18	10	27	20	8	40	129	79	8	136	165	780	4	350	3	2	187	115	765	0.1	132
Cells under 1 m^2 sea surface ($N \times 10^8$)	16.9	0.1	0.05	26.4	0.001	0.005	0.3	0.02	0.01	0.02	0.01	0.001	0.003	0.003	0.001	0.01	0.1	0.3	0.001	0.02	0.4	0.1	0.003	2.5	0.001	0.001	0.1	0.66	3.3	0.001	0.7
Bacillariophyceae (percent in total phytoplankton cell numbers)	98.2	100.0	99.7	99.8	99.7	100.0	96.0	83.0	67.0	100.0	99.6	99.9	100.0	100.0	100.0	100.0	99.5	98.5	100.0	100.0	10.0	67.0	96.6	98.5	99.8	100.0	97.6	96.1	98.0	100.0	99.9
Centrales																															
Actinocyclus sp.	p			p	p																										
Asteromphalus hookeri Ehr.	p		p																												
A. hyalinus Karst.	p																							p							
A. parvulus Karst.	p			p		p																	p	p							
Asteromphalus sp.																															
Biddulphia striata Karst.	p			p			22.0				p																				
Chaetoceros atlanticus Cl.	22.7	4.5	p	2.8	5.1						10.5		1.5	1.1			8.3	3.4			4.7			p					p		p
C. atlanticus v. *skeleton* (Schütt). Hust.																		1.9					8.1	4.8	p		2.4	22.0	15.0	p	3.3
C. bulbosum (Ehr.) Heiden	p			p	p		9.9	4.0										p					p	p	p						
C. concavicornis Mangin	3.2		p	p									p	1.1									p								
C. concavicornis f. *volans* (Schütt.) Hust.																													p		1.2
C. convolutus Castr.							5.0																						p		
C. criophilum Castr.	p	1.5		p	p						3.3	p						p							p			1.1	p		p
C. densus Cl.	1.5	1.4	p	p																				p				1.1	p		
C. debilis Cl.														p																	
C. dichaeta Ehr.	24.2	6.0		5.6				13.0									7.3	6.8		8.6		8.3							5.0		2.1
C. flexuosus Mangin																															
C. neglectus Karst.	11.5	p		31.0																											
C. peruvianus Brightw.																34.0		15.1						27.4				p	1.3		p
C. peruvianus f. *gracilis* (Schröd.) Hust.																															
C. schimperianum Karst.		p																													
C. socialis Lauder																															
C. tetrastichon Cl.																		p						1.5					1.5		
C. tortissimum Gran.	4.0	p		40.0						100.0	100.0						50.5	51.7		11.4				31.8				22.0	24.0	p	22.7
Chaetoceros spp.	p																														
Charcotia actinochilus (Ehr.) Hust.			p		p	p					p			1.5									p		p	p					p
Corethron criophilum Castr.	14.3	72.9	54.3	1.2	73.4	53.6	6.0	13.0	67.0		32.1	97.9	97.7	93.6	100.0	33.3	7.3	4.9	100.0	77.0	p	58.3	73.2	1.3	73.1	95.7	17.0	3.9	p	30.0	7.9
Coscinodiscus bouvet Karst.	p	p			p						p		p	p				p					2.7	p	p						p
C. furcatus Karst.		p									p																				
C. gyratus Jan.																															
C. inflatus Karst.						p					p																				
C. lentiginosus Jan.																															
C. oculoides Karst.											p																				
C. tabularis Grun.					p						p																				
Coscinodiscus spp.	p				p		p				3.8	p	p					p					p	p	p						
Coscinosira antarctica Kozlova																															
Dactyliosolen antarcticus Castr.	p			p	p						p							p			p			p					p		p
Dactyliosen sp.	p																														
Eucampia balaustium Castr.	p		p	p		p	15.0	30.0			2.9		p				13.0	2.3					p	p							
Melosira sol (Ehr.) Kütz.											p												p	p			9.8				4.1
Porosira pseudodenticulata		p	p	p							p												p								
(Hust.) Zhuse											p	p																			p
Rhizosolenia alata Brightw.	p	p	p	p												32.7	3.6	p					p	p				1.7	p		1.7
R. alata f. *curvirostris* Gran.	p																														
R. alata f. *gracillima* (Cl.) Grun.	p			p																											
R. alata f. *indica* (Perag.) Osten.	p																														
R. alata f. *inermis* (Castr.) Hust.				p																											
