CRUISE REPORT

HUDSON 70

Cruise No. 69-050

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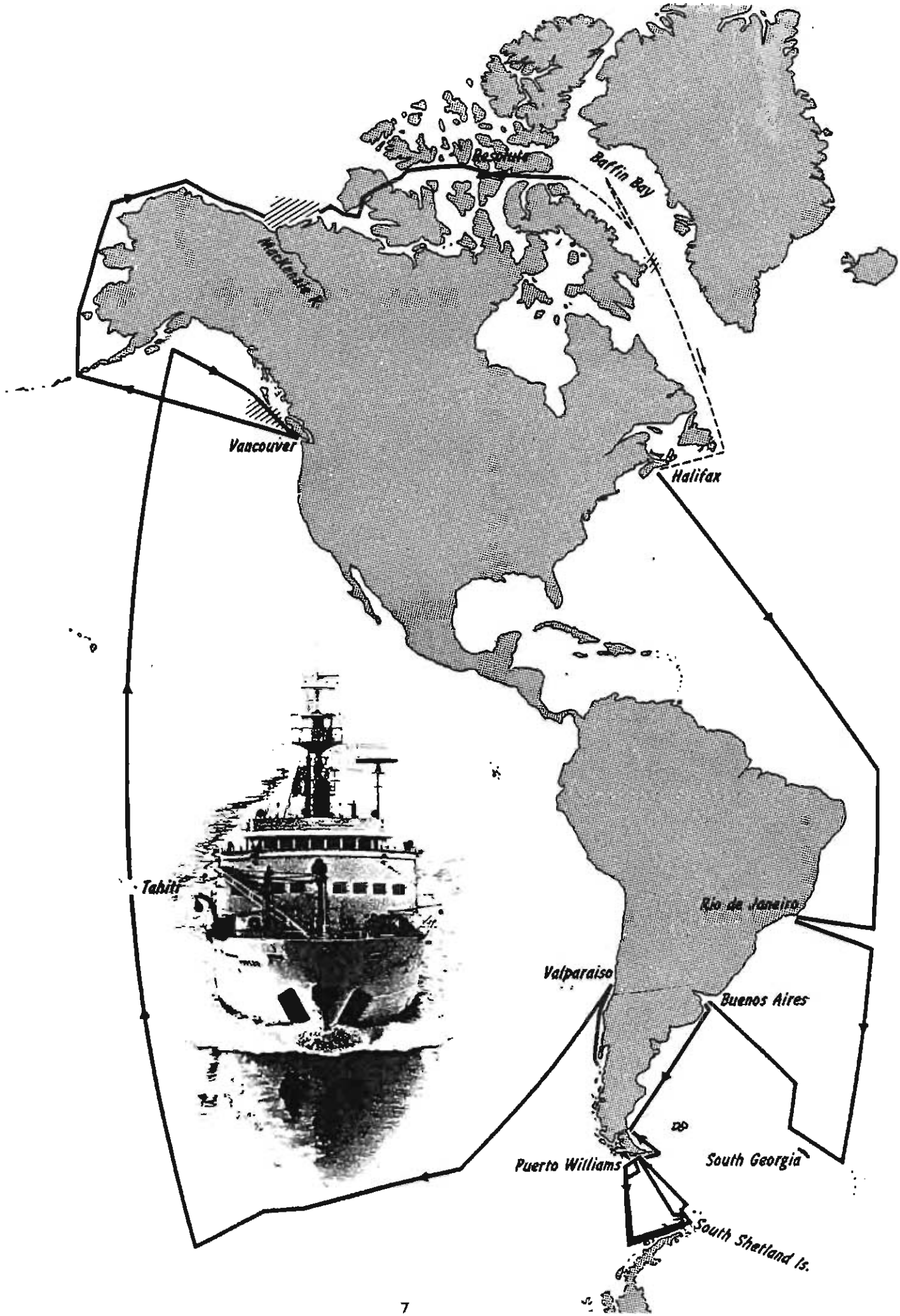
ACKNOWLEDGEMENTS

This cruise report of HUDSON 70 (Cruise 69-050) was extracted from the bound volume entitled, "The HUDSON 70 Expedition". The cruise report was compiled by Robert Reiniger and Michael P. Latremouille, with valuable assistance from Ms. Joni Henderson, Mr. Art Cosgrove, Mr. Roger Belanger, Dr. C.T. Schafer and Dr. S.P. Srivastava. Other contributors were the senior scientists on their respective legs of the cruise.

Phase	Departure	Date	Arrival	Date	Senior Scientist
I	Halifax, Nova Scotia	19 Nov. 1969	Rio de Janeiro, Brazil	20 Dec. 1969	Dr. C.R. Mann
II	Rio de Janeiro, Brazil	20 Dec. 1969	Buenos Aires, Brazil	16 Jan. 1970	Dr. C.R. Mann
III	Buenos Aires, Brazil	22 Jan. 1970	Punta Arenas, Argentina	23 Feb. 1970	Dr. C.R. Mann
IV	Punta Arenas, Argentina	1 March 1970	Valparaiso, Chile	7 Apr. 1970	Dr. G.L. Pickard
V	Valparaiso, Chile	15 Apr. 1970	Papeete, Tahiti	12 May 1970	Mr. R.C. Melanson
VI	Papeete, Tahiti	16 May 1970	Vancouver, British Columbia	12 June 1970	Dr. W.M. Cameron
VII	Victoria, British Columbia	12 July 1970	Victoria, British Columbia	5 Aug. 1970	Dr. C.D. Maunsell
VIII	Victoria, British Columbia	13 Aug. 1970	Resolute Bay, Northwest Territories	22 Sept. 1970	Dr. B.R. Pelletier
XI	Resolute Bay, Northwest Territories	30 Sept. 1970	Halifax, Nova Scotia	6 Oct. 1970	Dr. D.I. Ross


Resolute
Baffin Bay
Mackenzie R.
Vancouver
Halifax
Tahiti
Rio de Janeiro
Valparaiso
Buenos Aires
Puerto Williams
South Georgia
South Shetland Is.

HUDSON 70 - A BIBLIOGRAPHY OF PUBLISHED PAPERS
(Items included in this volume)

Atkinson, L.P. 1973. Effect of air bubble solution on air-sea gas exchange. Journal of Geophysical Research 78(6): 962-968. . . . . .

Banerji, R.K., C.T. Schafer, and R. Vine. 1971. Environmental relationships and distribution of planktonic foraminifera in the equatorial and northern Pacific waters. Atlantic Oceanographic Laboratory, AOL Report 1971-7. 65p. plus 15p. of appendices and plates. . . . . .

Barrett, D.L., C.E. Keen, K.S. Manchester, and D.I. Ross. 1971. Baffin Bay — an ocean. Nature 229(5286): 551-553. . . . . .

Brown, R.G.B., F. Cooke, P.K. Kinnear, and E.L. Mills. 1975. Summer seabird distributions in Drake Passage, the Chilean fjords and off southern South America. Ibis 117(3): 339-356. . . . . .

Chase, R.L., and D.L. Tiffin. 1972. Queen Charlotte fault-zone, British Columbia. In: Marine geology and geophysics; section 8, International Geological Congress (24th : 1972 : Montreal) = Geologie et geophysique du milieu marin; section 8, Congres Geologique International (24e : 1972 : Montreal), ed., J.E. Gill. Ottawa: The Congress, 17-27. . . . . .

Cooke, F., and E.L. Mills. 1972. Summer distribution of pelagic birds off the coast of Argentina. Ibis 114(2): 245-251. . . . . .

Coote, A.R., I.W. Duedall, and R.S. Hiltz. 1971. Automatic analysis at sea. In: Advances in automated analysis: Technicon International Congress on Automation (5th : 1970 : New York). Miami: Thurman Associates, v.2: 347-351. . . . . .

Coote, A.R., C.R. Mann, A. Walton, and J.M. Edmond. 1973. Deep-Sea Research 20(6): 579-581. . . . . .

Deevey, G.B. 1974. Pelagic ostracods collected on Hudson 70 between the equator and 55 degrees S in the the Atlantic. Proceedings of the Biological Society of Washington 87(32): 351-380. . . . . .

Duedall, I.W., A.R. Coote, D.F. Knox, and G.F. Connolly. 1971. A dispenser for Winkler's dissolved oxygen reagents. Journal of the Fisheries Research Board of Canada 28(11): 1815-1816. . . . . .

Duedall, I.W., and A.R. Coote. 1972. Oxygen distribution in the Pacific Ocean. Journal of Geophysical Research 77(12): 2201-2203.

Duedall, I.W., and A.R. Coote. 1972. Oxygen distribution in the South Atlantic. Journal of Geophysical Research 77(3): 496-498.

Foster, L.A. 1972. Current measurements in the Drake Passage. Unpublished M.Sc. thesis, Dalhousie University, Halifax, N.S. 61p.

Haworth, R.T. 1971. A geophysical profile in the south-east Pacific. Earth and Planetary Science Letters 11(2): 83-89.

Keen, C.E., D.L. Barrett, K.S. Manchester, and D.I. Ross. 1972. Geophysical studies in Baffin Bay and some tectonic implications. Canadian Journal of Earth Sciences 9(3): 239-256.

Lalli, C.M., and F.E. Wells, Jr. 1973. Brood protection in an epipelagic thecosomatous pteropod, Spiratella ("Limacina") inflata (d'Orbigny). Bulletin of Marine Science 23(4): 933-941.

Lister, C.R.B. 1972. On the thermal balance of a mid-ocean ridge. Geophysical Journal of the Royal Astronomical Society 26(5): 515-535.

Mann, C.R. 1971. Hudson '70 and past oceanographic expeditions. In: Canadian Hydrographic Service 10th annual hydrographic conference, 2-4 March 1971, Dartmouth, Nova Scotia: [proceedings]. [Dartmouth, N.S.: The Conference], 160-166.

Mann, C.R. 1971. The Hudson-70 cruise: a significant contribution to world oceanography. Science Forum 4(1): 19-22.

Mann, C.R., A.R. Coote, and D.M. Garner. 1973. The meridional distribution of silicate in the western Atlantic Ocean. Deep-Sea Research 20(9): 791-801.

Manning, R.B. 1971. The postlarva of the stomatopod crustacean, Heterosquilla polydactyla (Von Martens). Proceedings of the Biological Society of Washington 84(33): 265-270.

Pelletier, B.R., and J.M. Shearer. 1972. Sea bottom scouring in the Beaufort Sea of the Arctic Ocean. In: Marine geology and geophysics; section 8, International Geological Congress (24th : 1972 : Montreal) = Geologie et geophysique du milieu marin; section 8, Congres Geologique International (24e : 1972 : Montreal), ed., J.E. Gill. Ottawa: the Congress, 251-261.

Pickard, G.L. 1971. Some physical oceanographic features of inlets of Chile. Journal of the Fisheries Research Board of Canada 28(8): 1077-1106.

Pickard, G.L. 1973. Water structure in Chilean fjords. In: Oceanography of the South Pacific 1972, comp., R. Fraser. Wellington: New Zealand National Commission for UNESCO, 95-104.

Ross, D.I. 1972. The Hudson-70 expedition. In: Ocean '72: IEEE International Conference on Engineering in the Ocean Enbironment (1972 : Newport, RI), Record. New York: Institute of Electrical and Electronic Engineers, 328-332. (IEEE publication 72 CHO 660-1 OCC.)

Shearer,J.M., R.F. Macnab, B.R. Pelletier, and T.B. Smith. 1971. Submarine pingos in the Beaufort Sea. Science 174: 816-818.

Sheldon, R.W., A. Prakash, and W.H. Sutcliffe, Jr. 1972. The size distribution of particles in the ocean. Limnology and Oceanography 17(3): 327-340.

Srivastava, S.P., D.L. Barrett, C.E. Keen, K.S. Manchester, K.G. Shih, D.L. Tiffin, R.L. Chase, A.G. Thomlinson, E.E. Davis, and C.R.B. Lister. 1971. Preliminary analysis of geophysical measurements north of Juan de Fuca Ridge. Canadian Journal of Earth Sciences 8(10): 1265-1281.

Vilks, G. 1972. Planktonic foraminifera in the water and sediments of Beaufort Sea, Canadian Arctic. In: Marine geology and geophysics: section 8, International Geological Congress (24th : 1972 : Montreal) = Geologie et geophysique du milieu marin: section 8, Congres Geologique International (24e : 1972 : Montreal), ed., J.E. Gill. Ottawa: the Congress, 135-141.

Vilks, G. 1974. The distribution of planktonic foraminifera in the sediments and water of the Northwest Passage and northern Baffin Bay: a tool for paleooceanographic synthesis. In: Offshore geology of eastern Canada, volume 1. Concepts and applications of environmental marine geology, ed., B.R. Pelletier. Ottawa: Geological Survey of Canada, 109-121. (Geological Survey of Canada Paper 74-30 (v.1).)

Vilks, G. 1975. Comparison of Globorotalia pachyderma (Ehrenberg) in the water column and sediments of the Canadian Arctic. Journal of Foraminiferal Research 5(4): 313-325.

Vilks, G., and D.A. Walker. 1974. Morphology of Orbulina universa d'Orbigny in relation to other spinose planktonic foraminifera. Journal of Foraminiferal Research 4(1): 1-8. . . . . .

von Arx, W.S., D.C. Bowen, J.P. Dean, and R.T. Haworth. 1971. Hudson '70 gravity observations, 62.9 degrees S - 57.5 degrees N along 150 degrees W. Woods Hole Oceanographic Institution Reference No.71-68. 64p. . . . . .

Wagner, F.J.E. 1972. Molluscan fauna as indicators of Late Pleistocene history, southeastern Beaufort Sea. In: Marine geology and geophysics; section 8, International Geological Congress (24th : 1972 : Montreal) = Geologie et geophysique du milieu marin; section 8, Congres Geologique International (24e : 1972 : Montreal), ed., J.E. Gill. Ottawa: the Congress, 142-153. . .

Walker, D.A., and G. Vilks. 1973. Spinal ultrastructure of the planktonic foraminifers Hastigerina Thomson and Globigerinella Cushman. Journal of Foraminiferal Research 3(4): 196-198. . . . . .

Wangersky, P.J. 1976. Particulate organic carbon in the Atlantic and Pacific oceans. Deep-Sea Research 23(5): 457-465. . . . . .

Wong, C.S. 1972. Deep zonal water masses in the equatorial Pacific Ocean inferred from anomalous oceanographic properties. Journal of Geophysical Research 77(36): 7196-7202. . . . . .

Zurbrigg, R.E., and W.B. Scott. 1976. Diaphus hudsoni (Pisces: Myctophidae), a new lanternfish from the South Atlantic Ocean. Canadian Journal of Zoology 54(9): 1538-1541. . . . . .

OTHER REPORTS
(Copies not included in this volume)

Bellefontaine, L., J. Pritchard, and B. Reiniger. 1982. Atlas of physical oceanographic data for the South Atlantic Ocean, Drake Passage, Pacific Ocean, and Canadian Arctic - 1970. Canadian Technical Report of Hydrography and Ocean Sciences 14. 45p.

Chase, R.L., A.G. Thomlinson, and W.G. Bertrand. 1972. Catalogue of rock samples collected during phase VII of Hudson - 70 onboard CNAV Endeavour. Bedford Institute of Oceanography, Data Series BI-D-72-3. 126p.

Edmonds, A. 1973. Voyage to the edge of the world. Toronto: McClelland and Stewart Ltd. 254p.

Mann, C.R. 1971. The Hudson 70 expedition. Bedford Institute, Biennial Review 1969/70: 3-9.

Shih, K.G. 1971. Gravity and magnetic data collected in the Northwestern Pacific Ocean and the Bering Sea. Atlantic Oceanographic Laboratory, Data Series BI-D-1971-7. 126p. in various pagings.

Shih, K.G., D.I. Ross, and B.L. Johnston. 1972. Gravity and magnetic data of Baffin Bay collected in 1970, C.S.S. Hudson and C.S.S. Baffin cruises. Bedford Institute of Oceanography, Data Series BI-D-72-5. 247p. in various pagings.

Srivastava, S.P., ed. 1971. Geophysical data collected during Hudson-70, phase VII off British Columbia, Canada. Atlantic Oceanographic Laboratory, AOL Data Series 71-5-D. 295p. in various pagings.

A. CRUISE REPORTS

DATA COLLECTED DURING

THE HUDSON 70 EXPEDITION

INDEX OF ABBREVIATIONS

A.S.L.O.	Acoustic Scattering Layer Observations
A.CO^2 S.	Air CO^2 Samples
A. C14 S.	Air C14 Samples
A.D.G.	Anchor Dredge Grabs
B.L.	Bathysonde Lowerings
B.S.T.	Biological Sled Trawl
B.B. 9060 STD C.	Bissett Berman 9060 S.T.D. Casts
B.S.N.	Bottle Station Number
B.S.	Bottom Samples
C.S.	Camera Stations
C.-B.T.	Clarke-Bumpus Tows
C. Stn.	Collection Station
C.	Cores
C.M.M.	Current Meters Moored
C.M.R.	Current Meters Recovered
D.M.P.T.	Deep Multiple Plankton Tows
D.P.T.	Deep Plankton Tows
E.S.H.	Epibenthic Sled Hauls
I.-S. C-14 I.	In-Situ C-14 Incubation
I.K.T.	Issac Kidd Trawl
I.K.T.H.	Issac Kidd Trawl Hauls
K. & N.C.	Knudsen & Nisken Casts
K.C.	Knudsen Casts
Lat.	Latitude
Long.	Longitude
M.-O.P.H.	Multi-Oblique Plankton Hauls
N.O.	Nephelometer Observations
N.	Nutrients
O.B.T.	Oblique Biological Tow
O.P.T.	Oblique Plankton Tows
R. of W.S.	Recording of Whale Sounds
R.D.	Rock Dredges
S.W. CO^2 S.	Sea Water CO^2 Samples
S.D.	Sediment Dredges
S.H.	Shallow Hydro
S.M.G.	Smith McIntyre Grabs
S.#	Station Number
S.B.T.	Surface Biological Tows
S.P.T.	Surface Plankton Tows
S. Temp.	Surface Temperature
S.T.N.N.	Surface Tows Neuston Net
Temp.	Temperature
U./W./T.	Underwater Television
V.V.G.	Van Veen Grabs
V.B.T.	Vertical Biological Tows
V.P.H.	Vertical Plankton Hauls
V.P.T.	Vertical Plankton Tows

"HUDSON 70"

November 19, 1969 - January 14, 1970

Area:- Halifax, Nova Scotia to Puerto Williams, Chile, S.A.

Soundings - G.E.B.C.O.:	-	16155 km
Gravity Records:	-	3800 km
Magnetics:	-	4200 km

1) Oxygens were analyzed by the Carpenter modification of the Winkler method using 60 ml sampler bottles.

2) On some stations, samples were withdrawn for dissolved helium and helium isotope studies.

3) In the Atlantic, total dissolved CO_2 and CO_2 in the air were also determined on most stations.

S.#	Lat.	Long.	Date	S.P.T.	V.P.T.	O.P.T.	D.M.P.T.	D.P.T.	S.T.N.N.	I.K.T.	K.&M.C.	B.L.	C.	A.S.L.O.	R.ofW.S.	I.-S.C.-141.	S.M.	B.S.N.
1	02°31.00N	31°35.00W	29 11 69												X			
2	00°01.79N	29°58.27W	30 11 69	X	X					X	X	X		X				1
3	00°51.00S	30°00.00W	01 12 69		X				X									
4	02°28.76S	30°04.28W	01 12 69	X	X					X	X	X		X		X		2
5	03°31.90S	30°07.10W	02 12 69		X				X									
6	04°54.73S	30°00.50W	02 12 69	X	X					X	X			X		X		3
7	06°04.20S	30°00.50W	02 12 69		X				X					X				
8	07°27.06S	30°03.17W	03 12 69	X	X					X	X	X		X		X		4
9	08°30.77S	30°01.99W	04 12 69		X					X				X				
10	09°58.58S	30°02.77W	04 12 69	X	X					X	X	X		X		X		5
11	10°58.78S	29°58.88W	05 12 69		X					X				X				
12	12°25.48S	30°06.83W	05 12 69	X	X					X	X	X		X		X		6
13	13°28.70S	30°02.40W	06 12 69		X					X				X				
14	14°54.74S	30°06.54W	06 12 69	X	X					X	X	X		X		X		7
15	15°47.19S	29°59.03W	06 12 69		X				X					X				
16	17°31.57S	30°01.23W	07 12 69	X	X						X	X	X	X		X		8
17	18°19.48S	30°03.68W	07 12 69		X					X								
18	20°00.19S	30°00.23W	08 12 69	X	X						X	X		X		X		9

#	Lat.	Long.	Date	S.P.I.	V.P.I.	O.P.I.	D.M.P.I.	D.P.I.	S.T.M.N.	I.K.I.	K.&M.C.	B.I.	C.	A.S.I.O.	R.ofW.S.	I.-S.C-14I.	S.M.	B.S.M.
1	20°02.64S	30°31.34W	08 12 69										X					
1	20°07.60S	30°28.00W	09 12 69		X				X	X				X				
	22°30.16S	29°58.12W	09 12 69	X	X						X	X						10
1	23°21.00S	29°55.00W	09 12 69		X									X				
1	25°01.45S	30°01.55W	10 12 69	X	X					X	X	X		X		X		11
1	24°52.51S	30°07.89W	10 12 69		X									X				
	24°36.59S	32°30.62W	11 12 69		X					X				X				
	24°21.35S	32°36.21W	11 12 69											X				
	24°17.29S	32°43.47W	11 12 69		X									X				
	24°13.36S	35°02.99W	12 12 69		X							X	X	X				
	27°31.58S	30°07.01W	23 12 69	X	X	X				X	X	X		X				12
	29°59.89S	29°58.82W	24 12 69	X	X	X	X				X	X		X				13
	31°10.25S	29°58.00W	24 12 69		X				X	X								
	32°25.05S	30°09.60W	25 12 69	X	X	X	X				X			X				14
	34°59.65S	30°04.70W	26 12 69	X	X	X	X				X	X	X	X				16
	37°28.42S	29°59.20W	27 12 69	X	X	X	X				X	X		X				16
	38°39.50S	29°59.80W	28 12 69	X	X					X								
	39°54.98S	29°52.99W	28 12 69	X	X	X	X			X	X	X		X				17

	S.#	Lat.							Long.									
37	42°29.91S	29°57.53W	29 12 69	X	X	X	X				X	X		X				18
38	43°39.70S	29°52.50W	29 12 69	X	X					X								
39	45°07.29S	29°58.67W	30 12 69	X	X	X	X			X	X	X		X				19
40	46°04.17S	29°53.99W	30 12 69	X	X									X				
41	47°34.55S	29°53.44W	31 12 69	X	X	X		X			X	X		X				20
42	48°20.06S	29°51.94W	31 12 69		X							X						
43	49°03.39S	29°48.65W	01 01 70	X	X	X					X			X				21
44	49°07.27S	29°38.33W	01 01 70		X		X			X		X						
45	50°33.32S	29°35.36W	02 01 70	X	X	X	X			X	X	X		X				22
46	52°03.72S	30°03.67W	03 01 70	X	X	X		X			X	X	X					23
47	52°30.23S	29°50.60W	04 01 70											X				
48	53°27.22S	29°59.48W	04 01 70	X	X	X	X				X	X		X				24
49	53°52.92S	29°49.12W	05 01 70		X					X								
50	54°54.83S	29°23.16W	05 01 70	X	X	X	X				X	X		X				25
51	53°32.58S	33°56.26W	06 01 70	X	X		X			X								
52	51°27.91S	39°57.27W	08 01 70	X	X	X	X			X	X	X	X	X				26
53	50°19.80S	39°54.10W	08 01 70													X		
54	49°58.99S	39°57.76W	08 01 70	X	X	X					X							27

S.#	Lat.	Long.	Date	S.P.T.	V.P.T.	O.P.T.	D.M.P.T.	D.P.T.	S.T.M.N.	I.K.T.	K.&M.C.	B.L.	C.	A.S.I.O.	R.ofW.S.	I.-S.C-141.	S.H.	B.S.N.
55	48°58.93S	39°52.42W	09 01 70	X	X	X					X	X		X				28
56	47°58.90S	39°59.55W	10 01 70		X	X					X			X				29
57	47°03.28S	40°04.62W	11 01 70		X	X		X			X			X				30
58	45°41.67S	40°38.33W	11 01 70	X	X		X		X		X							
59	45°10.62S	41°10.75W	12 01 70	X	X									X				
60	44°12.44S	42°45.95W	12 01 70	X	X			X		X				X				
61	41°46.48S	46°26.37W	13 01 70	X	X		X				X			X				31
62	41°40.83S	46°52.06W	14 01 70	X	X					X				X				

"HUDSON 70"

January - February - 1970

Intertidal Marine Life Survey:-

Hudson 70 Expedition

Cape Horn Region, South America,

by the National Museum of National Sciences,

Ottawa, Ontario

Puerto Williams Launch Party, Isla Navarino and Vicinity,

Magallanes (Cape Horn Region) Chile.

Vessel:- Diesel Launch "REDHEAD" from C.S.S. "HUDSON"

Stn. #	Latitude	Longitude	Date	C. Stn.	Temp.	S. Temp.
F1	54°57.00S	67°40.00W	29 01 70	X	X	
F2	54°56.00S	67°37.00W	30 01 70	X		
F3	54°56.00S	67°37.00W	30 01 70	X	X	
F4	54°56.00S	67°37.00W	30 01 70	X		
F5	54°56.00S	67°37.00W	30 01 70	X	X	
F6	54°56.00S	67°38.50W	31 01 70	X	X	
F7a	54°51.00S	68°48.00W	01 02 70	X		
F7b	54°51.00S	68°48.00W	02 02 70	X		X
F8	54°52.00S	68°46.00W	02 02 70	X		
F9	54°56.00S	68°49.00W	02 02 70	X		X
F10a	55°03.00S	68°10.00W	02 02 70	X	X	
F10b	55°03.00S	68°10.00W	03 02 70	X	X	
F11	55°04.00S	68°10.50W	03 02 70	X	X	
F12	55°05.50S	67°04.50W	05 02 70	X	X	
F13	55°05.00S	67°04.50W	05 02 70	X	X	
F14	55°09.00S	67°04.00W	05 02 70	X		
F15	55°13.00S	66°52.00W	05 02 70	X		
F16	55°18.00S	66°49.00W	06 02 70	X	X	
F17	55°07.00S	66°50.00W	07 02 70	X	X	
F18	55°07.00S	68°12.00W	10 02 70	X		
F19	55°16.00S	67°49.00W	10 02 70	X	X	
F20	55°16.00S	67°49.50W	10 02 70	X	X	
F21	55°15.00S	67°57.00W	10 02 70	X	X	
F22	55°11.00S	67°55.00W	11 02 70	X		
F23	55°14.50S	67°45.00W	11 02 70	X		X

Stn. #	Latitude	Longitude	Date	C. Stn.	Temp.	S. Temp.
F24	55°14.50S	67°44.50W	11 02 70	X		
F25	55°14.50S	68°12.00W	14 02 70	X	X	
F26	55°23.50S	68°07.00W	14 02 70	X		
F27	55°31.50S	68°05.00W	14 02 70	X	X	
F28	55°32.00S	68°01.50W	15 02 70	X	X	
F29	55°30.00S	67°40.00W	15 02 70	X		
F30	55°12.50S	67°06.00W	16 02 70	X	X	
F31	54°56.00S	68°17.00W	19 02 70	X		
F32	54°56.00S	68°23.50W	19 02 70	X		
F33	54°56.00S	67°38.00W	20 02 70	X		
F34	52°54.00S	70°17.00W	22 02 70	X	X	

"HUDSON 70"

January 29, 1970 - February 18, 1970

Area: Puerto Williams - Drake Passage - Punta Arenas

Soundings - G.E.B.C.O.:- 4755 km

Stn. #	Lat.	Long.	Date	S.P.T.	V.P.H.	K.&N.C.	B.L.	E.S.H.	A.D.G.	S.M.G.	C.M.M.	C.M.R.	N.O.	V.P.I.	B.S.N.
63	54°54.58S	67°35.42W	29 01 70					X							
64	55°36.91S	67°11.80W	29 01 70	X				X							
65	55°42.69S	66°57.62W	29 01 70	X				X							
66	57°11.55S	65°59.72W	29 01 70	X											
67	57°48.62S	68°18.51W	31 01 70			X							X	X	32
68	57°49.15S	68°19.60W	31 01 70								X				
69	60°04.50W	68°04.00W	01 02 70		X						X				
70	60°16.30S	67°59.62W	02 02 70	X	X	X							X		33
71	61°59.00S	67°33.30W	02 02 70								X				
72	62°07.21S	67°32.98W	03 02 70		X	X							X		34
73	63°28.05S	67°07.00W	03 02 70								X				
74	63°34.07S	66°47.62W	04 02 70		X	X		X	X				X		35
75	62°38.98S	60°25.93W	05 02 70	X				X							
76	62°29.10S	59°44.30W	05 02 70	X				X		X					
77	62°12.90S	58°40.60W	05 02 70	X				X		X					
78	62°19.30S	57°51.20W	06 02 70			X							X	X	36
79	62°06.80S	58°25.00W	06 02 70			X		X		X					37
80	61°47.50S	58°43.20W	07 02 70					X							

Stn. #	Lat.	Long.	Date	S.P.T.	V.P.H.	K.&M.C.	B.I.	E.S.H.	A.D.G.	S.M.G.	C.M.M.	C.M.R.	N.O.	V.P.T.	B.S.N.
81	56°41.07S	68°27.44W	10 02 70	X			X								
82	57°02.06S	68°25.36W	10 02 70		X		X								
83	57°33.51S	68°15.66W	11 02 70		X	X									38
84	58°01.38S	68°17.61W	11 02 70		X		X					X			
85	58°28.25S	68°06.15W	11 02 70			X								X	39
86	58°58.44S	68°03.37W	12 02 70				X								
87	59°29.65S	67°57.72W	12 02 70			X									40
88	60°01.63S	67°54.59W	12 02 70		X		X					X			
89	60°32.09S	67°45.60W	12 02 70	X	X	X									41
90	61°02.18S	67°43.28W	13 02 70	X	X		X								
91	61°30.97S	67°29.01W	13 02 70		X	X									42
92	61°58.34S	67°35.14W	13 02 70	X	X		X					X			
93	62°28.16S	67°17.75W	13 02 70	X	X	X									43
94	62°59.56S	67°13.45W	14 02 70		X		X								
95	63°30.62S	67°06.22W	14 02 70		X	X						X			44
96	63°59.61S	66°57.37W	14 02 70		X		X								
97	64°20.00S	66°58.00W	14 02 70	X	X		X								
98	62°57.80S	60°39.00W	15 02 70	X	X	X	X								45

Stn. #	Lat.	Long.	Date	S.P.T.	V.P.H.	K.&N.C.	B.L.	E.S.H.	A.D.G.	S.M.G.	C.M.M.	C.M.R.	M.O.	V.P.T.	B.S.N.
99	61°60.00S	55°39.00W	15 02 70	X	X			X							
100	60°53.57S	57°46.03W	17 02 70		X	X									46
101	60°23.28S	56°42.61W	18 02 70			X							X	X	47
102	54°59.00S	66°51.00W	19 02 70						X	X					
103	55°32.00S	67°27.00W	20 02 70						X	X					

"HUDSON 70"

March 1, 1970 - April 7, 1970

Area: Chilean Fjords and passages from Punta Arenas to Puerto Montt and Ocean Sections along 42°S, 81°W and 31°S to Valparaiso.

Soundings:- G.E.B.C.O.:-

Fjords:	-	4042 km
Pacific:	-	1792 km
Total:	-	5834 km

In this phase of the cruise, some stations were done from lifeboats or launches. Nutrients are listed separately as they were not done at each and every station.

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	B.S.N.
104	53°38.40S	70°12.50W	03 03 70	X	X	X		X		X		X	48
105	53°56.00S	70°14.50W	03 03 70	X	X	X							49
106	54°08.00S	70°07.00W	04 03 70	X	X	X							50
107	54°14.50S	69°46.0W	04 03 70	X	X	X		X	X	X			51
108	54°19.00S	69°26.80W	04 03 70	X	X	X							52
109	54°24.50S	69°12.50W	04 03 70	X	X	X	X						53
110	53°29.20S	70°37.20W	04 03 70	X	X	X		X	X	X		X	54
111	53°51.00S	71°38.00W	06 03 70		X	X							55
112	53°17.00S	72°22.80W	06 03 70	X	X	X							56
113	53°12.50S	72°05.0W	06 03 70	X	X	X		X		X		X	57
114	53°10.00S	71°54.10W	06 03 70		X	X							58
115	53°04.10S	71°38.50W	06 03 70	X	X	X							59
116	52°59.00S	71°29.50W	06 03 70	X	X	X	X						60
117	52°53.30S	71°20.50W	06 03 70		X	X							61
118	53°21.40S	73°01.30W	07 03 70	X	X	X							62
119	53°07.80S	73°25.00W	07 03 70	X	X	X		X				X	63
120	53°08.00S	72°57.50W	07 03 70		X	X							64
121	53°11.20S	72°49.70W	07 03 70	X	X	X	X	X				X	65

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	B.S.N.
122	52°58.80S	72°56.80W	07 03 70		X								66
123	52°54.10S	72°55.60W	07 03 70		X								67
124	52°52.30S	72°57.70W	07 03 70		X								68
125	53°02.70S	72°57.00W	07 03 70	X	X	X		X		X		X	69
126	53°07.70S	73°08.80W	08 03 70	X	X	X		X	X	X		X	70
127	52°54.10S	73°56.10W	08 03 70	X	X	X		X	X	X		X	71
128	52°49.80S	73°37.50W	08 03 70	X	X	X		X				X	72
129	52°46.20S	73°30.60W	08 03 70	X	X	X	X						73
130	52°42.30S	73°25.70W	08 03 70	X	X	X				X		X	74
131	52°43.50S	73°18.50W	08 03 70	X	X	X	X			X			75
132	52°48.70S	73°20.5W	09 03 70	X	X	X							76
133	52°01.60S	73°46.20W	09 03 70	X	X	X		X	X				77
134	52°01.10S	73°36.50W	09 03 70		X	X	X						78
135	52°06.50S	73°28.60W	09 03 70	X	X	X		X		X		X	79
136	52°10.00S	73°23.10W	09 03 70	X	X	X							80
137	52°06.60S	73°16.20W	09 03 70	X	X								81
138	51°69.60S	73°18.10W	09 03 70	X	X			X		X		X	82
139	51°62.60S	73°18.00W	09 03 70	X	X		X						83
140	51°37.50S	72°46.6W	11 03 70		X								84

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	B.S.N.
141	61°36.70S	72°49.10W	11 03 70		X								85
142	51°53.00S	72°42.20W	12 03 70		X	X	X			X		X	86
143	51°56.50S	72°62.40W	12 03 70		X								87
144	52°01.80S	72°57.20W	12 03 70	X	X	X		X		X		X	88
145	51°36.60S	73°59.8W	12 03 70	X	X	X							89
146	50°52.20S	74°14.80W	13 03 70	X	X								90
147	50°51.60S	74°02.60W	13 03 70	X	X	X		X	X	X		X	91
148	50°49.50S	73°53.60W	13 03 70	X	X								92
149	50°45.50S	73°47.80W	13 03 70	X	X			X		X		X	93
150	50°39.80S	73°47.10W	13 03 70	X	X								94
151	50°54.80S	73°49.20W	13 03 70	X	X					X		X	95
152	50°31.80S	73°59.50W	13 03 70	X	X								96
153	50°29.50S	74°05.30W	13 03 70	X	X		X	X	X			X	97
154	50°28.20S	74°14.20W	14 03 70	X	X								98
155	50°23.60S	74°24.60W	14 03 70	X	X			X		X		X	99
156	50°20.00S	74°34.10W	14 03 70	X	X								100
157	50°20.40S	74°49.50W	14 03 70	X	X			X	X	X	X		101
158	50°01.70S	74°55.20W	14 03 70	X	X								102
159	50°20.50S	74°49.80W	14 03 70	X									

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	B.S.N.
160	50°12.50S	74°11.00W	14 03 70		X								103
161	50°08.00S	74°13.60W	14 03 70		X								104
162	50°04.10S	74°19.00W	14 03 70		X								105
163	49°59.40S	74°26.20W	14 03 70	X	X			X	X	X		X	106
164	49°33.50S	74°14.10W	15 03 70	X	X								107
165	49°31.10S	74°08.10W	15 03 70	X	X			X	X	X	X		108
166	49°26.10S	74°08.70W	15 03 70	X	X								109
167	49°20.20S	74°06.80W	15 03 70	X	X		X			X		X	110
168	49°17.00S	74°06.10W	15 03 70									X	
169	48°43.00S	74°26.70W	15 03 70	X	X			X	X	X		X	111
170	48°42.50S	74°11.00W	15 03 70		X								112
171	48°43.80S	74°18.00W	15 03 70		X								113
172	48°25.60S	74°32.60W	16 03 70	X	X			X	X	X		X	114
173	48°00.80S	74°41.40W	16 03 70	X	X			X	X	X		X	115
174	47°56.40S	74°29.70W	16 03 70	X				X		X	X		116
175	48°06.20S	74°17.40W	16 03 70	X	X								117
176	48°09.50S	74°15.50W	16 03 70	X	X								118
177	48°11.20S	73°20.00W	16 03 70		X		X	X		X		X	119
178	48°07.30S	73°18.60W	16 03 70	X	X								120

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.N.	O.P.T.	V.P.T.	B.S.N.
179	48°11.80S	73°27.40W	17 03 70	X	X								121
180	48°08.20S	73°34.80W	17 03 70	X	X			X		X		X	122
181	48°02.80S	73°43.20W	17 03 70	X	X								123
182	48°01.30S	73°50.90W	17 03 70	X	X	X		X	X	X		X	124
183	47°58.50S	74°07.30W	17 03 70	X	X		X						125
184	48°00.00S	74°17.40W	17 03 70	X	X								126
185	48°00.00S	73°19.00S	17 03 70	X	X								127
186	47°59.70S	73°25.80W	17 03 70	X	X			X		X	X		128
187	47°58.70S	73°31.70W	17 03 70	X	X		X						129
188	47°54.20S	73°36.40W	17 03 70	X	X			X	X	X		X	130
189	47°52.50S	73°47.90W	18 03 70	X	X								131
190	47°49.70S	73°44.90W	18 03 70	X	X	X		X		X		X	132
191	47°45.60S	73°46.00W	18 03 70	X	X		X						133
192	47°41.80S	73°43.70W	18 03 70	X	X	X		X		X		X	134
193	47°51.50S	73°59.40W	18 03 70	X	X								135
194	47°47.80S	74°15.60W	18 03 70	X	X	X							136
195	47°49.20S	74°32.00W	18 03 70	X	X								137
196	47°45.60S	74°43.70W	18 03 70	X	X								138
197	47°34.50S	74°54.10W	18 03 70	X	X			X	X	X		X	139