R. bidens Karst.	p																														p
R. delicatula Cl.																															
R. hebetata f. *semispina* (Hensen) Gran.	p																							p							
R. rhombus Karst.																															
R. setigera Brightw.																															
R. simplex Karst.	p																														
R. styliformis Brightw.																															
R. styliformis v. *longispina* Hüst.																															
R. truncata Karst.																															
Rhizosolenia spp.																								p							
Schimperiella antarctica Karst.																															
Thalassiosira delicatula Hust.					p	p																									
T. gracilis (Karst.) Hust.	p						3.9																								
Thalassiosira spp.	p																						p			p					
Pennales											p												p								
Achnanthes sp.																															
Amphora sp.					p						p																				
Cocconeis costata Greg.																							p								
C. imperatrix A. Schm.														p									p								
Cocconeis sp.																							p								
Gomphonema sp.																							p								
Navicula criophila (Castr.)				p																			2.7								
DeToni	p					p																	p								
Navicula sp.					p						p																				
Nitzschia angulata Hasle																										p					
N. curta (V. Heurck) Hasle	1.3	2.5	p	1.1	14.9	13.4					29.2	p		2.3				p					3.4	p	p	p		14.4			4.1
N. cylindrus (Grun.) Hasle											p																	14.4			
N. kerguelensis (O'Meara) Hasle	1.5	p	16.0	p	p						p												p								
N. obliquecostata (V. Heurck) Hasle																															
N. sublineata Hasle						10.3					p			p																	
N. heimii Manguin**)																	3.6	p						1.5	p						4.1
N. longissima (Brèb.) Ralfs																													27.4		
Nitzschia "delicatissima" complex***)	10.9	7.0	11.7	14.2			4.0	17.3			p						p	7.9			1.5		p	24.3		p	59.0	25.6	19.0	55.0	44.2
N. lineola Cl.																															
N. prolongatoides Hasle																															
N. turgidula Hust.																															
N. turgiduloides Hasle																															
Nitzschia ssp.			8.5																												
Pleurosigma sp.																															
Synedra reinboldii V. Heurck																															
Synedra sp.																															
Thalasionema elegans Hust.																															
Thalassiothrix antarctica Schimper et Karsten		4.0	p	p	2.3		8.0	4.0		7.2	7.2	p	p	p			4.6	3.7		3.0	1.5		p	p	9.6		9.8	3.3	1.3	p	1.2
Triceratium arcticum Bright														p																	
Triceratium sp.											p		p										p			p					
Tropidoneis sp.	p																														
Dinophyceae																															
Ceratium sp.	p	p																													
Dinophysis tuberculata Mangin								p																							
Dinophysis spp.							4.0	33.0									p					4.1									
Gymnodinium spp.																															
Gyrodinium spp.																															
Oxytoxum criophilum Balech																													p		
Peridinium antarcticum Schimper																															
P. curtum Balech																															
P. pseudoantarcticum Balech																															
Peridinium spp.	p		p								p																				
Silicoflagellatae																															
Dictyocha speculum Lemm.				p	p						p	p						p					3.4	p	p			3.9	1.5		p
Haptophyta																															
Phaeocystis antarctica Karst.	p																	p			90.0			p							
Unidentified flagellates								17.0													p	29.2					2.4		p		

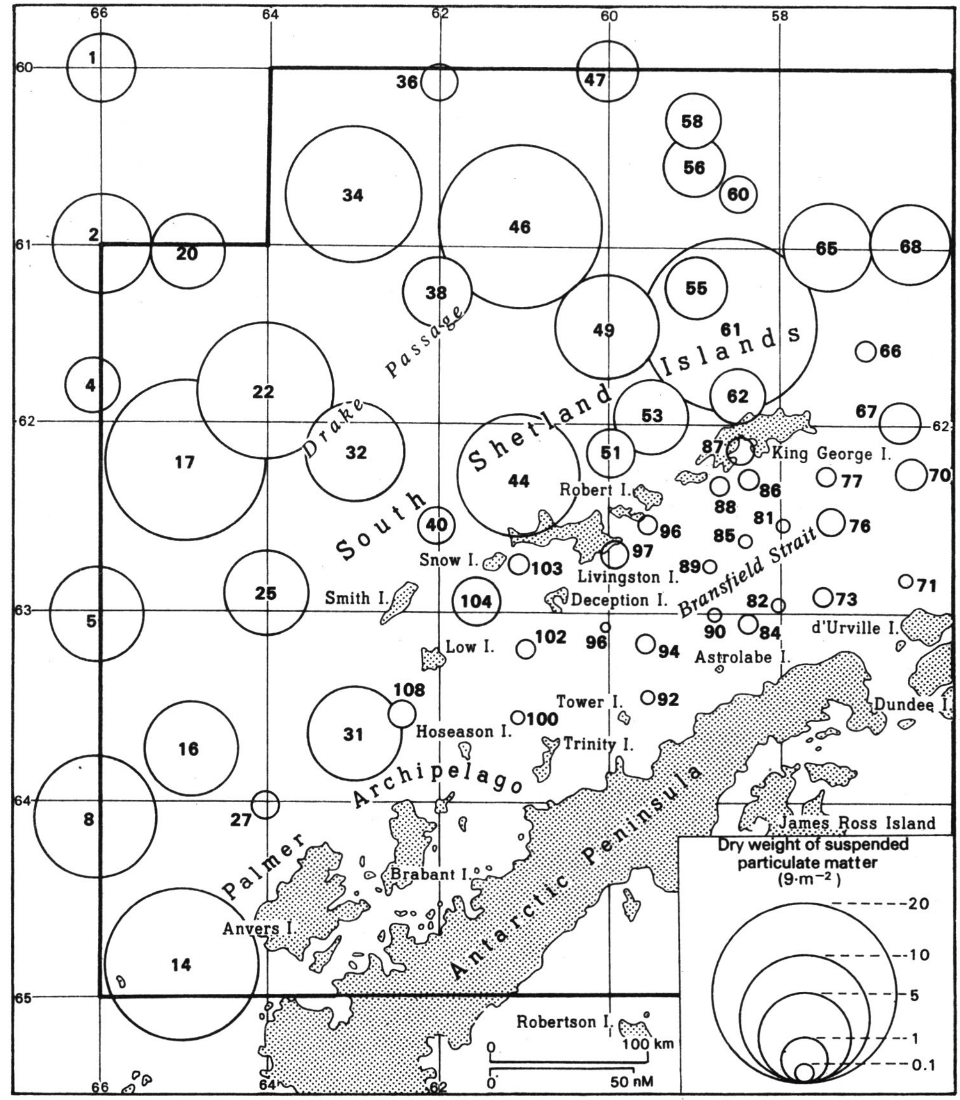

Fig. 2. Dry weight of suspended particulate matter expressed as grams under 1 m^2 sea surface, in 100 m water column, 14 February—14 March, 1981

north of the King George Island. These high quantities were largely due to the mass occurrence of *Phaeocystis*; at stations 11 and 14 this alga accounted for more than 95 per cent of the total phytoplankton numbers. Phytoplankton quantities at the remaining stations with high values of particulate matter (stations 44, 46, 34, 17, 25 and 32) ranged between 9 and 67×10^8 cells$\cdot m^{-2}$. The algal populations at these stations were dominated in nearly 100% by diatoms. Two stations, 65 and 68 west of the Elephant Island had also rather high numbers, 17 and 26×10^8 cells$\cdot m^{-2}$; respectively. Lowest quantities of cells, usually less than 10^4 cells$\cdot m^{-2}$, were observed at most stations located in the Bransfield Strait. Generally, in the majority of samples collected during this cruise, diatoms made up more than 99 per cent of the flora. They were the predominant algae at all, but three stations (11, 14 and 92), which were noted for the presence of *Phaeocystis*.

Total phytoplankton cell volumes

Figure 4 demonstrates how both the numbers of cells contained in the sample, and different sizes of the various phytoplankton species affect the total cell volume of the sample. The average cell volumes of several major species used for the calculations are shown in Table II. The graetest