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	B.S.N.
198	46°55.00S	74°14.40W	19 03 70	X	X	X							140
199	46°50.60S	74°19.50W	19 03 70		X								141
200	46°49.20S	74°29.10W	19 03 70		X	X							142
201	46°49.00S	74°36.50W	19 03 70		X		X						143
202	47°10.00S	74°19.00W	19 03 70	X	X	X		X	X		X		144
203	47°11.40S	74°10.00W	19 03 70		X								145
204	47°09.60S	74°03.50W	19 03 70		X								146
205	47°18.80S	74°06.30W	19 03 70		X								147
206	47°34.50S	74°54.10W	19 03 70	X									
207	47°00.40S	76°47.50W	20 03 70	X	X	X			X				148
208	45°45.80S	76°40.20W	20 03 70	X	X	X			X				149
209	45°50.00S	74°30.60W	20 03 70	X	X			X		X		X	150
210	45°44.60S	73°59.20W	20 03 70		X		X			X		X	151
211	45°52.10S	73°37.10W	20 03 70	X	X					X		X	152
212	46°08.00S	73°39.50W	21 03 70		X	X							153
213	46°14.60S	73°41.50W	21 03 70		X					X		X	154
214	46°19.50S	73°43.50W	21 03 70		X	X	X						155
215	46°02.50S	73°25.10W	21 03 70	X	X	X							156

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	S.T.	B.S.N.
216	46°06.30S	73°27.50W	21 03 70	X	X		X	X	X	X		X		157
217	46°12.30S	73°32.50W	21 03 70	X	X	X								158
218	46°18.10S	73°36.60W	21 03 70	X	X		X	X		X		X		159
219	46°08.40S	73°58.50W	21 03 70		X	X								160
220	46°14.60S	74°16.40W	21 03 70		X	X								161
221	46°13.00S	74°07.30W	21 03 70		X	X								162
222	45°58.20S	73°39.40W	21 03 70		X									163
223	45°21.20S	73°39.00W	22 03 70	X	X									164
224	45°27.10S	73°31.20W	22 03 70	X	X		X	X		X		X		165
225	45°39.40S	73°33.20W	22 03 70	X	X									166
226	45°48.50S	73°33.50W	22 03 70	X	X		X							167
227	45°44.60S	73°27.10W	22 03 70		X									168
228	45°41.60S	73°23.70W	22 03 70		X									169
229	45°40.00S	73°17.50W	22 03 70		X									170
230	45°22.20S	73°25.70W	22 03 70	X	X									171
231	45°18.40S	73°17.40W	22 03 70	X	X		X	X	X	X		X		172
232	45°17.70S	73°09.70W	23 03 70	X	X									173
233	45°22.60S	73°04.40W	23 03 70	X	X	X								174

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	M.	B.S.	C.-B.I.	I.K.I.H.	V.P.M.	O.P.I.	V.P.I.	S.I.	B.S.M.
234	45°26.20S	72°67.20W	23 03 70	X	X	X	X	X				X		175
235	45°24.50S	72°61.50W	23 03 70	X	X	X								176
236	45°22.00S	73°04.70W	23 03 70	X										
237	45°18.00S	73°17.40W	24 03 70	X										
238	45°26.00S	73°33.00W	24 03 70	X										
239	45°20.50S	73°39.70W	24 03 70	X										
240	45°07.50S	73°39.00W	24 03 70	X	X		X	X						177
241	44°49.20S	73°29.50W	24 03 70	X	X									178
242	44°17.40S	73°11.70W	24 03 70	X	X									179
243	44°18.30S	73°01.60W	24 03 70	X	X		X	X		X		X		180
244	44°23.30S	72°65.30W	24 03 70	X	X		X							181
245	44°26.80S	72°45.70W	24 03 70	X	X	X		X		X		X		182
246	44°25.50S	72°37.00W	24 03 70	X	X	X								183
247	44°33.20S	72°044.10W	25 03 70	X	X		X							184
248	44°38.20S	72°45.10W	25 03 70	X	X	X		X		X				185
249	44°45.60S	72°49.40W	25 03 70	X	X									186
250	44°49.00S	72°65.70W	25 03 70	X	X	X	X							187
251	44°54.50S	73°04.20W	25 03 70	X	X			X	X	X				188

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	S.T.	B.S.N.
252	44°56.80S	73°15.00W	25 03 70	X	X		X							190
253	44°27.10S	73°29.60W	25 03 70	X	X		X	X	X	X				190
254	44°12.80S	73°25.50W	25 03 70	X	X									191
255	43°66.10S	73°24.30W	26 03 70	X	X	X	X	X		X				192
256	43°44.60S	74°19.60W	26 03 70	X										
257	43°45.50S	75°11.70W	26 03 70	X	X	X			X					193
258	43°33.30S	73°23.80W	26 03 70	X	X									194
259	43°18.40S	73°17.60W	26 03 70	X	X			X		X				195
260	43°00.30S	73°01.30W	26 03 70	X	X		X							196
261	42°27.00S	72°58.60W	27 03 70	X	X		X	X		X				197
262	42°28.30S	72°48.60W	27 03 70	X	X									198
263	42°30.00S	72°42.80W	27 03 70	X	X									199
264	42°32.50S	72°37.40W	27 03 70	X	X		X			X				200
265	42°34.40S	72°33.20W	27 03 70	X	X									201
266	42°10.10S	72°41.50W	27 03 70	X	X									202
267	42°11.50S	72°32.30W	27 03 70	X	X		X	X		X				203
268	42°19.10S	72°31.30W	27 03 70	X	X									204
269	42°23.50S	72°28.80W	27 03 70	X	X		X	X		X				205

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	M.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	S.T.	B.S.N.
270	42°27.80S	72°29.00W	27 03 70	X	X									206
271	42°06.80S	72°29.50W	27 03 70	X	X									207
272	42°03.50S	72°28.30W	28 03 70	X	X			X		X				208
273	41°59.70S	72°30.40W	28 03 70	X	X									209
274	42°03.30S	72°32.10W	28 03 70	X	X	X		X		X				210
275	42°07.50S	72°48.00W	28 03 70	X	X		X	X		X				211
276	42°04.20S	73°09.20W	28 03 70	X	X	X								212
277	41°48.70S	72°55.60W	28 03 70	X	X									213
278	41°43.10S	72°45.20W	28 03 70	X	X		X							214
279	41°35.50S	72°49.50W	28 03 70	X	X									215
280	41°43.00S	72°38.00W	28 03 70	X	X		X	X		X		X		216
281	41°42.60S	72°30.80W	28 03 70	X	X									217
282	41°40.80S	72°24.30W	28 03 70	X	X	X	X	X		X				218
283	41°35.40S	72°20.50W	29 03 70		X									219
284	41°31.10S	72°19.80W	29 03 70	X	X		X	X		X				220
285	41°25.30S	72°18.10W	29 03 70		X									221
286	41°40.60S	74°14.10W	31 03 70	X										
287	41°39.00S	75°02.10W	01 04 70	X										

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	M.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	S.T.	B.S.N.
288	41°38.80S	76°00.00W	01 04 70	X										
289	41°40.00S	77°00.00W	01 04 70	X	X									222
290	41°39.50S	78°00.00W	01 04 70	X										
291	41°40.00S	79°00.00W	01 04 70	X										
292	41°39.50S	79°59.80W	02 04 70	X										
293	41°39.30S	80°58.50W	02 04 70	X	X									223
294	41°00.00S	80°59.00W	02 04 70	X										
295	40°01.20S	80°59.40W	02 04 70	X										
296	38°58.30S	81°00.10W	02 04 70	X										
297	38°00.00S	81°00.00W	03 04 70	X	X				X					224
298	37°00.00S	80°58.50W	03 04 70	X										
299	35°58.10S	80°57.80W	03 04 70	X										
300	35°03.10S	81°01.30W	03 04 70	X										
301	33°57.70S	81°00.00W	04 04 70	X										
302	33°30.00S	81°00.00W	04 04 70	X	X									225
303	33°31.9S	80°08.30W	04 04 70	X										
304	33°30.80S	79°00.80W	04 04 70	X										
305	33°30.90S	78°01.00W	05 04 70	X										

Stn. #	Lat.	Long.	Date	B.B. 9060 STD C.	K.C.	N.	B.S.	C.-B.T.	I.K.T.H.	V.P.H.	O.P.T.	V.P.T.	S.T.	B.S
306	33°24.50S	77°00.00W	05 04 70	X	X									22
307	33°19.00S	76°00.60W	05 04 70	X										
308	33°16.00S	75°01.90W	05 04 70	X										
309	33°09.50S	74°00.00W	05 04 70	X										
310	33°05.00S	73°00.00W	06 04 70	X										
311	32°58.50S	72°01.40W	06 04 70	X										

"HUDSON 70"

April 15, 1970 - June 6, 1970

Area:- Valparaiso to Vancouver

Soundings - G.E.B.C.O.: - 19920 km

Gravity Records: - 19920 km

Magnetics: - 19920 km

1) Oxygens were analyzed by the Carpenter modification of the Winkler method using 60 ml sampler bottles.

2) Normally, nutrient samples were withdrawn from Knudsen bottles into 25 ml polyethelene tubes and preserved for a few hours in a refrigerator after the addition of 2 drops of chloroform. They were then analyzed in an auto analyzer.

1) Normally, the samples taken from the Nisken bottles were used by Dr. P.J. Wangersky for determination of nitrogen, argon, dissolved and particulate organic carbon, and ratios of major ions.

2) On some stations, samples were withdrawn for helium and helium isotope studies.

Stn. #	Lat.	Long.	Date	S.P.T.	V.P.T.	O.P.T.	A.S.I.O.	K.M.C.	C.	A. CO^2 S.	A.C14 S.	S.W. CO^2 S.	B.S.M.
312	59°39.70S	126°14.00W	24 04 70									X	
313	60°14.80S	136°10.30W	25 04 70									X	
314	61°16.20S	141°30.80W	26 04 70									X	
315	62°55.80S	149°57.90W	27 04 70	X	X	X	X	X		X	X	X	227
316	59°54.20S	149°56.30W	28 04 70		X	X	X	X		X	X	X	228
317	54°55.70S	149°49.7W	29 04 70	X	X		X	X		X	X	X	229
318	49°55.90S	150°01.30W	01 05 70	X	X	X	X	X		X	X	X	230
319	44°54.90S	150°01.70W	02 05 70	X	X		X	X		X	X	X	231
320	39°59.60S	150°01.40W	04 05 70	X	X		X	X		X	X	X	232
321	35°00.0S	149°59.90W	05 05 70	X	X	X	X	X		X	X	X	233
322	29°58.40S	149°58.20W	07 05 70	X	X	X	X	X	X	X	X	X	234
323	24°50.10S	150°00.70W	09 05 70	X	X	X	X	X		X	X	X	235
324	19°57.80S	150°02.90W	10 05 70	X	X	X	X	X	X	X	X	X	236
325	16°37.00S	150°02.00W	11 05 70				X		X				

Stn. #	Lat.	Long.	Date	M.-O.P.H.	S.P.T.	V.P.H.	K.N.C.	B.L.	A.S.L.O.	C.	A. CO^2 S.	A. C14 S.	S.W. CO^2 S.	B.S.N.
326	15°03.10S	149°59.70W	17 05 70		X	X	X		X		X	X	X	237
327	09°50.00S	150°01.50W	19 05 70	X	X	X	X	X	X		X	X	X	238
328	04°59.30S	150°08.30W	20 05 70	X	X	X	X	X	X			X	X	239
329	00°03.60S	149°52.20W	22 05 70	X	X	X	X	X	X		X	X	X	240
330	04°47.40N	150°00.20W	23 05 70	X	X	X	X		X		X		X	241
331	10°05.10N	150°03.80W	25 05 70	X	X	X	X	X	X		X	X	X	242
332	16°02.80N	150°05.70W	26 05 70	X	X	X	X		X		X	X	X	243
333	22°09.80N	149°58.90W	28 05 70	X	X	X	X		X		X	X	X	244
334	28°50.20N	149°57.30W	30 05 70	X	X	X	X		X	X	X	X	X	245
335	35°56.70N	149°54.50W	01 06 70	X		X	X		X		X		X	246
336	42°48.60N	149°51.90W	03 06 70	X	X	X	X		X		X	X	X	247
337	49°09.00N	150°00.40W	04 05 70	X	X	X	X		X		X	X	X	248
338	54°25.00N	150°04.60W	06 06 70	X	X	X	X		X	X	X	X	X	249

"HUDSON 70"

July 12, 1970 - August 8, 1970

Geophysical Survey off the Coast of British Columbia

Soundings - G.E.B.C.O.:	- 6933 km
Gravity Records:	- 6933 km
Magnetics:	- 6933 km
Reflection Profiling:	- 1675 km
Seismic Refraction:	- 621 km

Stn. #	Latitude	Longitude	Date	Heat Flow Stn. #	Camera Stn.	Coring Stn.	Velocimeter Stn.
339	50°58.00N	131°64.70W	15 07 70	1			
340	51°34.70N	134°20.70W	19 07 70	2			
341	51°43.80N	130°00.40W	26 07 70				X
342	49°58.60N	129°32.60W	29 07 70	4			
343	50°01.60N	129°43.00W	29 07 70	5			
344	50°04.40N	129°46.40W	30 07 70	6			
345	50°07.70N	129°49.80W	30 07 70	7		X	
346	50°07.70N	130°01.80W	30 07 70	8			
347	50°13.20N	130°09.20W	30 07 70	9			
348	50°16.30N	130°17.80W	30 07 70	10			
349	50°21.00N	130°06.60W	31 07 70	11			
350	50°45.90N	130°36.60W	01 08 70	12			
351	50°39.50N	130°33.00W	02 08 70	13			
352	50°16.60N	130°17.70W	03 08 70		X		

"HUDSON 70"

August 14, 1970 - September 30, 1970

Esquimalt to Resolute

Soundings G.E.B.C.O.:	- 9653 km
Gravity Records:	- 9653 km
Magnetics:	- 9653 km
Reflection Profiling: (done in Beaufort Sea Area)	- 2194 km

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	R.D.	C.	C.S.	K. & M.C.	B.S.T.	U./W/T.	O.B.T.
353	49°56.40N	128°56.20W	14 08 70	X	X					X					
354	54°02.50N	161°41.40W	19 08 70	X	X					X					
355	54°58.00N	165°21.00W	20 08 70		X										
356	57°05.00N	166°24.00W	20 08 70		X										
357	59°21.00N	167°38.00W	21 08 70		X										
358	61°40.00N	168°47.00W	21 08 70		X										
359	63°01.00N	169°10.00W	22 08 70		X										
360	67°02.30N	168°23.00W	22 08 70		X										
361	67°38.00N	167°44.00W	23 08 70		X										
362	69°44.00N	164°59.00W	23 08 70		X										
363	70°44.00N	161°03.00W	23 08 70		X										
364	71°23.30N	156°57.19W	24 08 70		X	X									
365	71°26.50N	156°30.50W	24 08 70					X							
366	70°54.50N	151°08.50W	25 08 70		X										

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	S.D.	C.	C.S.	K. & N.C.	B.S.T.	U./W/T.	O.B.T.
367	70°33.61N	147°26.43W	25 08 70		X										
368	70°07.00N	141°14.00W	26 08 70		X										
369	69°38.00N	138°45.00W	26 08 70			X	X	X		X					
370	69°45.00N	138°34.00W	26 08 70			X		X		X					
371	69°28.00N	138°48.00W	26 08 70			X		X		X					
372	69°36.00N	138°24.00W	26 08 70			X		X							
373	69°40.00N	138°14.00W	26 08 70			X	X	X							
374	70°27.50N	138°57.00W	27 08 70		X	X	X	X							
375	70°19.00N	138°47.50W	27 08 70	X	X	X	X	X		X					
376	70°12.50N	138°40.0W	27 08 70			X		X							
377	70°06.50N	138°31.00W	27 08 70		X	X	X	X		X					
378	69°57.50N	138°27.00W	27 08 70			X		X							

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	S.D.	C.	C.S.	K.C.	B.S.T.	U./W.T.	O.B.T.	B.S.N.
379	69°50.50N	138°18.00W	27 08 70	X	X	X	X	X		X						
380	69°56.00N	138°54.80W	27 08 70		X	X	X	X								
381	69°53.20N	139°05.00W	27 08 70			X		X					X			
382	70°29.70N	139°00.40W	28 08 70	X	X	X	X									
383	70°22.00N	139°05.50W	28 08 70	X	X	X	X	X								
384	70°15.50N	139°12.30W	28 08 70	X	X	X	X	X								
385	70°08.40N	139°15.90W	28 08 70	X	X	X	X	X	X		X	X				250
386	69°54.20N	139°28.10W	28 08 70	X	X	X	X	X			X					
387	69°42.00N	139°42.10W	28 08 70		X	X	X	X								
388	71°31.30N	138°11.00W	29 08 70	X	X	X				X						
389	70°59.80N	138°14.70W	30 08 70	X	X	X	X			X						
390	70°37.00N	139°29.00W	30 08 70	X	X	X	X	X		X		X				251
391	70°22.00N	139°42.00W	30 08 70	X	X	X	X	X		X		X				252
392	70°10.30N	139°52.60W	30 08 70	X	X	X	X	X		X		X				253
393	69°59.30N	140°15.70W	30 08 70	X	X	X	X	X		X		X				254
394	69°42.00N	140°38.00W	30 08 70	X	X	X	X	X		X		X				255
395	69°11.00N	137°57.00W	31 08 70	X	X	X	X	X		X						
396	69°22.10N	138°04.80W	31 08 70	X	X	X	X	X		X						

Stn. #	Latitude	Longitude	Date	S.P.I.	V.P.I.	S.B.I.	V.B.I.	V.V.G.	S.D.	C.	C.S.	K.C.	B.S.I.	U./M.I.	O.B.I.	B.S.M.
397	69°33.00N	138°11.80W	31 08 70	X	X	X	X	X		X						
398	70°30.50N	138°19.60W	01 09 70	X	X	X	X	X								
399	70°19.80N	138°11.00W	01 09 70	X	X	X	X	X								
400	70°10.50N	137°59.60W	01 09 70	X	X	X	X	X								
401	70°01.00N	137°57.00W	01 09 70	X	X	X	X	X								
402	69°47.00N	137°32.00W	01 09 70	X	X	X	X	X								
403	69°36.00N	137°20.00W	01 09 70	X	X	X	X	X								
404	69°27.00N	137°10.00W	01 09 70	X		X	X	X								
405	70°29.80N	137°49.00W	02 09 70	X	X	X	X	X		X						
406	70°21.50N	137°33.00W	02 09 70	X	X	X	X	X	X	X						
407	70°08.20N	137°15.80W	02 09 70	X	X	X	X	X		X	X					
408	69°58.00N	137°00.00W	02 09 70	X	X	X	X	X		X						
409	69°51.00N	136°48.00W	02 09 70;	X		X	X	X			X					
410	69°44.70N	136°37.30W	02 09 70	X		X	X	X	X							
411	69°58.50N	137°07.60W	03 09 70							X				X		
412	70°45.70N	137°04.00W	04 09 70	X	X	X	X	X								
413	70°32.00N	136°40.00W	04 09 70	X	X	X	X	X								
414	70°18.00N	136°15.00W	04 09 70	X	X	X	X	X								