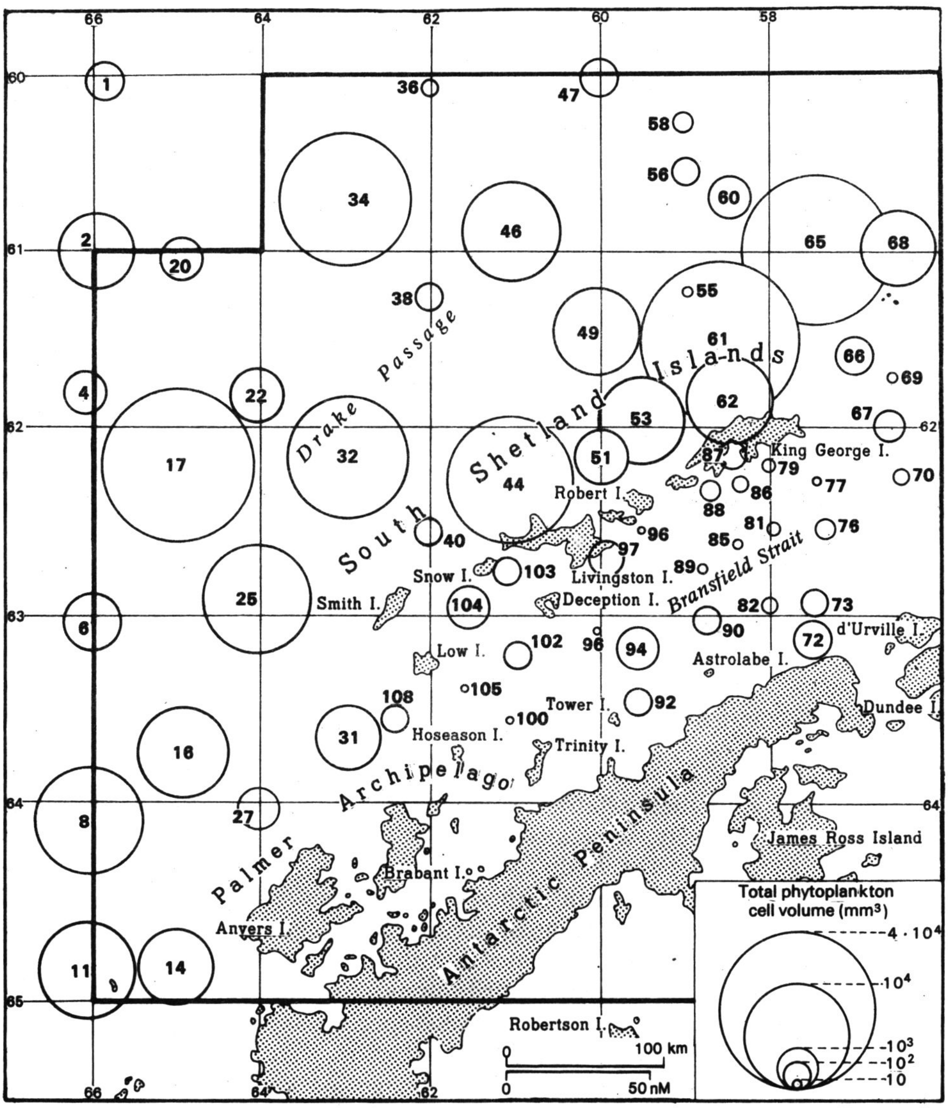

Fig. 4. Total phytoplankton cell volume expressed as mm^3 under 1 m^2 sea surface, in 100 m water column, 14 February—14 March, 1981

Table II.
Average cell volumes of dominant algal species and groups found in the „A" area

Species	Cell volume (μm^3)
Biddulphia striata Karst.	35000
Chaetoceros atlanticus Cl.	2500
C. criophilus Castr.	12000
C. dichaeta Ehr.	10000
C. neglectus Karst.	700
C. tortissimum Gran.	2000
Corethron criophilum Castr.	78000
Nitzschia Hass., (*Fragilariopsis*)	1500
Nitzschia Hass., (*Pseudonitzschia*)	1600
Phaeocystis sp.	230

values of algal biomass expressed in terms of total cell volumes (15.8—37.6$\times 10^3$ $mm^3 \cdot 1\ m^{-2}$ sea surface) were found at stations with the highest diatom counts (stations 17, 25, 32, 34, 44, 61 and 65). Stations 11 and 14, richest in the numbers of algae, but dominated by small in size (4–6 µm) *Phaeocystis*, had only medium biomass values characteristic of stations with moderate diatom cell counts such as at sts. 53, 49, 46. On the other hand, some of the poor in numbers stations in the Bransfield Strait reached total cell volumes similar to those in the Drake Passage (for instance stations 94 (780 $mm^3 \cdot m^{-2}$), 104 (765 $mm^3 \cdot m^{-2}$) this was due to the large size of *Corethron criophilum* which was virtually the only frequently found species in the net-collected plankton there. Generally, however, the loweat values were found in the Bransfield Strait, due to the extremely low numbers of algal cells.