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	S.D.	C.	C.S.	K.C.	B.S.T.	U./W.T.	O.B.T.	B.S.M.
415	70°10.60N	135°54.50W	04 09 70	X	X	X	X	X								
416	70°00.60N	135°39.10W	04 09 70	X	X	X	X	X								
417	70°50.85N	136°17.92W	05 09 70	X	X	X	X	X		X						
418	70°42.50N	135°52.00W	05 09 70	X	X	X	X	X		X						
419	70°37.60N	135°49.40W	05 09 70	X	X	X	X	X		X						
420	70°26.00N	135°27.00W	05 09 70		X	X	X	X		X						
421	70°17.60N	135°11.00W	05 09 70		X	X	X	X		X						
422	70°08.00N	134°54.00W	05 09 70			X		X		X						
423	70°41.30N	134°41.50W	06 09 70	X	X	X	X	X				X				256
424	70°26.50N	134°17.50W	06 09 70	X	X	X	X	X				X				257
425	70°17.00N	134°00.00W	06 09 70	X	X	X	X	X				X				258
426	71°31.98N	135°57.48W	07 09 70	X	X	X	X			X						
427	70°57.40N	135°03.40W	07 09 70	X	X	X	X	X		X		X				259
428	70°52.35N	134°57.00W	07 09 70	X	X	X	X	X				X				260
429	70°46.50N	134°50.00W	07 09 70	X	X	X	X	X				X				261
430	70°08.50N	132°47.90W	08 09 70			X	X	X		X						
431	70°14.50N	132°06.10W	08 09 70			X	X	X			X			X		
432	70°07.00N	131°35.00W	08 09 70			X	X	X	X							

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	S.D.	C.	C.S.	K.C.	B.S.T.	U./W.T.	O.B.T.	B.S.N.
433	70°00.00N	132°32.00W	08 09 70			X	X	X	X							
434	69°52.00N	133°19.50W	08 09 70			X	X	X								
435	70°02.00N	133°45.80W	08 09 70			X	X	X								
436	71°12.00N	134°22.50W	09 09 70	X	X	X	X	X		X						
437	71°01.00N	134°07.00W	09 09 70	X	X	X	X	X		X						
438	70°56.00N	133°59.50W	09 09 70	X	X	X	X	X		X						
439	70°47.00N	133°47.00W	09 09 70	X	X	X	X	X		X						
440	70°38.00N	133°29.00W	09 09 70	X	X	X	X	X		X						
441	70°24.00N	133°09.00W	09 09 70	X	X	X	X	X		X						
442	71°18.50N	133°23.50W	10 09 70	X	X	X	X	X								
443	71°09.50N	133°07.00W	10 09 70	X	X	X	X	X								
444	71°02.80N	132°59.50W	10 09 70	X	X	X	X	X								
445	70°56.20N	132°47.00W	10 09 70	X	X	X	X	X								
446	71°01.20N	132°53.20W	10 09 70							X	X			X		
447	70°45.20N	132°27.60W	10 09 70	X	X	X	X	X								
448	70°31.80N	132°10.00W	10 09 70	X	X	X	X	X								
449	70°52.00N	128°33.00W	12 09 70	X	X	X	X	X		X						
450	70°41.00N	128°19.00W	12 09 70	X	X	X	X	X	X	X	X			X		

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	S.D.	C.	C.S.	K.C.	B.S.T.	U./W.T.	O.B.T.	B.S.N.
451	70°29.80N	129°22.80W	12 09 70	X		X	X	X	X						X	
452	70°38.70N	129°39.40W	12 09 70	X	X		X	X				X				262
453	71°25.70N	132°06.00W	12 09 70	X	X	X	X	X		X						
454	71°14.14N	131°54.76W	12 09 70	X	X	X	X	X		X						
455	71°03.50N	131°42.70W	13 09 70		X			X		X						
456	70°56.50N	131°24.70W	13 09 70		X	X	X	X		X						
457	70°41.30N	130°52.10W	13 09 70		X	X	X	X		X						
458	70°31.80N	130°41.60W	13 09 70		X	X	X	X		X						
459	70°22.40N	130°31.00W	13 09 70		X	X	X	X	X	X						
460	71°26.75N	130°53.90W	14 09 70		X		X	X				X				263
461	71°16.60N	130°37.60W	14 09 70	X	X		X	X				X				264
462	71°07.00N	130°17.80W	14 09 70	X	X	X	X	X				X				265
463	70°56.80N	130°03.60W	14 09 70	X	X	X	X	X				X				266
464	70°50.00N	129°52.00W	14 09 70		X		X	X				X				267
465	71°25.20N	129°27.30W	15 09 70	X	X	X	X	X		X						
466	71°17.50N	129°10.60W	15 09 70	X	X	X	X	X		X						
467	71°07.90N	128°59.10W	15 09 70	X	X	X	X	X		X						
468	71°01.00N	128°49.50W	15 09 70	X	X		X	X	X	X					X	

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	S.D.	C.	C.S.	K.C.	B.S.T.	U./W.T.	O.B.T.	B.S.N.
469	69°56.50N	134°33.00W	18 09 70			X	X	X	X	X		X				268
470	69°51.00N	135°20.00W	19 09 70			X	X	X	X	X		X				269
471	71°34.30N	127°41.80W	20 09 70	X	X	X	X	X								
472	71°38.00N	129°50.00W	20 09 70							X						
473	71°15.80N	127°57.60W	23 09 70	X	X	X	X	X		X		X				270
474	71°02.00N	125°44.00W	23 09 70	X	X	X	X	X		X		X				271

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	S.B.T.	V.B.T.	V.V.G.	R.D.	C.	C.S.	K.C.	B.S.T.	U./W.T.	O.B.T.	B.S.N.
475	70°49.80N	123°30.50W	23 09 70	X	X	X	X	X		X		X				272
476	71°20.00N	119°24.00W	24 09 70	X	X	X	X	X		X		X				273
477	71°59.00N	119°30.00W	24 09 70	X	X	X	X	X		X		X				274
478	72°30.00N	118°39.00W	24 09 70	X	X	X	X	X		X		X				275
479	73°01.00N	117°12.00W	24 09 70	X	X	X	X	X		X		X				276
480	73°24.20N	115°04.00W	25 09 70	X	X	X	X	X		X		X				277
481	73°48.10N	113°45.50W	26 09 70	X	X	X	X	X		X		X				278
482	74°39.00N	108°10.50W	26 09 70	X	X	X	X	X		X		X				279
483	74°41.80N	105°15.50W	27 09 70	X	X	X	X	X		X		X				280
484	74°47.90N	101°35.20W	27 09 70	X	X	X	X	X		X		X				281
485	74°53.00N	98°03.00W	28 09 70	X	X	X	X			X		X				282
486	74°13.90N	95°29.70W	28 09 70	X	X	X	X	X		X		X				283
487	74°28.00N	92°32.00W	29 09 70	X	X	X	X	X		X		X				284
488	74°28.60N	90°04.00W	29 09 70	X	X	X	X	X				X				285
489	74°22.80N	90°08.00W	29 09 70	X	X	X	X	X				X				286
490	74°16.80N	90°17.00W	29 09 70	X	X	X	X	X		X		X				287
491	74°11.00N	90°12.00W	29 09 70	X	X	X	X	X				X				288
492	74°02.50N	90°30.00W	29 09 70	X	X	X	X					X				289
493	74°16.00N	88°01.50W	30 09 70	X	X	X	X					X				290

"HUDSON 70"

October 1, 1970 - October 16, 1970

Area:- Resolute to Halifax
(Covering - Eastern Arctic - Baffin Bay - Labrador Sea)

Soundings - G.E.B.C.O.:	- 4570 km
Gravity Records:	- 4570 km
Magnetics:	- 4570 km
Seismic Reflection Profiling:	- 770 km
Reversed Seismic Refraction:	- 250 km

Stn. #	Latitude	Longitude	Date	S.P.T.	V.P.T.	C.	K.C.	B.S.N.
494	74°10.80N	84°58.00W	01 10 70	X	X			
495	74°01.00N	79°56.00W	01 10 70	X	X		X	291
496	72°13.00N	69°50.00W	04 10 70	X	X	X	X	292
497	71°02.00N	64°54.00W	05 10 70	X	X	X	X	293
498	72°17.50N	66°02.00W	06 10 70	X	X	X	X	294
499	72°16.00N	67°40.00W	06 10 70	X	X		X	295
500	71°00.90N	59°48.80W	08 10 70	X	X		X	296
501	69°00.00N	59°39.50W	09 10 70	X	X		X	297
502	67°11.90N	59°22.20W	09 10 70	X	X		X	298
503	64°45.40N	58°28.30W	10 10 70	X	X		X	299
504	62°25.00N	57°06.00W	10 10 70	X	X		X	300
505	57°37.00N	55°01.90W	11 10 70	X	X		X	301
506	52°46.90N	53°15.50N	12 10 70	X	X			
507	50°13.00N	52°26.50W	13 10 70	X	X			
508	48°32.20N	52°12.40W	13 10 70	X	X			

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

A. HALIFAX TO RIO DE JANEIRO

B. RIO DE JANEIRO TO BUENOS AIRES

C.R. MANN

CRUISE NO. 69-050

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

A. HALIFAX TO RIO DE JANEIRO

Local Cruise Designation:	69-050
CODC Reference Number:	10-69-050
Vessel:	C.S.S. HUDSON
Dates:	19 November to 20 December 1969
Area:	Halifax to Rio de Janeiro
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain D.W. Butler

Scientific Staff:

C.R. Mann Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
R.C. Melanson Assistant Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
B.D. Carson	Atlantic Oceanographic Laboratory Bedford Institute
A.R. Coote	Atlantic Oceanographic Laboratory Bedford Institute
T.J. Corbett	Atlantic Oceanographic Laboratory Bedford Institute
A.B. Grant	Atlantic Oceanographic Laboratory Bedford Institute
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P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
P.C. Beamish	Marine Ecology Laboratory Bedford Institute
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Scientific Staff (Continued):

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Chung I. Choi	Institute of Oceanography Dalhousie University
R.C. Cooke	Institute of Oceanography Dalhousie University
W. Watt	Institute of Oceanography Dalhousie University
O. Bluy	Defence Research Establishment Atlantic Dartmouth, Nova Scotia
J.G. Gill	Defence Research Establishment Atlantic Dartmouth, Nova Scotia
R. Smith	Queen's University Kingston, Ontario
R.J. Beamish	University of Toronto Toronto, Ontario

Summary:

Surface Plankton Tows	21
Vertical Plankton Hauls	25
Isaacs Kidd Midwater Trawls	13
Surface Tows - Neuston Net	4
Knudsen and Niskin Casts (Surface to Bottom)	11
Bathysonde Lowerings	12
Expendable Bathythermographs Used	90
Cores Taken	3
Acoustic Scattering Layer Observations	21
In-Situ C^{14} Incubation Experiments (Including 4-bottle Niskin Cast)	10

Summary (continued):

Miles of Soundings (GEBCO)	4463
Miles of Gravity Records (approximate)	3800
Miles of Magnetics (approximate)	4200
Recordings of Whale and Dolphin Sounds	2

Narrative:

C.S.S. Hudson left Halifax for Rio de Janeiro at 1535 hours, 19 November, 1969, on the first leg of her cruise to circumnavigate the Americas. The following report covers activities up to the time of departure from Rio de Janeiro.

On leaving Halifax, a great circle route was followed to 0° Lat., 30° Long., the position of the first of a line of stations extending along 30°W Long. in the South Atlantic. Gravity, magnetics, and bathymetry were recorded enroute to the first station, and from then on between stations until 250 miles from Cape Frio. Gravity was measured with an Askania gravimeter, magnetics with a Barringer magnetometer, and bathymetry using an Alpine precision depth recorder with a Gifft receiver. As much as possible of the data were processed on board by computer. All the magnetic data were reduced to give the earth's magnetic field but it was not possible to process the gravity data due to lack of time. The bathymetric data were copied onto plotting sheets. The positions of the oceanographic stations and of other stops for observations were also recorded on these sheets.

A herd of sperm whales was sighted on 29 November 1969; the ship was stopped and records of their sounds were made. The ship arrived at 0° Lat., 30°W Long., on 30 November, 1969, and commenced the sampling program for chemistry, biology, acoustics, and physical oceanography. As the chemists could not analyze water samples from more than one station each day, it was decided to do one station each day at which all samples were taken. This allowed two or three hours extra time each night as each complete station took 12 hours and the ship could steam between stations in 9 hours. From 0° Lat. one station each day was occupied every 2½° of latitude along the 30°W meridian and the work at Station 11, the last station before making for Rio de Janeiro, was completed on 10 December, 1969. Usually, each station consisted of scattering-layer observations; vertical and surface plankton tows; two casts, one deep and one shallow, of Knudsen and Niskin bottles on the same wire; a bathysonde cast; and an Isaacs Kidd haul. The scattering layer observations were made with a 1 lb. explosive sound-source, a directional receiving system consisting of a hydrophone in an inverted cone, and an omnidirectional receiving system. Four to five charges were fired at each station.

Each night the ship was stopped at about 2130 hours, depending on the

program, and an additional set of scattering layer observations made and a vertical plankton tow taken. On occasion, a Neuston net was towed to catch surface fish and the Isaacs Kidd net was hauled at night instead of early in the day.

A series of three cores was obtained where the water was shallower than 4,000 metres, as this was the deepest that a core could be taken. Mostly soft mud was recovered and the core on two occasions went into its maximum depth so that 57 and 60 foot cores were obtained.

Experiments to study primary production were made at each station. This required lowering 4 sets of small bottles attached to a line to 120 metres, and allowing them to sit in position for four hours at midday. As the experiment had to be conducted while doing other work, it could not be done from the ship. A lifeboat was put out and the string of bottles lowered from the lifeboat. This worked very well except that the lifeboat tended to drift away from the ship and the bottles could not be brought inboard quickly enough for processing. Eventually the lifeboat was tethered to the bow of the ship by a long nylon line and allowed to drift away with the wind about 200 metres.

The newly installed sea-water loop was used to collect samples of sea water for a study of productivity by measuring the uptake of C^{14}, and a series of samples obtained for measurement of chlorophyll, RNA, ATP, and particulate carbon.

On completing the sampling program at the 11 stations laid out at every $2\frac{1}{2}^{o}$ of latitude in the original plan, the ship made for Rio de Janeiro. There was additional time available enroute to Rio and this was used for scattering-layer observations and plankton hauls.

The ship arrived in Rio de Janeiro on 14 December, 1969, with the first phase of Hudson 70 completed. While in Rio, permission was obtained to capture a dolphin. Recordings of sounds from the dolphins in the bay were made and one dolphin was captured and frozen for return to Halifax for identification. The ship remained in Rio until 20 December, 1969, when she departed for the southern part of the Atlantic.

B. RIO DE JANEIRO TO BUENOS AIRES

Local Cruise Designation:	69-050
CODC Reference Number:	10-69-050
Vessel:	C.S.S. HUDSON
Dates:	20 December 1969 to 16 January 1970
Area:	Rio de Janeiro to Buenos Aires with operations in vicinity of South Georgia.
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain D.W. Butler
Scientific Staff:	
C.R. Mann Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
R.C. Melanson Assistant Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
B.D. Carson	Atlantic Oceanographic Laboratory Bedford Institute
A.R. Coote	Atlantic Oceanographic Laboratory Bedford Institute
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G. Vilks	Atlantic Oceanographic Laboratory Bedford Institute
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R.J. Conover	Marine Ecology Laboratory Bedford Institute

Scientific Staff (continued):

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Mrs. G.B. Deevey	Institute of Oceanography Dalhousie University
J.H. Sharpe	Institute of Oceanography Dalhousie University
P. Wangersky	Institute of Oceanography Dalhousie University
O. Bluy	Defence Research Establishment Atlantic Dartmouth, Nova Scotia
J.G. Gill	Defence Research Establishment Atlantic Dartmouth, Nova Scotia
R. Smith	Queen's University Kingston, Ontario
Mrs. C.M. Lalli	McGill University Montreal, Quebec
R.E. Zurbrigg	University of Toronto Toronto, Ontario

Summary:

Surface Plankton Tows	36
Vertical Plankton Hauls	32
Oblique Plankton Tows	18
Deep Multiple Plankton Tows	15
Isaacs Kidd Midwater Trawls	14
Knudsen and Niskin Casts (Surface to Bottom)	20

Summary (continued):

Bathysonde Lowerings	16
Expendable Bathythermographs Used	162
Cores Taken	3
Acoustic Scattering Layer Observations	23
Recording of Whale Sounds	1
Miles of Soundings (GEBCO)	3270

Narrative:

At noon on 20 December, 1969, C.S.S. Hudson left Rio de Janeiro for the southernmost regions of the Atlantic Ocean. The general plan was to continue the sampling at stations running south along the 30°W meridian that had been started before entering Rio. This line of stations was to terminate at 55°S Lat., to the east of South Georgia. A second line of stations running north along 40°W meridian was then to be worked after which the ship was to steam for Buenos Aires.

The ship arrived at the first station on 23 December, 1969, and commenced a program of casts of Knudsen and Niskin bottles for the chemical and physical oceanographic studies, and various plankton tows for biological programs. Measurement of gravity and the earth's magnetic field was terminated in Rio and not carried on further south. The program on station became heavier than during the Halifax to Rio de Janeiro transit because of the increase in the number of plankton tows. Each station took approximately 12 hours to complete and consisted of a deep and shallow cast of Knudsen and Niskin bottles on the same wire, two vertical plankton tows from 200 metres, an oblique tow (underway) at 200 metres, a deep tow with three nets on one wire (usually done from the Telecon winch) with the deepest net at 1000 metres or deeper, an Isaacs Kidd haul, a surface plankton tow, and a streaming of hydrophones for observation of the scattering layer. When time permitted, and this was not often, additional tows and observations of the scattering layer were made between stations.

On running down the 30th meridian, one station was occupied each day. This was more time consuming than running the 90 miles between stations as quickly as possible but was adopted because the two teams of chemists could not complete their analysis, and the biologists could not sort plankton and conduct the experiments that they were performing faster than one station each day. Still, more data were acquired than originally anticipated when it was thought only every second station could be fully processed.

On 29 December, 1969, after Station 18, the sub-tropical convergence was crossed and Antarctic plankton forms began to appear in the tows.

On 2 January, 1970, at Station 22, large icebergs appeared 11 miles south on the radar. After leaving the station, the ship crossed the Antarctic convergence in the vicinity of the icebergs and the surface temperature dropped to 1.5°C. While steaming on the night of the 2 January, 1970, many icebergs appeared on the radar, and on one occasion, when visibility was poor due to fog, the ship had to go astern to avoid a growler too low to show on the radar screen. Due to the density of icebergs and growlers, it was decided to stop at night. As there were only six hours of darkness and the stations were only 60 miles apart, this did not slow up the program greatly.

On completing the stations down the 30th meridian, the ship headed for 51°30'S Lat., 40°W Long. to start a line of five stations running north along the 40th meridian, across the south edge of the Argentine Basin. In view of the work up to this time, it was decided to run these stations as fast as possible to allow time for more work in the Argentine Basin. Also, a message had been received from Bedford Institute that the fire extinguishers had to be overhauled in Buenos Aires, and it was learned from the agent in Punta Arenas that Hudson had to call at Possession Bay for clearance before proceeding to Puerto Williams after leaving Buenos Aires. This made it desirable to attempt to reach Buenos Aires a day early and to leave on the afternoon of 21 January, 1970, instead of the morning of 22 January, 1970, so that Puerto Williams could be reached by 27 January, 1970, as originally planned.