3.3. Species composition

114 phytoplankton taxa were recorded in this study. They are shown in Table I along with their relative abundance at each station. Diatoms, most abundant quantitatively, were also the most important group in terms of the numbers of species. Of the 90 diatom species identified, several were found to dominate the phytoplankton in rather well defined areas of the study region. Some of them were also the most frequently occurring species present in almost all samples. Fig. 3 illustrates the distirbution of the major diatoms and shows their percentage contributions to the total phytoplankton at each station. A brief account of these species is given below:

Chaetoceros atlanticus Cl. and *C. dichaeta* Ehr. were the prevalent diatoms in the open oceanic waters of the Drake Passage; particularly they contributed largely to the algal cell numbers at stations with the highest diatom counts. The former species made up 40 to 78 per cent of the total cell numbers at about a half of the Drake Passage area stations (max, numbers 39$\times 10^8$ cells.

m^{-2} at st. 34). The latter species was usually next in abundance, but reached 50 per cent of the flora (28×10^8 cells) at st. 17. Both species are considered as cosmopolitan and oceanic in their distribution.

Chaetoceros tortissimum Gran was conspicuous at stations located nearest and around the South Shetland Archipelago, especially at stations 61 (55%; 154×10^8 cells), 44 (90%; 60×10^8 cells) and also at station 68 west of the Elephant Island (40%; 10×10^8). This species has been noted for its occurrence in neritic areas of the Antarcitc.

Chaetoceros neglectus Karsten, an endemic and neritic species, was abundant in various samples characterized by the dominance of *C. tortissimum*, north and south of the South Shetland Islands. It made up 2 — 31% at some of the richest in plankton stations and reached a maximum concentration of about 8×10^8 cells at stations 68 and 61.

Corethron criophilum Castr., considered essentially as an oceanic species, was present in all, but one (at st. 77) samples collected during this cruise. It was the major species in the poor in algae Bransfield Strait, and was common at the stations located north and east of the South Shetlands Archipelago, Maximal densities of cells (2.4×10^8) were found at st. 65.

Species of the "*Nitzschia delicatissima*" complex, group *Pseudonitzschia* (*N. lineola* Cl., *N. prolongatoides* Hasle, *N. turgidula* Hust., N. *turgiduloides* Hasle) were among the dominant diatoms at various stations of the Drake Passage and in the western part of the Bransfield Strait. Peak numbers of 2.7 — $5.3\times10^8\cdot m^{-2}$ were found at stations with some of the highest diatom counts (sts. 17, 25, 32, 34, 65, 68).

Species of the genus *Nitzschia*, group *Fragilariopsis*, were represented mainly by *N. kerguelensis* (O'Meara) Hasle, *N. curta* (V. Heurck) Hasle and *N. cylindrus* (Grun.) Hasle. They were chiefly found in the open waters of the Drake Passage with a maximum abundance of 12.4×10^8 cells$\cdot m^{-2}$ at st. 17. The representatives of *Nitzschia*, both groups, *Pseudonitzschia* and *Fragilariopsis*, included in the majority species which are endemic to the Southern Ocean, but also they contained bipolar species (*N. cylindrus*) and cosmopolitan species (*N. turgidula*).

Chaetoceros criophilus Castr., (bipolar, oceanic) was frequently found, particularly in the entire western part of the "A" area investigated. Greatest concentration (31×10^8 cells$\cdot m^{-2}$) was noted at st. 8.

Several large-size species such as *Thalassiothrix antarctica* Schimper et Karsten, and *Rhizosolenia alata* Bright, were conspicuous in most samples but not in large numbers. Others, such as *Eucampia balaustium* Castr. and *Biddulphia striata* Karsten, occurred mainly, in a low abundance, in the near-shore stations of the Bransfield Strait.

4. Discussion

The shortcomings of phytoplankton assessments based on net-haul sampling are known, and the present results should, first of all, be treated as a picture of the relative distribution of planktonic algae and especially of the larger-size species with a greater chance of being retained by the net.