The five stations along 40°W Long. were completed on 11 January, 1970, and the ship steamed for Buenos Aires. As a line of soundings was listed on the latest bathymetric chart of the oceans along the direct track, the ship steamed 60 miles north before heading for the pilot station at the mouth of the Rio de la Plata, so as to provide a new set of soundings for GEBCO.

During the run in, a station was occupied on the western side of the Argentine Basin, and Isaacs Kidd and plankton hauls made at several positions on the way across. The scientific program was terminated on the evening of 13 January, 1970. Hudson arrived in Buenos Aires at 0800 hours on 16 January, 1970.

The two groups of chemists onboard determined oxygen, phosphate, nitrate, silicate, pH, alkalinity, argon, nitrogen, and total carbonate from sea-water samples taken from the surface to bottom at each station. Samples were also collected for determination of particulate organic carbon, major-ion ratios, and helium isotope analyses. At Station 25, in the South Sandwich Trench, a special cast of Niskin bottles was made to 7400 metres to collect samples for determination of dissolved organic carbon at depths greater than 5000 metres.

The biological program consisted of a series of tows of nets at various depths from the surface to about 2000 metres. Some difficulty was experienced south of the Antarctic Convergence with steaming and recovery of the nets. Generally, the wind speed was 30-40 knots in this area and the motion of the ship caused slackening of the wire and snarls

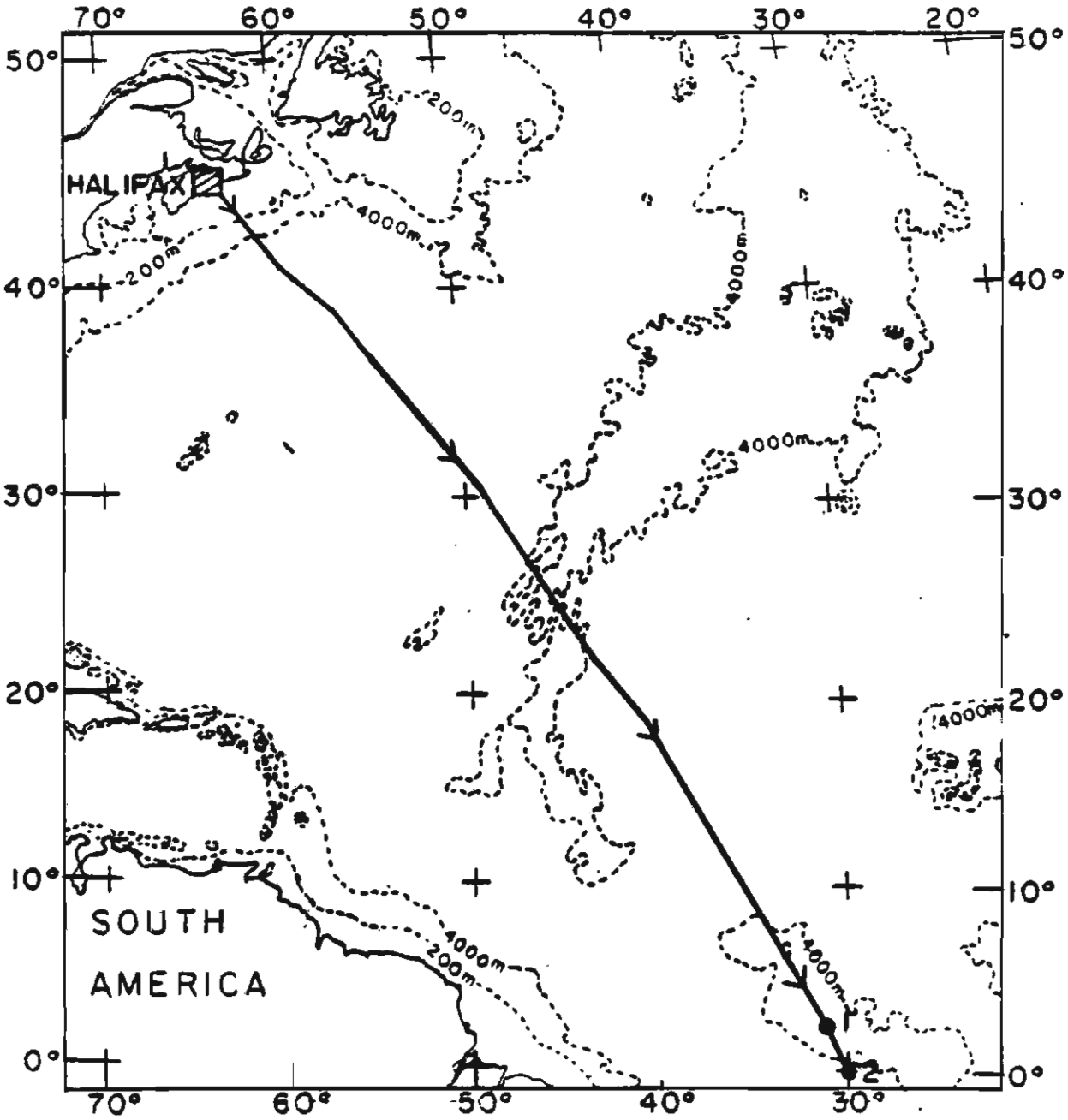
in it. The nets also flapped badly in the wind and tore on occasion.

At several stations, it was not possible to tow the Isaacs Kidd net. Some preliminary identification was done onboard and feeding experiments carried out. Surface samples were collected using the sea-water loop for the study of productivity of surface water started on the run from Halifax to Rio de Janeiro. In addition to the determination of chlorophyll, RNA, ATP, and particulate carbon, a Coulter Counter was operated after leaving Rio to give a count of particulate matter of various sizes. A preliminary examination shows a correlation with the water-mass structure. Three cores were obtained.

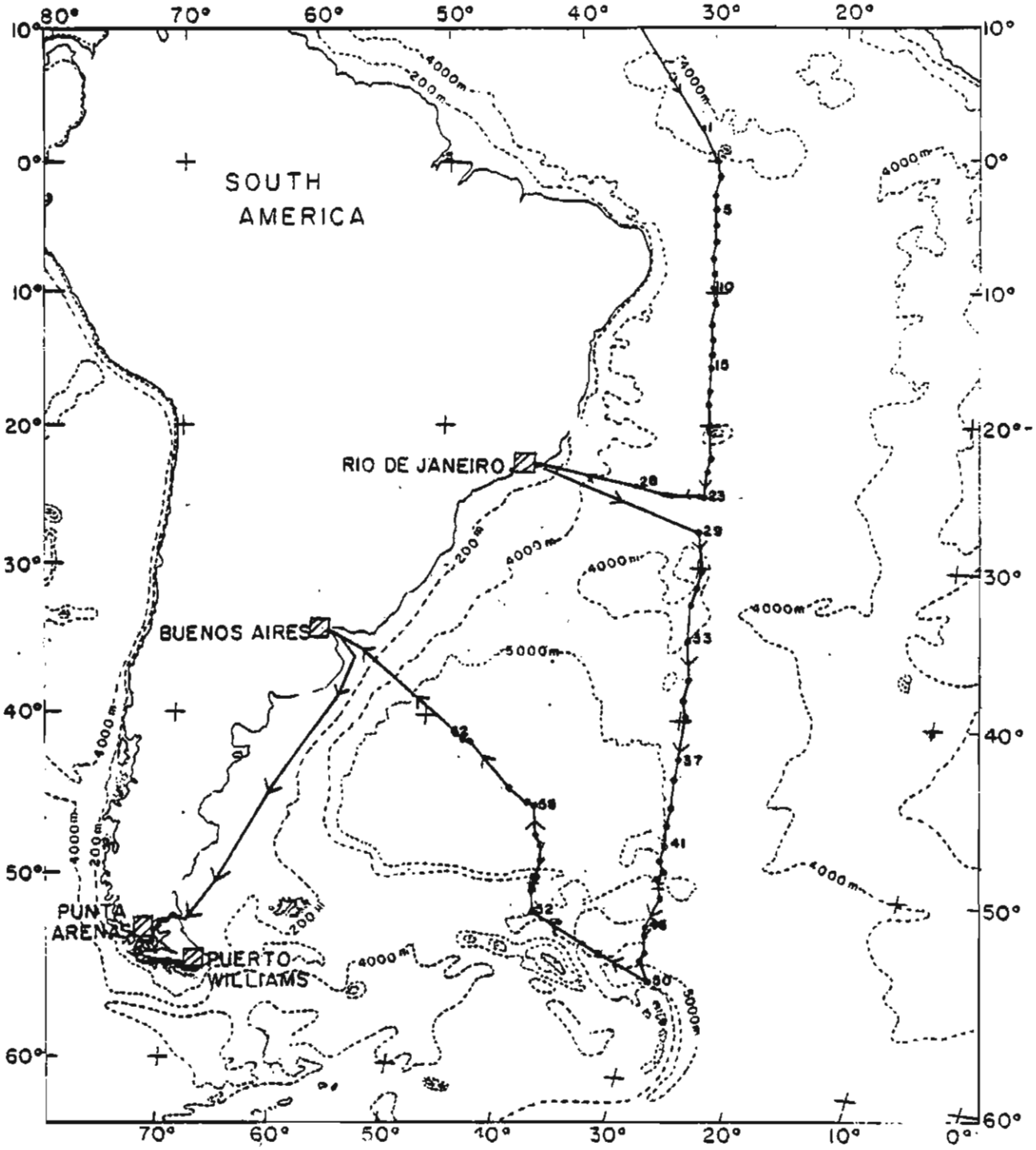
Measurements of sound scattering from the scattering layer were continued as on the Halifax to Rio leg. It was not possible to operate the directional receiving system in the southernmost areas as the seas made steaming and recovery of the directional hydrophone in the cone-reflector hazardous, with possible loss of the cone. The omnidirectional receiving system was operated at all stations.

Whales were sighted on occasion although in the vicinity of South Georgia none were seen. A recording of sounds from whales, tentatively identified as Fin whales, was made in the vicinity of Station 26. A large number of pilot whales came near the ship at Station 29 but no good recordings were obtained. After leaving Station 30, pictures were obtained of a spectacular striped dolphin which could not be identified from reference pictures aboard.

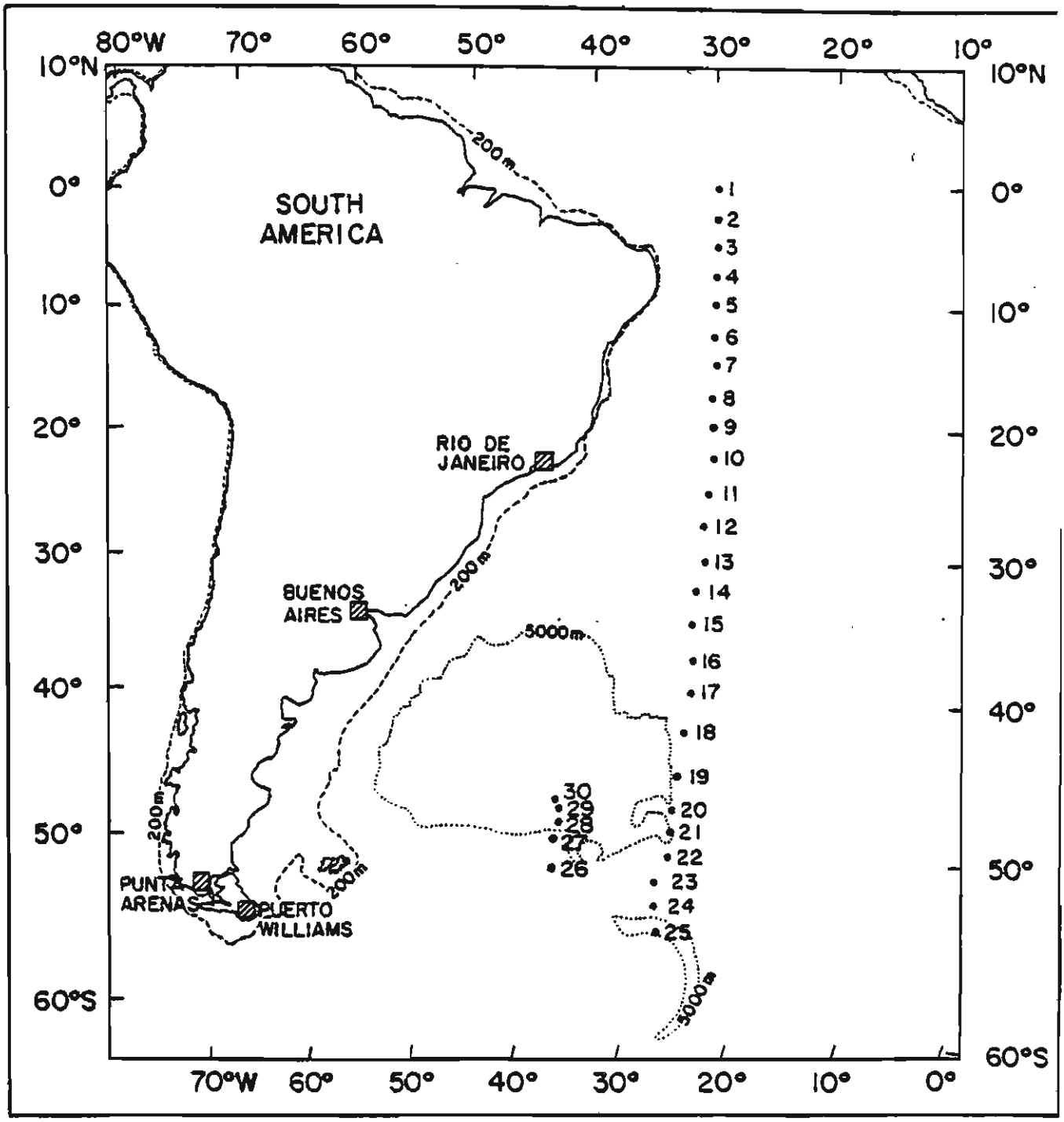
As the skies were overcast, the satellite navigation system proved invaluable. On one station near the Antarctic Convergence that took 14 hours, the ship was found to drift 23 miles.



The first two stations of the HUDSON 70 Expedition on the Halifax to Rio de Janeiro leg (Phase I).



Cruise stations occupied on the first two legs of HUDSON 70: Halifax to Rio de Janeiro (Phase I) and Rio de Janeiro to Buenos Aires (Phase II).



Oceanographic bottle stations during the first two phases of HUDSON 70

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

BUENOS AIRES TO PUNTA ARENAS

C.R. MANN

CRUISE NO. 69-050

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

BUENOS AIRES TO PUNTA ARENAS

Local Cruise Designation:	69-050
CODC Reference Number:	10-69-050
Vessel:	C.S.S. HUDSON
Dates:	22 January to 23 February 1970
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain D.W. Butler

Scientific Staff:

C.R. Mann Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
T.R. Foote Asst. Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
B.D. Carson	Atlantic Oceanographic Laboratory Bedford Institute
A.B. Grant	Atlantic Oceanographic Laboratory Bedford Institute
J.G. Murray	Atlantic Oceanographic Laboratory Bedford Institute
P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
J.M.R. Pilote	Atlantic Oceanographic Laboratory Bedford Institute
S.B. McHughen	Atlantic Oceanographic Laboratory Bedford Institute
E.A. Lewis	Atlantic Oceanographic Laboratory Bedford Institute
R.F. Reiniger	Atlantic Oceanographic Laboratory Bedford Institute
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J.W. Markham	National Research Council Halifax, Nova Scotia
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P.G. Brewer	Woods Hole Oceanographic Institution Woods Hole, Massachusetts
R.L. Edwards	Trent University Peterborough, Ontario
R.R. Hessler	Scripps Institution of Oceanography La Jolla, California
N.R. Rock	I.O. Sao Paulo Sao Paulo, Brazil
R.S. Rebaudi	Argentine Navy Buenos Aires

Summary:

Surface Plankton Tows	16
Vertical Plankton Tows	34
Knudsen and Niskin Casts	16
Bathysonde Lowerings	10
Expendable Bathythermographs	32
Current Meter Moorings	4
Epibenthic Sled Hauls	11

Summary (continued):

Anchor Dredge Grabs	1
Smith McIntyre Grabs	3
Bird Count Watches	23
Nephelometer Lowerings	8
Miles of Soundings (GEBCO)	3700

Launch Operations - Isla Navarino:

Marine and fresh-water invertebrate animals: About 20,000 specimens collected at 33 collecting stations.

Intertidal Marine Algae: About 500 samples.

Narrative:

At 1015 on 22 January, C.S.S. Hudson left Buenos Aires for Puerto Williams, the Drake Passage, and the Bransfield Strait. An Argentine oceanographer, Lt. S. Rebaudi, and a Brazilian oceanographer, Dr. N. Rock, joined the vessel for this part of the voyage. Hudson entered the Strait of Magellan on 26 January and sailed west through the Strait to Punta Arenas where she stood offshore to allow transfer of personnel ashore. She then proceeded to Puerto Williams through the Islands of Tierra del Fuego, approaching Puerto Williams from the west, through the Beagle Channel, on the evening of the 27 January.

The ship was made welcome by the Commandante and his staff. Drs. Bousfield, Markham and Coxwain, F. Durnford, were put ashore with the launch 'Redhead' to remain at Puerto Williams and collect algae and molluscs around the shores of Isla Navarino while Hudson worked in the Drake Passage. The Chilean navy very kindly provided quarters for them and a naval officer went with them in the launch and guided them around the Islands.

Hudson left Puerto Williams on 28 January and took a dredge sample of the sea bed to start the collection of bottom fauna and after rounding Navarino Island, collected more samples in the vicinity of Cape Horn.

Leaving Cape Horn on 30 January, Hudson proceeded south to start laying buoys carrying current meters and temperature recorders across the Drake Passage. At the first position, a bathymetric survey showed an uneven bottom with several hundred metres between crest and trough. The current meters could not be laid here and the location was shifted 60 miles west where an acceptably flat area was found. Even so, undulations of 50 metres in the topography made an uncertainty of 25 metres in the depth at which the subsurface float would settle as the length of line between float and anchor had to be cut before laying. The first of four buoys was laid on the afternoon of 31 January. The subsurface float was set at 150 metres and carried three current meters, one at 100 metres from the bottom, one at a depth of 1500 metres, and one at a

depth of 150 metres. Temperature recorders were located in the mooring immediately below the current meters. Hudson proceeded across the Passage towards Anvers Island laying three more sets of current meters and buoys enroute. A rough bottom at the second mooring position caused problems as in the first mooring; at the two southern locations, the bottom was smooth and gently rising to the south and the buoys were laid without difficulty.

Enroute across the Passage, Knudsen bottle casts and plankton hauls were made at four locations. Lowerings of a nephelometer to study turbidity in the water column were made. These showed clear water throughout the deeper part of the water column with no sign of the deep nepheloid layer of the Atlantic. Five one litre Niskin bottles were set in the knudsen bottle casts to collect water samples for trace element analysis.

Having completed laying the current meters on 4 January, a start was made on the collection of benthic fauna in the Bransfield Strait area using sleds and dredges to obtain samples from the surface of the sea floor. A haul was made north of Anvers Island in depths of 1500 metres. Hudson then sailed into the Bransfield Strait and samples were collected in southern bays of the South Shetland Islands where mud was known to occur. South Bay, Discovery Bay, and Marion Cove were visited on 5 February. The ship entered Admiralty Bay, King George V Island, on 6 February and remained in the bay during the day. A landing was made in the vicinity of the old base of the Falkland Islands Dependencies Survey.