With this in mind, valid comparisons of the present phytoplankton data may only be made with other analyses of net-collected algae from the same area, such as those of Fukase (1964), Fukase and El-Sayed (1965) and Macchiavello (1972).

In the present investigation maximal numbers of phytoplankton (10^9 — 10^{10} and > 10^{10} under 1 m^2 sea surface) were observed in the open water oceanic stations of the southern Drake Passage and also west of the Anvers Island, in an area of a mass occurrence of *Phaeocytis*. Lowest quantities were found in the Bransfield Strait. Fukase (1964) who studied phytoplankton in the same general area in February–March 1963, also found the bulk of diatoms (10^6 — 10^7 cells per 100 m haul) in the southern Drake Passage, and much smaller numbers (10^3 — 10^4) in the Bransfield Strait. When simple calculations considering the differences in the size of nets used by Fukase (a mouth opening of 22.5 cm in diameter) and by us (50 cm diameter) are made, and also when we consider the differences in expressing the results (cells per 100 m haul by Fukase), and cells under 1 m^2 sea surface by us) it appears, that the maximum numbers obtained by us are one order of magnitude greater than those found by Fukase at his station 28 north of the King George Island. His maxima were, on the other hand, comparable to our medium size counts ($10^8 \cdot m^{-2}$) obtained at various stations over the entire Drake Passage area investigated. The same observations pertain to the comparisons of the settling values reported by Fukase and by us.

The striking paucity of phytoplankton found by us in the Bransfield Strait, could probably be best explained by the possibility that most of the algae were of such small size, as to escape through the net. This was very likely to occur, since previous investigations (Kopczyńska 1980, 1981) based on bottle samples from Admiralty Bay, South Shetland Islands, revealed the predominance of tiny flagellates and monads (4–17 μm) and of small *Thalassiosira antarctica* Comber (< 20 μm in diameter). Similar observations were made by Hasle (1969) in the Bransfield Strait.

Actually, the large number of stations investigated during this cruise, helped to reveal, that the most characteristic feature of phytoplankton distribution in the investigated area is a "patchy" distribution of algal numbers and biomass. This can by easilly seen in the Drake Passage (Figs. 1, 2, 3 and 4), where stations with maximal values, as for instance, station 61, are located in the close vicinity of stations with minimal values (station 55).

The distribution of the major diatoms noted during this study is comparable to the previous results from the same area. *Chaetoceros atlanticus* and *C. dichaeta* were found by us to be dominant in the Drake Passage; they were recorded in substantial quantities in the same area by Hendey (1937), Fukase (1964) and by Fukase and El-Sayed (1965). The species of the genus *Nitzschia*, group *Pseudonitzschia*, apparently reffered to by Fukase and El-Sayed as *N. seriata*, were found to contribute a high per cent to the diatom quantities both in our Drake Passage samples and in those examined by these two authors. *Chaetoceros neglectus* and *C. tortissimum* were abundant at our shallow-water stations around the South Shetland

Islands. The former species was observed in the same waters by Hendey (1937), and the latter was reported by Macchiavello (1972) from the entrance to the Admiralty Bay and also along the coast of the Antarctic Peninsula. Hart (1942) listed these two species among neritic and ice edge forms. Our observations confirm also previous findings about the predominance of *Corethorn criophilum* in the net collections from the Bransfield Strait (Hart 1934, 1942, Hendey 1937, Macchiavello 1972). Kopczyńska (1980) stated that *Corethron criophilum* exceeded other diatoms many times in abundance in the net collections obtained from the Admiralty Bay.

The authors thank Dr. S. Rakusa-Suszczewski for making this study possible for them. Thanks are also due to Drs. K. Jażdżewski and W. Kittel of the University of Łódź, and to Mr. K. Łotocki of the Sea Fisheries Institute in Gdynia, for their help in obtaining the samples.