On leaving King George V Island, a heavy storm was encountered and Hudson moved north to obtain a lee north of the Island where bottom samples were obtained on 7 January. As one of the party was ill, the ship headed for Puerto Williams arriving early on 9 January. The ill member of the party was put ashore and contact was made with the launch party who needed repairs to the 'Redhead'. These were made and Hudson left Puerto Williams during late afternoon, for the Drake Passage.

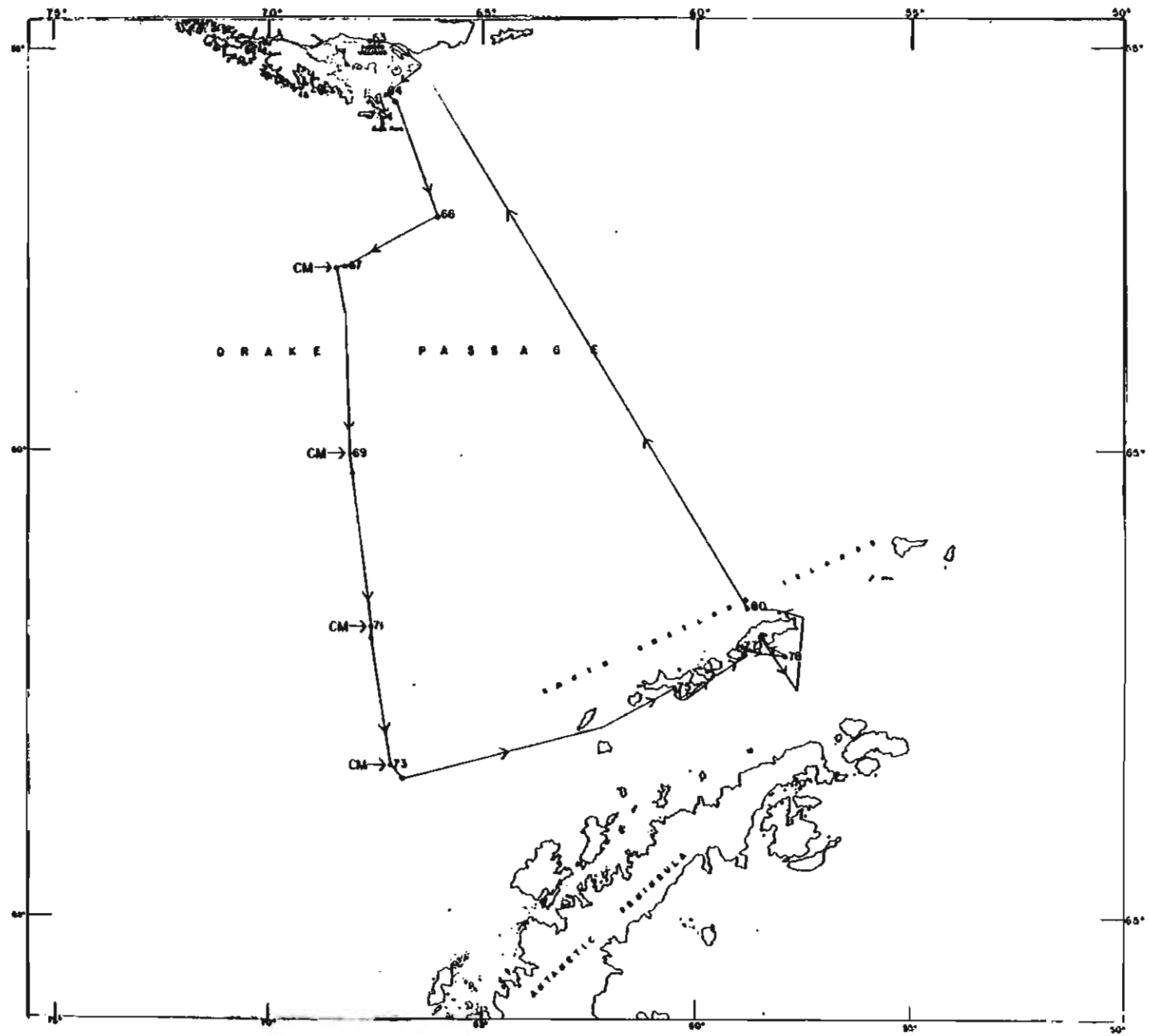
From 10 to 14 January, a series of Knudsen bottle casts and bathysonde lowerings was made as the ship proceeded south along the line that the current meters were laid on. The current meters were recovered as the ship moved south. All acoustic releases operated on command and the buoys and meters were recovered without incident. Calm weather helped the recovery but fog caused difficulty in sighting the buoys after they had surfaced. The radio beacons mounted on the buoys proved very useful as the ship could be guided to them by D/F.

After recovering the current meters. Bransfield Strait was again entered to complete the collection of bottom samples at the eastern end of the Strait. A call was made at Deception Island enroute on 15 February. Hudson cleared the Bransfield Strait on 16 January, collected some sea water samples north of Elephant Island, and made for Puerto Williams. A bottom sample was obtained at the entrance to the Beagle Channel.

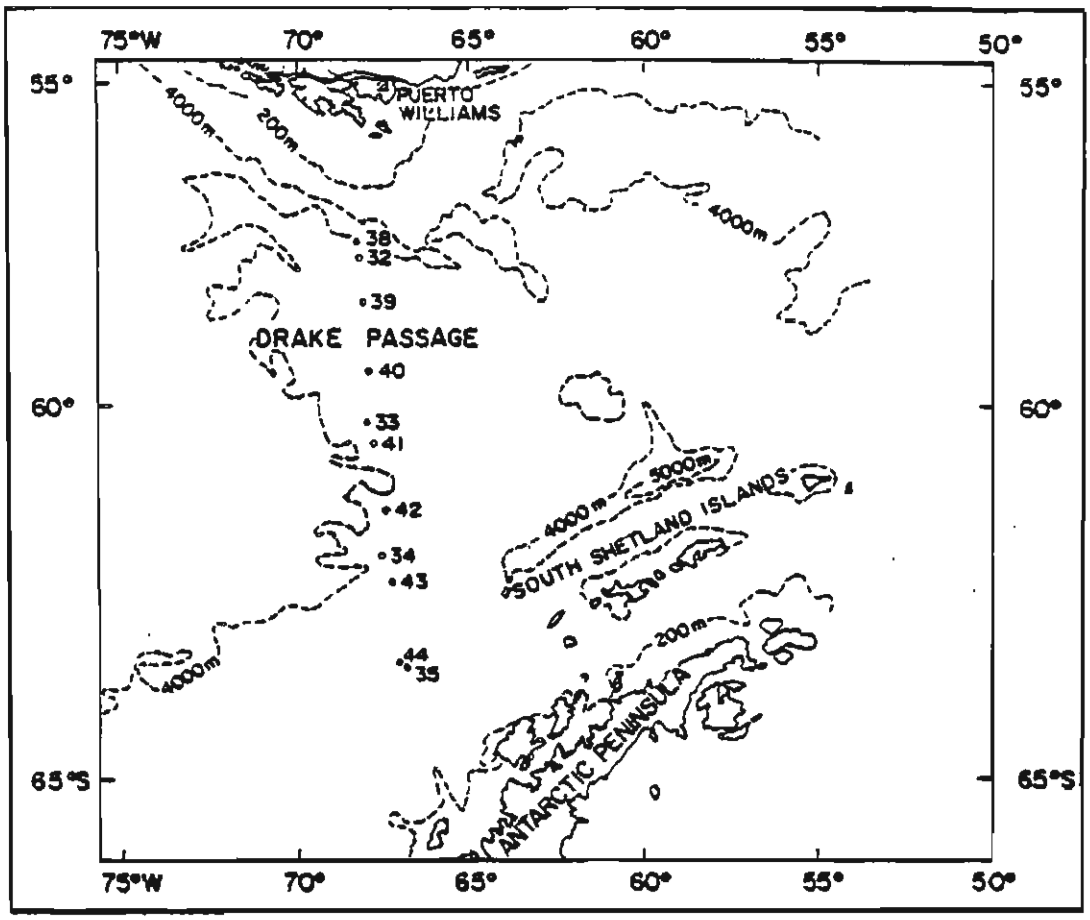
On arrival at Puerto Williams on 20 February, the launch party was taken aboard. Their expedition had proven very successful. Leaving

Puerto Williams in the late afternoon, Hudson made for the area south of Isla Navarina where a final bottom sample was obtained; she then sailed, via the Magellan Strait, for Punta Arenas arriving on 23 February 1970.

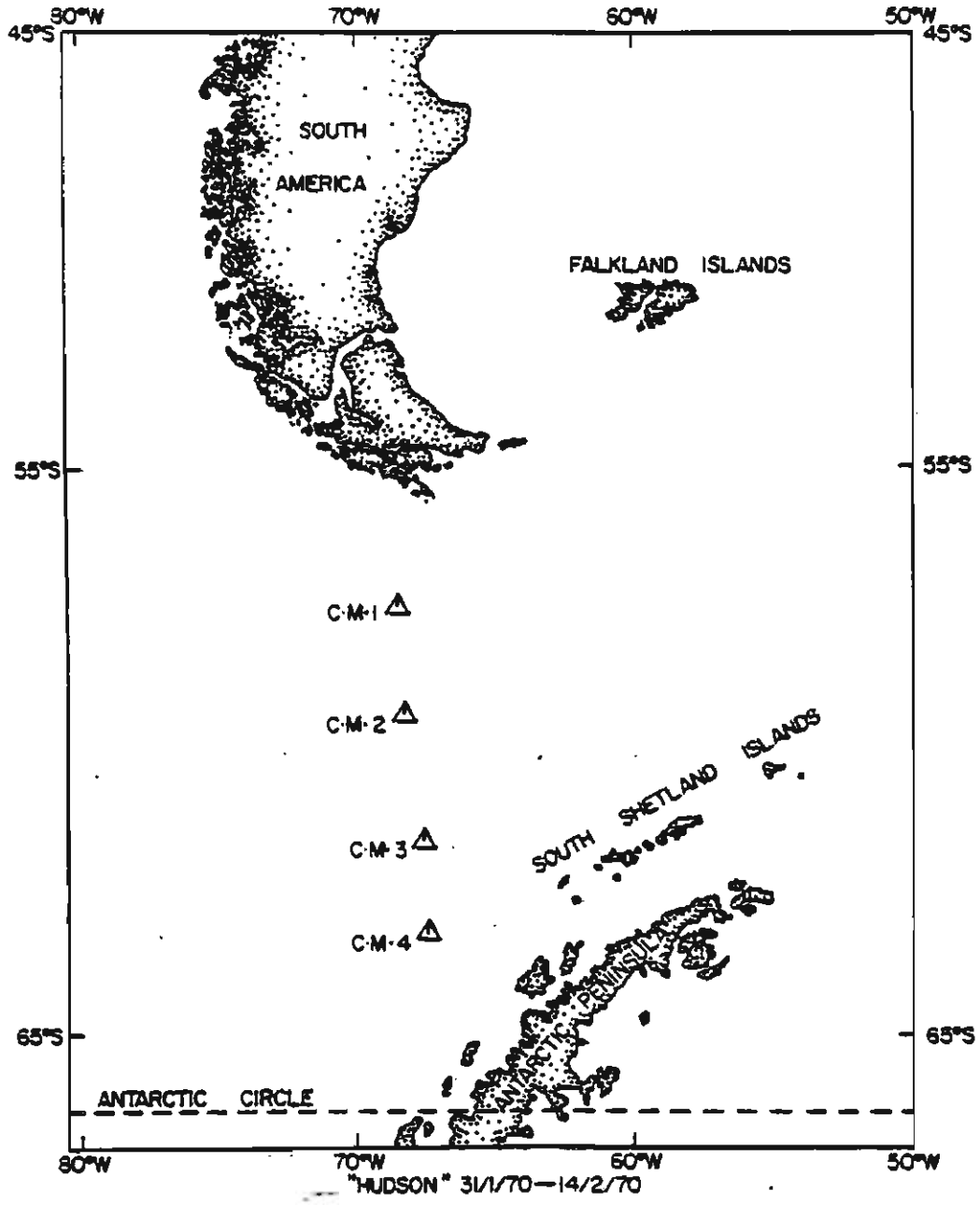
The collection of molluscs and algae for Bousfield and Markham, a series of sea bed samples for Mills and Hessler, water samples and nephelometer lowerings for Brewer and Sacks, plankton samples for Edwards, and current meter measurements and water samples for chemical analysis by AOL staff had all been obtained. In addition, some ardent bird watching by F. Cooke provided new information on the bird life in the area. The scientific program of this phase of Hudson 70 was completed to the satisfaction of all staff.



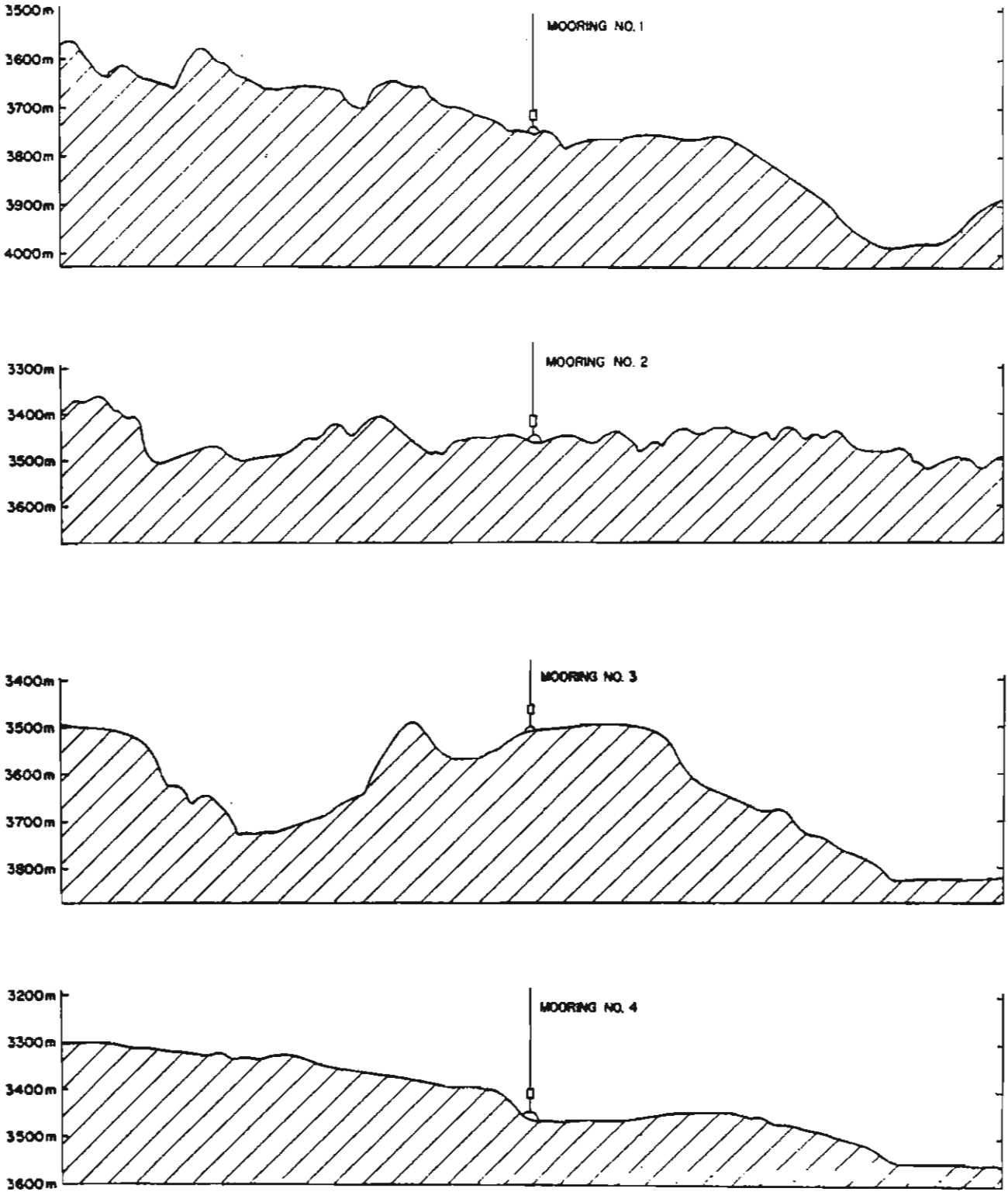
Track plot and cruise station numbers occupied in Drake Passage in the Buenos Aires to Punta Arenas leg (Phase III).



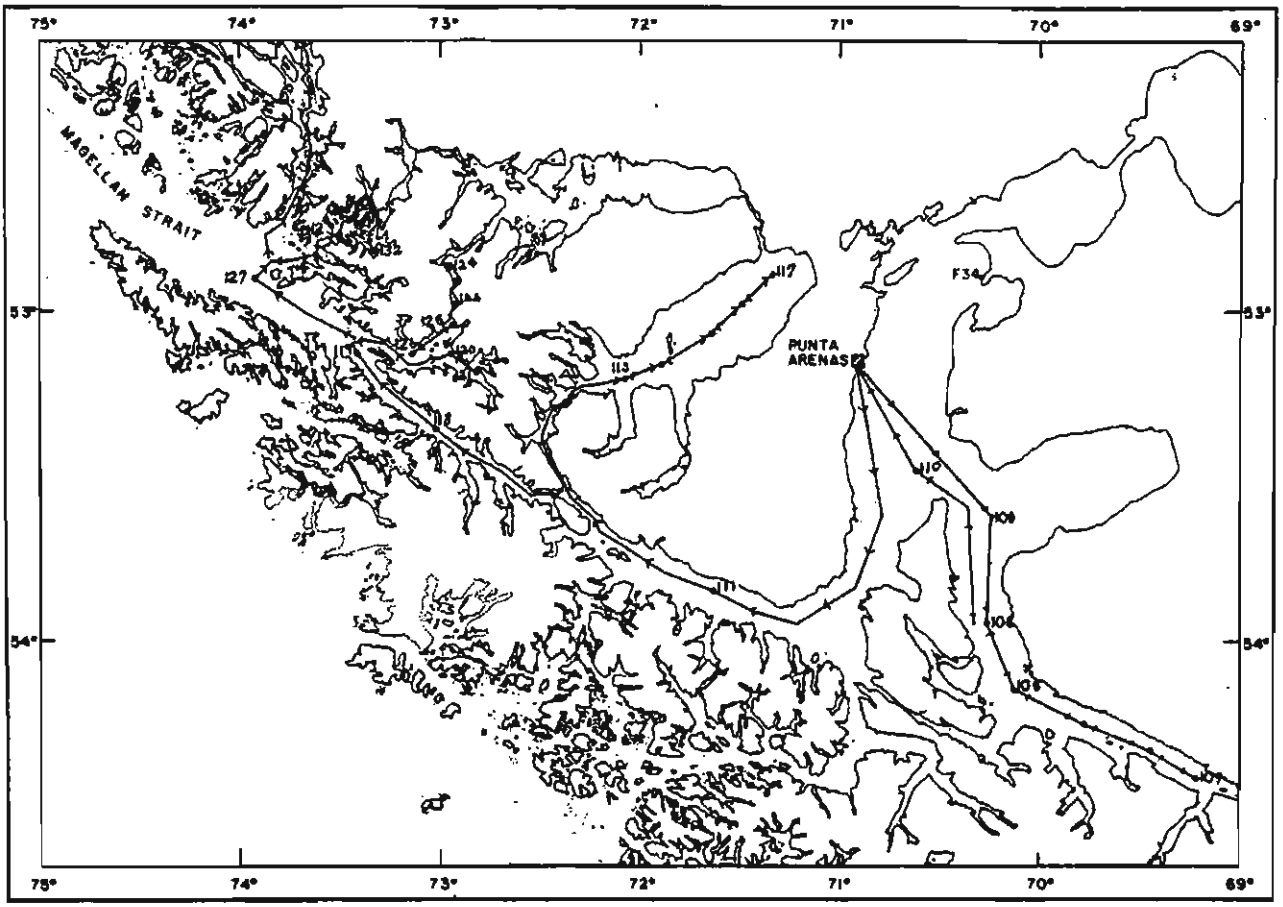
Oceanographic bottle stations during Phase III.