5. Резюме

В период с 14 февраля до 14 марта 1981 с борта НИС "Профессор Седлецки" отбирались сетные пробы антарктического фитопланктона. Пробы происходили из 63 океанологических станций, находящихся в южной части пролива Дрейка и в проливе Брансфилда, т.е. в районе "А" программы БИОМАСС-ФИБЭКС (таблица I). Самые высокие величины мокрого объема сестона (580—950 см$^3 \cdot$м$^{-2}$) и сухого веса сестона (9,5—19,6 г$\cdot$м$^{-2}$) были установлены в открытых океанических водах пролива Дрейка, особенно между 60°8′ и 62°11′ ю.ш., а также на запад от о. Анверс. Самые низкие значения этих параметров (4—14 см$^3 \cdot$м$^{-2}$ и 0,06—0,40 г$\cdot$м$^{-2}$) были обнаружены в проливе Брансфилда. Распределение целых числовых значений численности и обьема клеток фитопланктона весьма сходно с распределением данных по сестону. Максимальные концентрации клеток (41—379$\times 10^8 \cdot$м$^{-2}$) и самое высокое значение общего их обьема (15—37$\times 10^3$ мм$^3 \cdot$м$^{-2}$) наблюдались в местах, отличающихся максималными значениями мокрой и сухой массы. Самые низкие величины (обычно меньше чем 10^4 клеток и 0,1—780 мм$^3 \cdot$м$^{-2}$ обьема) были установлены в проливе Брансфилда. Все же в общем, характероной чертой распределения исследуемых параметров было присутствие на значительной части исследуемой территории максимальных величин по соседству со средними и низкими.

Самой важной группой водорослей, так с точки зрения общего количества клеток, как и числа видов, были диатомеи. Из 114 определенных таксонов, 90 составляли именно диатомовые водоросли. Некоторые из этих видов преобладали в фитопланктоне в определенных частях исследуемого района. *Chaetoceros atlanticus, C. dichaeta* и виды рода *Nitzschia*, групп *Fragilariopsis* и *Pseudonitzschia* преобладали в проливе Дрейка, тогда как представители рода *Nitzschia* тоже в западной части пролива Брансфилда. *Chaetoceros tortissimus* и *C. neglectus* были обнаружены в значительном количестве главным образом в мелких водах вокруг архипелага Южных Шетландских о-вов в то время, когда *Corethron criophilum* был видом характерным для бедного водорослями пролива Брансфилда.

6. Streszczenie

W okresie od 14 lutego do 14 marca 1981 roku w rejonie badawczym "A" programu BIOMASS-FIBEX pobrano ze statku badawczego "Profesor Siedlecki" sieciowe próby fitoplanktonu antarktycznego. Próby pobrano na 63 stacjach oceanologicznych wyznaczonych na Ocea-

nie Atlantyckim w południowej części Cieśniny Drake'a i w Cieśninie Bransfielda (tabela I). Największe wartości mokrej objętości sestonu (580–950 $cm^3 \cdot m^{-2}$) i suchej masy sestonu 9,5 — 19,6 $g \cdot m^{-2}$) stwierdzone zostały w otwartych, oceanicznych wodach Cieśniny Drake'a, szczególnie pomiędzy 60°8' S i 62°11' S, a także na zachód od wyspy Anvers (rys. 1 i 2). Najniższe wartości tych parametrów (4—14 $cm^3 \cdot m^{-2}$ i 0,40 $g \cdot m^{-2}$) zanotowano w Cieśninie Bransfielda. Maksymalne liczebności komórek (41—379 $\cdot 10^8 \cdot m^{-2}$) i największe wartości orientacyjnej całkowitej objętości komórek (15—37 $\times 10^3$ $mm^3 \cdot m^{-2}$) wystąpiły w rejonach charakteryzujących się największymi wartościami mokrej i suchej masy. Najmniejsze wartości (zwykle mniej niż 10^4 komórek i 0,1—780 $mm^3 \cdot m^{-2}$ objętości) obserwowano w Cieśninie Bransfielda (rys. 3 i 4). Ogólnie jednak na znacznej części obszaru badań maksymalne wartości obserwowane były w bliskim sąsiedztwie wartości średnich i niskich.

Pod względem ogólnej liczebności komórek oraz liczby gatunków, najważniejszą grupą glonów były okrzemki. Na 114 zidentyfikowanych taksonów okrzemki stanowiły 90 (tabela I). W różnych częściach rejonu badań dominowało w fitoplanktonie kilka gatunków okrzemek. W Cieśninie Drake'a dominowały: *Chaetoceros atlanticus*, *C. dichaeta* oraz gatunki rodzaju *Nitzschia* z grup *Fragilariopsis* i *Pseudonitzschia*. W zachodniej części Cieśniny Bransfield'a dominowali przedstawiciele rodzaju *Nitzschia*. *Chaetoceros tortissimus* i *C. neglectus* znaleziono w dużych ilościach głównie w płytszych wodach wokół Archipelagu Szetlandów Południowych, a *Corethron criophilum* był gatunkiem dominującym w ubogiej w glony Cieśninie Bransfielda.