Current meter stations during Phase III.



Current meter depth contours in Drake Passage, Phase III.



Coastal stations occupied during Phase III of HUDSON 70.

APPENDIX A

LAUNCH OPERATIONS - ISLA NAVARINO

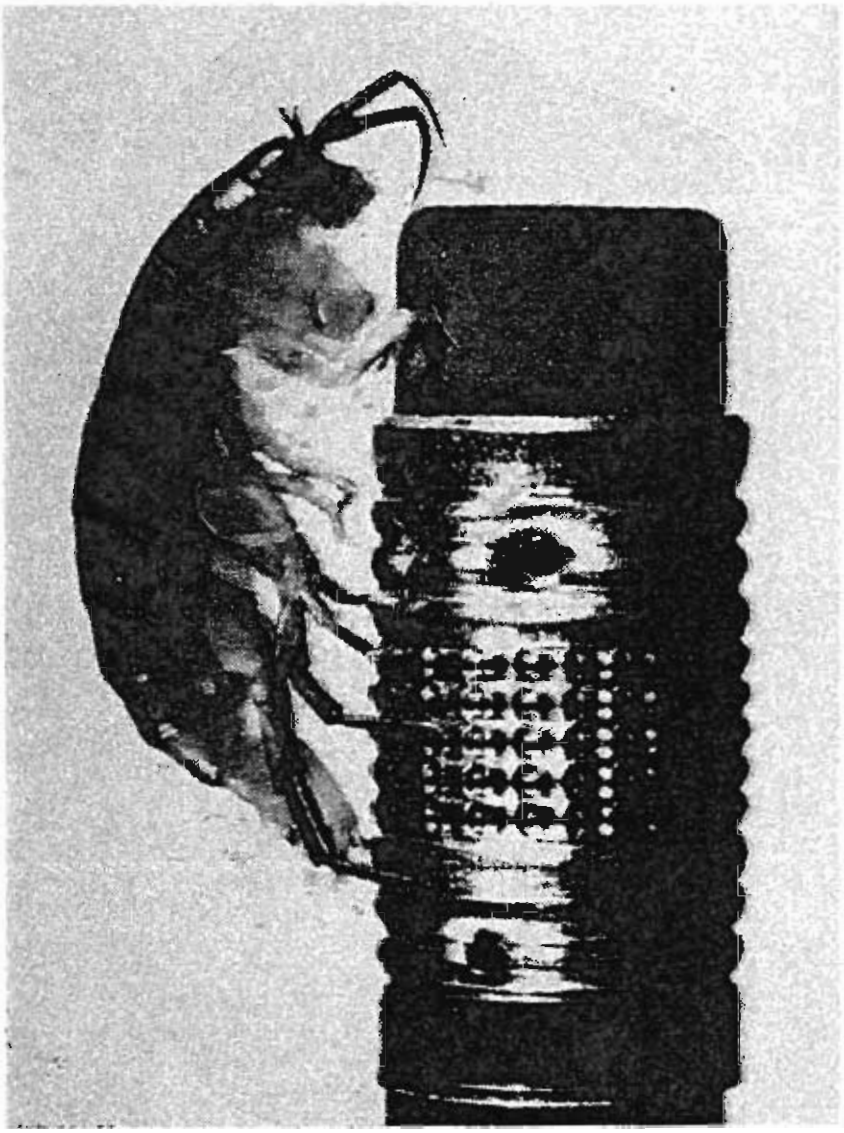
E.L. Bousfield

The three and one half week period 29 January to 19 February was spent in the Beagle Channel and Isla Navarino region. The main field operations were based at the southern Chilean naval base of Puerto Williams located near the mid-point of the north coast of Isla Navarino, on Beagle Channel. Through the courtesy of the Chilean Naval Department, comfortable living quarters and meals were provided for the two scientists and coxswain while staying in Puerto Williams between cruises. Particularly helpful in providing facilities and hospitality were the base Commandant, Raul Consina, and Lieutenant Commander Louis Parga. Lt. Augusto Tapia, on loan to the launch party, proved a most helpful and competent advisor during the work cruises, particularly in maintaining radio contact with remote island outposts where suitable nightly accommodation could be arranged.

Six field cruises were conducted from the Hudson's diesel launch, 'Redhead', which has a top speed of about 10 knots and a cruising range of about 200 miles. Seven hundred nautical miles were logged by the 30-foot launch during visits to 33 collecting stations. About 60 lots of marine and freshwater invertebrate animals, particularly crustaceans and molluscs (20,00+ specimens) were collected by means of light dredges and hand nets. In addition, Dr. James Markham, University of British Columbia, obtained more than 500 samples of intertidal marine algae. Highlights of the six launch cruises were recorded on 35 mm colour transparencies and 16 mm colour motion film. These include sequences on remarkable marine birds and mammals of these yet-unspoiled, sparsely populated, subantarctic islands.

The launch performed reasonably well and enabled the field party to accomplish all major objectives. Its shallow draft and echo sounder made the vessel particularly suitable for work in rocky, kelp-clogged, inshore waters. However, its living quarters were somewhat restrictive for four men, and the stern deck area proved rather small for dredging operations. The electric winch lacked variable speed control and the wire snapped several times in lifting the loaded dredge out of water. The side-mounted main pulley could not be swivelled and thus was not usable during actual bottom dredging. However, despite such operational limitations, the iron-frame dredge yielded excellent biological specimens until it was lost overboard near Seno Grandi. The 16-foot wooden dory could not be used because of the cut-away stern, which shipped water when the outboard motor was turned on. Ship-to-shore transportation was therefore provided by a small inflatable dinghy that required some practice for successful two-man use! A broken valve in the water-cooling system of the launch would have halted cruise operations on 9 February but for the timely unscheduled return of the Hudson to Puerto Williams that very day! The launch continued to lose revolutions in subsequent cruises, dropping to a maximum of about 1600 r.p.m. by final pick-up date. However, the launch could be used for

work even in head winds up to 20 m.p.h. or run down-wind—even above 30 m.p.h. Meteorological conditions were unusually favourable, with tail-winds, light winds, or calm prevailing for more than 80% of the cruise time. The fact that really severe (gale) winds set in only after we departed Puerto Williams reinforces the suspicion that good fortune may be the most important single ingredient in successful completion of a field project!



The Cape Horn Beach Flea on the End of a Pencil.

HUDSON 70 EXPEDITION. PUERTO WILLIAMS LAUNCH PARTY. JANUARY-FEBRUARY, 1970
ISLA NAVARINO AND VICINITY, MAGALLANES (CAPE HORN REGION), CHILE.

Personnel:

Dr. E.L. Bousfield, Chief Zoologist, National Museum of Natural Sciences, Ottawa

Dr. James W. Markham, Phycologist. National Research Council of Canada, Halifax

Mr. Frank Durnford, Coxswain, C.S.S. Hudson

Lt. Augusto Tapia, Armada de Chile, Puerto Williams

Vessel: Diesel launch 'Redhead' from C.S.S. Hudson

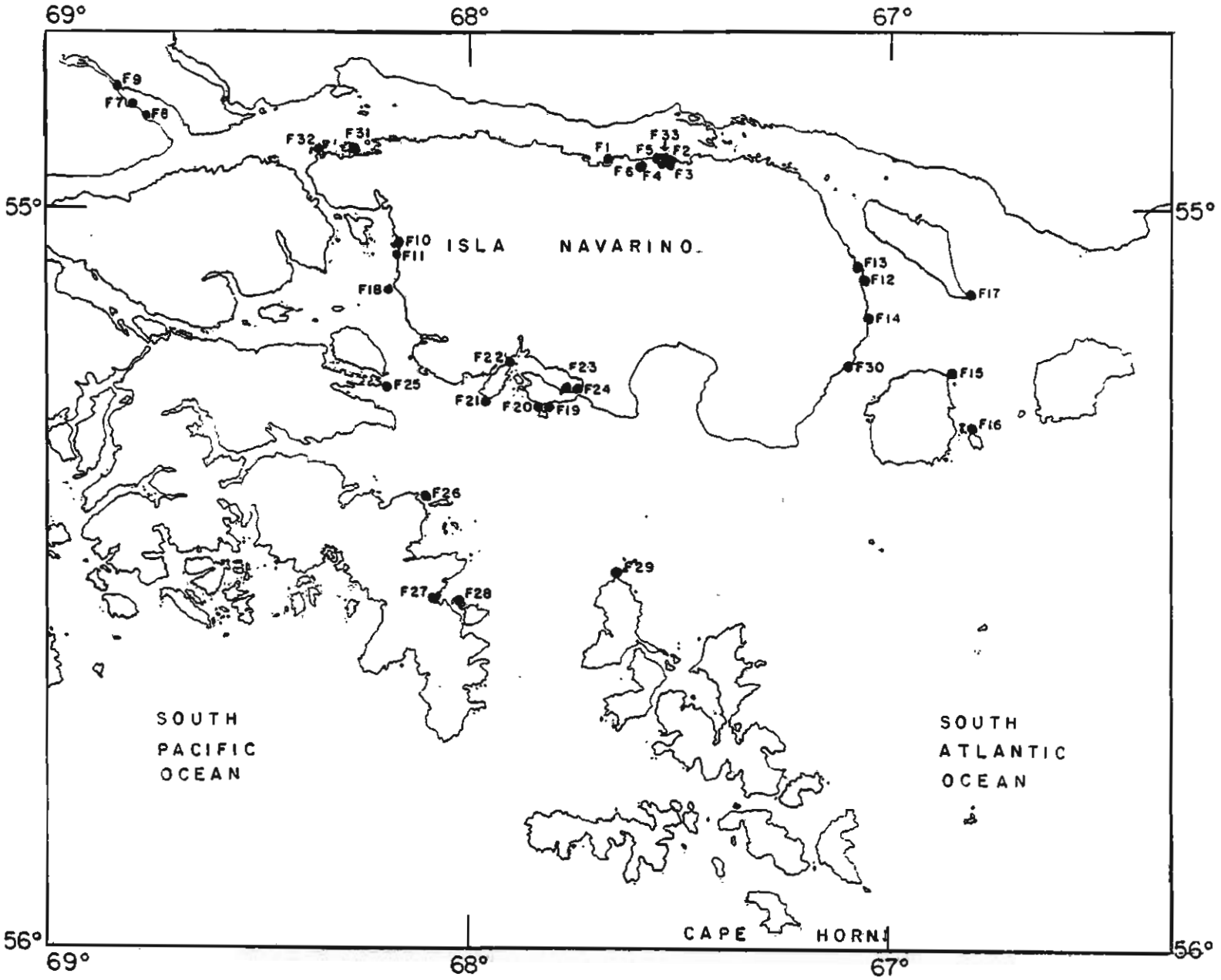
COLLECTION STATIONS

Stn. #	Date	Locality	Position	Temp. °C.	Salinity ppt.	Collected Materials
F1	29 01 70	Punta Robalo, Isla Navarino	54°57'S 67°40'W	12.6	30.0	Intertidal; Inv., algae
F2	30 01 70	Puerto Williams, E. Shore at Stream Mouth	54°56'S 67°37'W	---	brackish	Intertidal; Inv., fishes
F3	30 01 70	Puerto Williams E. FW stream, near mouth	54°56'S 67°37'W	8.0	fresh	Supra-tidal; Inv., fishes
F4	30 01 70	Puerto Williams East, Notofagus forest	54°56'S 67°37'W	---	----	Terr; cryptozoic Inv., lich
F5	31 01 70	Puerto Williams Hbr.	54°56'S 67°37.5W	9.8	----	Dredge, 30-40 ft.;

Stn. #	Date	Locality	Position	Temp. °C.	Salinity ppt	Collected Materials
		Isla Navarino		(surface)	----	Inv.; algae
F6	31 01 70	Seno Lauta, Puerto	54°56.5S 67°38.5W	10.5	----	Intertidal; Inv.
F7a	01 02 70	Caleta Ferrari, Bahia Yendegaia, Tierra del	54°51'S 68°48'W	---	----	HW. Level; terr Inv.
F7b	02 02 70	" " "	" "	4.0 (surf)	nearly fresh	Intertidal; Inv., algae
F8	02 02 70	Bahia Contreras, near mouth of Bahia Yendegaia	54°52'S 68°46'W	---	----	Intertidal; inv., algae
F9	02 02 70	Mouth of Yendegaia R.	54°56'S 68°49'W	3.0 (surf)	fresh	LW and Subtidal Inv.
F10a	02 02 70	Caleta Wulaia, Isla Navarina	55°03'S 68°10'W	5.0	fresh	Mouth of small stream; Inv.
F10b	03 02 70	Caleta Wulaia, Isla at wharf	55°03'S 68°10'W	5.0	fresh	Surface dipnet; squid
F11	03 02 70	Punta Wulaia, Isla Navarino	55°04'S 68°10.5W	9.5	31.4	Intertidal; Inv., algae
F12	05 02 70	Banco de las Tacas, Isla Navarino (East)	55°05.5S 67°04.5W	9.5	----	Intertidal & Dredged, Inv. and algae
F13	05 02 70	Laguna Roja, Banca de las Tacas	55°05'S 67°04.5'W	9.0	fresh	Bottom Inv.
F14	05 02 70	Playa Aaron, Isla Navarino (East)	55°09'S 67°04'W	---	----	Intertidal; Inv.

Stn. #	Date	Locality	Position	Temp. °C.	Salinity ppt	Collected Materials
F15	05 02 70	Playa Lennox, Isla Lennox (N.E.)	55°13'S 66°52'W	---	----	Intertidal; Inv.
F16	06 02 70	Islotes Mamones, off Isla Lennox	55°18'S 66°49.5'W	10.2	32.3	Intertidal; Inv., algae
F17	07 02 70	Cabo Maria, Isla Picton	55°07'S 66°50'W	10.0	32.4	Intertidal; Inv., algae
F18	10 02 70	Off Isla Troude Seno Ponsonby	55°07'S 68°12'W	abt.	----	Surface Dipnet; Inv.
F19	10 02 70	Peninsula Scott, E. beach, I. Navarino	55°16'S 67°49'W	10.5	----	Intertidal; invertebrates
F20	10 02 70	Peninsula Scott, W. Beach, I. Navarino	55°16'S 67°49.5'W	13.0	----	Intertidal; Inv.
F21	10 02 70	Isla Bertrand, South Point, S. Navarino	55°15'S 67°57'W	10.5	----	Intertidal; algae, Inv.
F22	11 02 70	Seno Grandi, off N. end Isla Bertrand	55°11'S 67°55'W	---	----	Dredged, 70-75 ft.; Inv. and algae.
F23	11 02 70	Seno Grandi, W. of Head Island	55°14.5'S 67°45'W	10.5 (surf)	----	Dredged, 40 ft.; Inv., algae
F24	11 02 70	Seno Grandi E. of Head Island	55°14.5'S 67°44.5'W	---	----	Dredged, 25 ft.; Inv., algae
F25	14 02 70	Isla Green, off Peninsula Pasteur, Isla Hoste	55°14.5'S 68°12'W	10.0	31.9	Intertidal; Inv., algae
F26	14 02 70	Small Island NW of Packsaddle I., Peninsula Hardy, I. Hoste	55°23.5'S 68°07'W	---	----	Intertidal; kelp, shells (clams)

Stn. #	Date	Locality	Position	Temp. °C.	Salinity ppt	Collected Materials
F27	14 02 70	Bahia Orange, Isla Hoste; at stream mouth	55°31.5'S 68°05'W	10.5	brackish	Intertidal; Inv., algae
F28	15 02 70	Isla Bullock, E. side Peninsula Hardy	55°32'S 68°01.5'W	10.0	32.1	Intertidal; Inv., algae
F29	15 02 70	Isla Grevy, N. end beach	55°30'S 67°40'W	---	----	Intertidal; Inv., Obs.
F30	16 02 70	"Tern I." near Punta Yawl, Isla Navarino	55°12.5'S 67°06'W	10.5	----	Intertidal; Inv., algae
F31	19 02 70	Puerto Navarino, Isla Navarino	54°56'S 68°17'W	---	----	Shallow rake; crabs
F32	19 02 70	Isla Tongo, Islas Whaits, Canal Beagle	54°56'S 68°23.5'W	8.5	30.6	Intertidal; Inv., algae
F33	20 02 70	Puerto Williams Harbour	54°56'S 67°38'W	---	----	Trap, 30 m. crabs
F34	22 02 70	Punta Percy, Tierra del Fuego	52°54'S 70°17'W	11 appr.	----	Intertidal; Inv., algae



Intertidal marine life stations near Isla Navarino occupied during Phase III of HUDSON 70.

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

PUNTA ARENAS TO VALPARAISO

G.L. PICKARD

CRUISE NO. 69-050

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

PUNTA ARENAS TO VALPARAISO

Local Cruise Designation:	69-050
Code Reference Number:	10-69-050
Vessel:	C.S.S. Hudson
Dates:	1 March 1970 to 7 April 1970
Area:	Chilean Fjords and passages from Punta Arenas to Puerto Montt and ocean sections along 42°S, 81°W and 33°S to Valparaiso.
Responsible Agency:	University of British Columbia Vancouver, British Columbia
Personnel:	Ship's Master, Captain D.W. Butler
Scientific Staff:	
G.L. Pickard Chief Scientist	Institute of Oceanography Vancouver, British Columbia
B. McK. Bary Asst. Chief Scientist	Institute of Oceanography Vancouver, British Columbia
M.P. Storm	Institute of Oceanography Vancouver, British Columbia
D. English	Institute of Oceanography Vancouver, British Columbia
W.V. Burt	Oregon State University Corvallis, Oregon
G.S. Pond	Oregon State University Corvallis, Oregon
R.G. Brown	Canadian Wildlife Service
H.M. Inostroza	Universidad de Concepcion, Chile
L.A. Chuecas	Universidad de Concepcion, Chile
R. Ahumada	Universidad de Concepcion, Chile
R.E. Montaner	Instituto Hidrografico, Chile

Scientific Staff (continued):

B.D. Uccelletti	Instituto Hidrografico, Chile
F.R. Rey	Universidad de Chile, Valparaiso
N. Silva	Universidad Catiolica, Valparaiso
I.W. Duedall	Marine Ecology Laboratory Bedford Institute
P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
J.M.R. Pilote	Canadian Hydrographic Service

Summary:	Fjords		Pacific		Total
Knudsen Casts (T,S,O_2)	175	+	5	=	180
Nutrients	65	+	-	=	65
Bissett/Berman 9060 STD Casts	147	+	26	=	173
Bathythermograph Casts	151	+	3	=	154
Bottom Samples	41	+	-	=	41
Vertical Plankton Hauls	58	+	-	=	58
Oblique & Vertical Plankton Tows	65	+	-	=	65
Clarke-Bumpus Tows	58	+	-	=	58
Isaacs Kidd Trawl Hauls	27	+	1	=	28
Acoustic Scattering Observations	58	+	-	=	58
Soundings - GEBCO Miles	2210	+	980	=	3190
Bird Identification and Counts (all day stations)					

Purpose of Cruise:

The prime purpose was to obtain data on the water characteristics and plankton in the fjords of the southern coast of Chile, an area not previously investigated oceanographically, to add to the fund of knowledge on fjord estuaries and to permit comparison with other fjord regions, particularly on the west coast of North America. Oceanographic observations in the open oceans between 42°S and 33°S were also planned.