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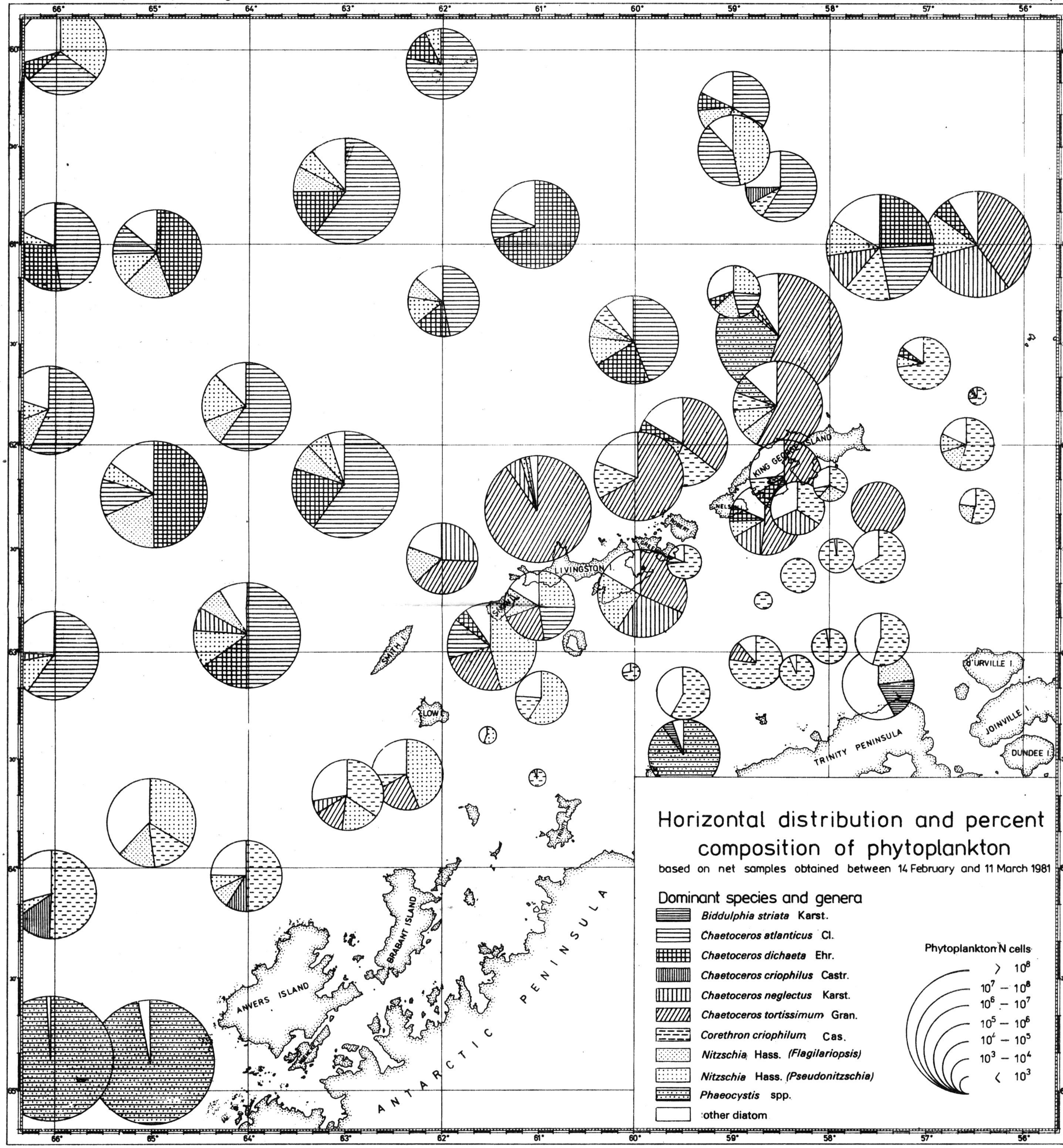

Fig. 3. Horizontal distribution and per cent composition of phytoplankton based on net--samples obtained between 14 February and 14 March, 1981. Numbers of cells are shown under 1 m² sea surface, in 100 m water column