The general intention was to make observations at as many stations as possible in as many fjords as time permitted, together with stations in the south-north passages and at openings to the Pacific through the Island Archipelagoes.

Narrative:

The start was scheduled for 1 March from Punta Arenas, Chile, but was delayed until 2030 hours on 5 March awaiting the arrival of the second pilot, two being required for extended passages in Chilean waters. (The unusual length of this cruise had been something of a deterrent to pilots volunteering for the duty.) The four-day wait was used, in part, to complete the study of the first inlet, Seno del Almirantazgo. This also served as a shakedown for the scientific staff enabling them to get to know each other and to develop familiarity with equipment and procedures.

As it was planned to work continuously, as far as possible, three watches were organized to carry out the bottle casts for temperature, salinity, oxygen, and nutrient observations, BT casts, and STD casts for temperature and salinity profiles to 500 m. Two watches of two were organized for the plankton studies at about one half of the total stations to be occupied. Counts of sea birds were made at stations to obtain quantitative estimates of species numbers.

On leaving Punta Arenas on 5 March, CSS Hudson proceeded Pacific-ward along the Strait of Magellan, taking stations in the passages enroute to Otway Water where stations in a 50-60 knot wind tested the new group's abilities. The proposed boat expedition to the connecting Skyring Water was cancelled because of the probability that the weather would continue too severe for the boat operations. Continuing north, the ship occupied stations in Golfo Xaultegua on 7 March while the sounding launch operated in Canal Gajardo. While the launch was being hoisted, one of the falls broke and the boat was severely damaged. Inspection revealed that the lifting wire was corroded at a babbitt joint; similar corrosion was found on the falls for the second launch, making it imprudent to attempt to lower either of them again.

The consequent unavailability of both launches was a severe blow to our plans, as we had been relying on using them to precede Hudson in the many unsounded fjords which it was planned to study. As it would be imprudent for Hudson to sail in those areas without the sounding launches ahead, it was decided that the ten unsounded fjords would have to be deleted from the ship's programme, but that, when daylight and weather permitted, efforts would be made to get some oceanographic information in some of them using a lifeboat and hand winch. On 8 March, stations were occupied in some reaches of Bahia Beaufort, the innermost stations being omitted because of lack of soundings. Several glaciers had been seen earlier but it was here that evidene of their runoff of meltwater became apparent by the reduced salinity and increased silt content of the surface waters. The ship continued north by Smyth Channel to Canal las Montagnes for stations terminating at nightfall before the inlet head. Here the glaciers were more numerous, some coming down close to sea level. The appearance of the glacier fronts and the areas of light rock

surrounding many of the glacier caps on mountains suggest that most of them are at present retreating. On 10 March, the ship passed through the narrow Canal Kirke and across Golfo Almirante Montt to Puerto Natales where a day was spent while two stations were made from the lifeboat in Seno Ultima Experanza in the uncomfortable conditions of a 20-25 knot wind, short steep waves and cold water coming aboard. Numerous Chileans visited Hudson informally and a reception was held for local dignitaries. On 12 March, the ship completed stations in this area and continued north for Estero Asia and Bahia San Andres on 13 March. Glaciers were very numerous in this area and there were many bergy bits in Estero Asia.

On 14 March, while the ship worked in Trinidad and Concepcion Passages, the lifeboat was sent into Europa Inlet and stations were taken until ice prevented further travel toward the inlet head. On the following day in Eyre Channel, there was considerable ice during the night stations and near the head there was so much accumulation of ice against the ship when on station that the bathythermograph was retrieved with difficulty and further work there abandoned. The flow of ice past the ship clearly indicated the estuarine outflow. The water was extremely silty with 'rock flour' from extensive glaciers visible further up the inlet.

After passing English Narrows in sunshine and flat calm, contrasting with the usual weather in the region, and passing two wrecks perched sedately on rocks, two stations were made from the lifeboat in Iceberg Inlet which lived up to its name.

On 16 March, we entered the extensive Canal Baker area and were struck by the considerable siltiness of the water even at the mouth some 60 miles from the glacial inflow from very large glaciers near the head. Another conspicuous feature of this region was the almost complete absence of bird life, in contrast to regions further south, and small plankton catches.

On 18 March, after several days of good weather, we emerged into Golfo de Penas to 40-50 knot winds and 6-8 foot swells and were told that this represented good weather in this area. On the next day, stations were taken from the lifeboat in Seno Jesuitas and Seno Julian, the latter showing the first evidence of low oxygen conditions yet encountered. From here, the ship sailed outside, taking open sea stations, to Bahia Anna Pink on 20 March.

After some work in the wide but very shallow Golfo Elefantes, the ship worked in Estuario Francisco while the lifeboat was in Estuario Puelma. The lack of silt in these northern area waters was in noticeable contrast to the southern regions, the glaciers from here north being generally smaller and terminating higher at 2000-3000 feet above sea level. The general character of the scenery changed from the spectacular abrupt barren rock hills with scrubby trees of the southern regions to dense woods from sea level to mountain tops in this northern region.

On 22 March, the ship worked north up Golfo Elefantes, stations were taken in Estero Quitralco from the lifeboat, the last of the boat

expeditions that, while they provided limited data from regions judged inaccessible to the ship, were tiring and, at times, miserable in rain and wind because of lack of shelter.

On 23 March, the ship worked up Seno Aysen to Checabuco where the ship anchored for 12 hours to catch up on chemical work and for a short break ashore in brilliant sunshine, the first for a week there and the warmest day for the ship for a couple of months. Two hours after Checabuco stations were being taken in a 40 knot wind and heavy rain; by morning on 24 March, it was calm and dry again in Canal Jacaf where the clearest water so far was noted.

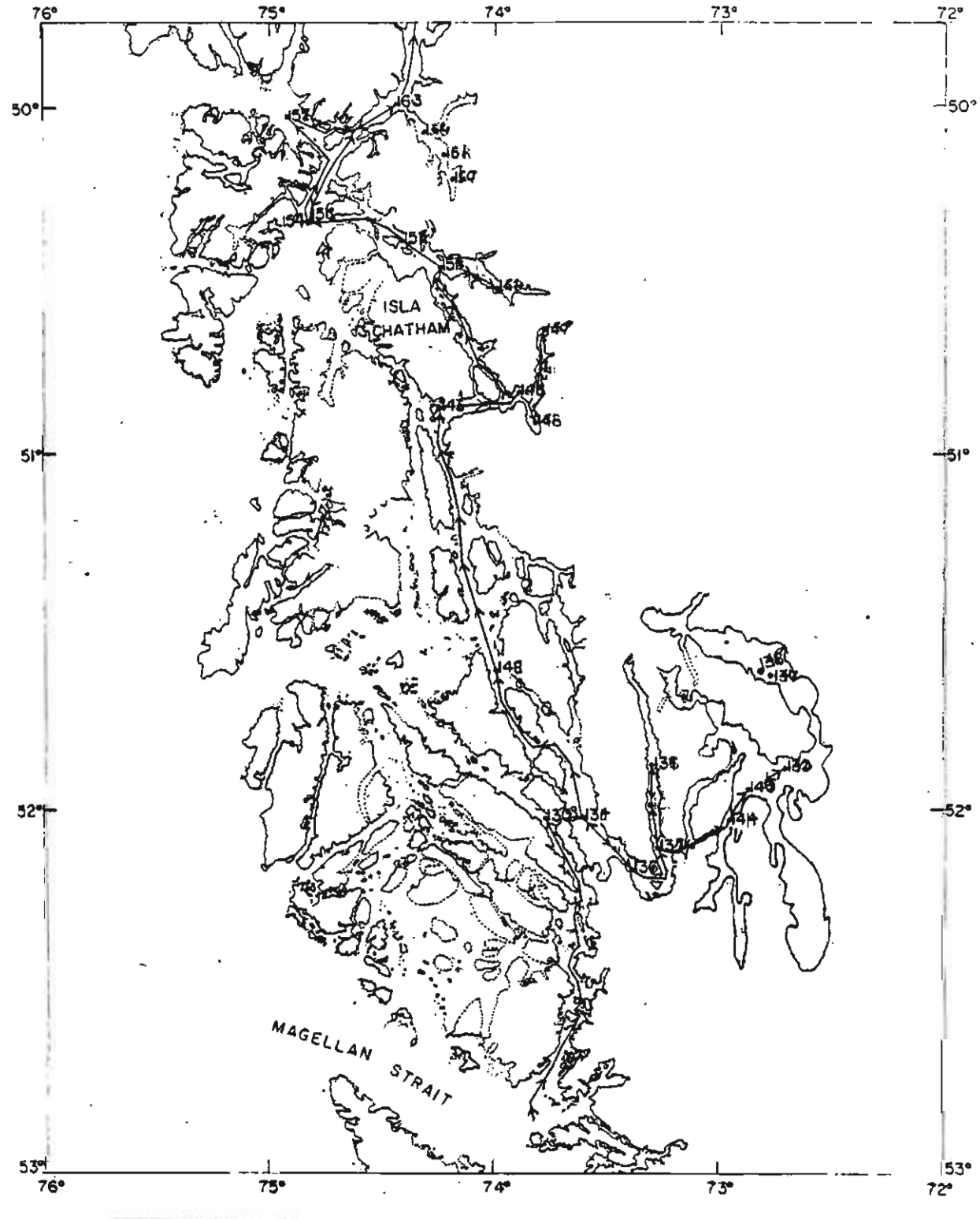
On 25 March, work in Canal Puyuguapi was completed and the ship worked up the Canal Moraleda and to the Pacific west of Isla Guafo for an open sea station.

On 26 March, we returned to Golfo Corcovado and Golfo de Ancud for the last group of inlets. Fjordo Renihue, Estero Comau, Canal Hornopiern, and Estero Reloncavi. Considerable numbers of medusae, one to two feet in diameter and 10-15 feet long, interfered with bottle casts, clogged plankton nets, and rendered it impractical to use the Isaacs Kidd mid-water trawl in this region. In the valleys ashore, areas of cultivated land were noted and fishermen came out to sell mussels on several occasions. The only silty water here was in the upper 20 miles or so of Reloncavi, appearing to be brownish alluvial silt rather than white glacial rock flour. The last station of the fjord series was taken on 29 March and the ship proceeded to Puerto Montt where two of the scientific staff left.

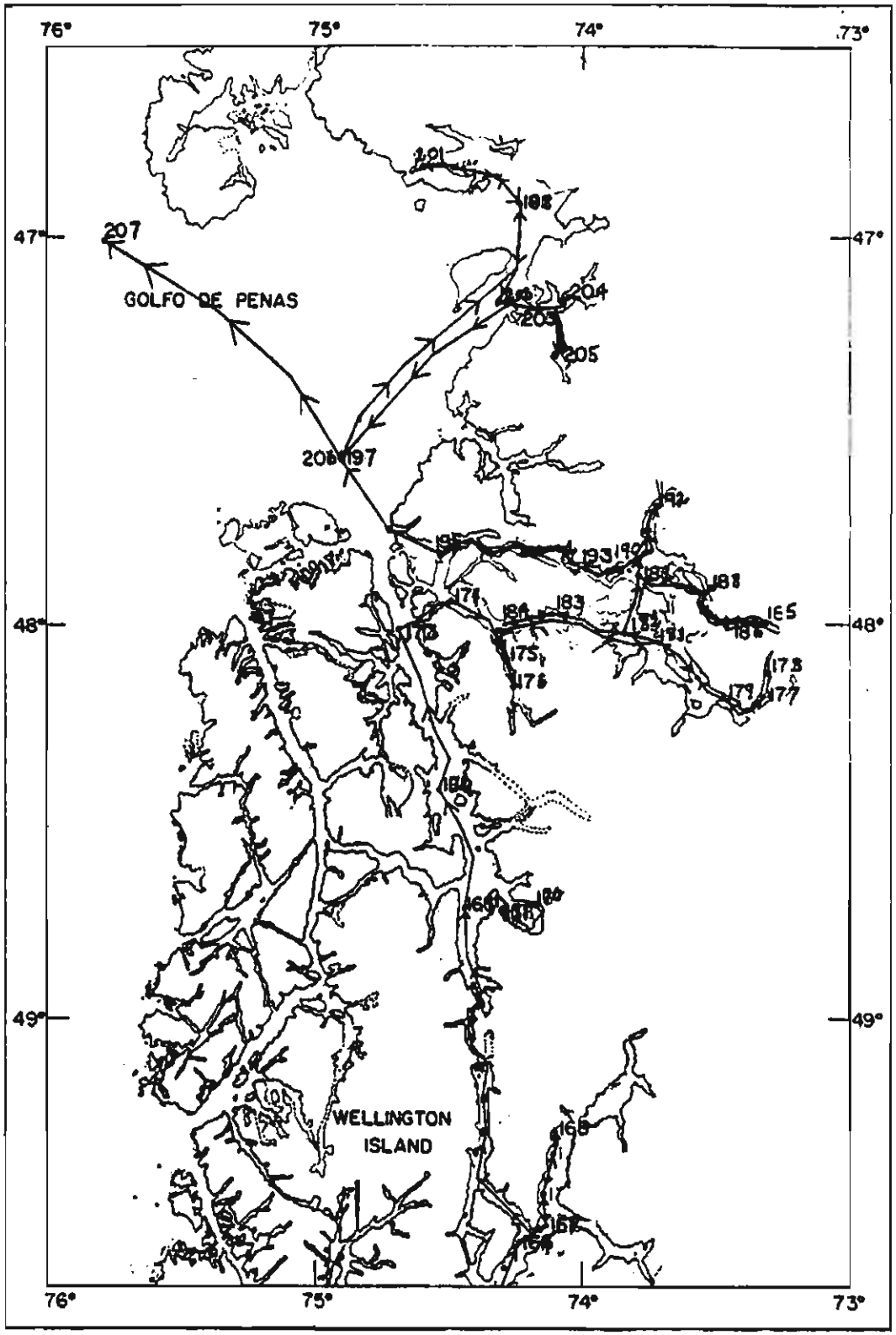
On 31 March, C.S.S. Hudson left Puerto Montt for Canal Chacao to drop one of the pilots at Ancud and then proceeded west along 41°40'S to make a section across the Humboldt Current with STD casts every 45 miles and bottle casts at 77°and 81°W. The change from the green-blue water of the Humboldt Current to the cobalt blue of Pacific water was noticeable. Turning north along 81°W, into a steep swell and strong wind, STD casts were made every 60 miles and bottle casts at 38°and 33°30'S. The ship turned east for a second section across the Humboldt Current with STD casts every 50 miles and a bottle cast at 77°W.

On 4 April, we anchored for a few hours in Cumberland Bay in Isla Robinson Crusoe of the Juan Fernandex Islands, an open anchorage but attractive in the sun with its backdrop of steep wooded mountains. Visits were paid to the community of a few hundred persons subsisting chiefly on a lobster fishery. Large numbers of very tame colorful fish were seen when skin diving in the clear water of the Bay. In the afternoon, the ship continued east and the last station of this phase of the cruise was taken 15 miles off Valparaiso at 0200 hours on 6 April.

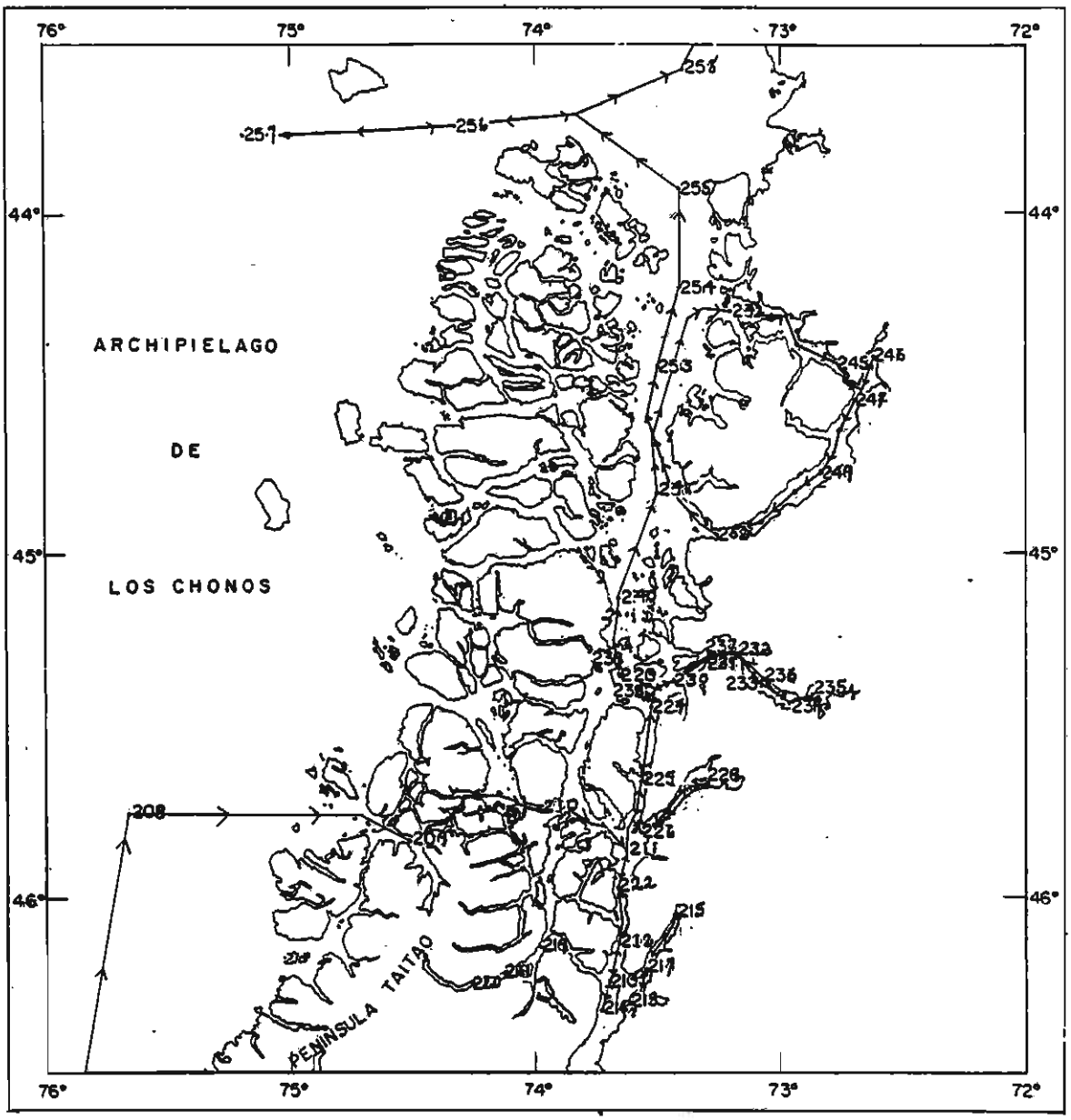
On 7 April, the ship entered Valparaiso to complete Phase V of the Hudson 70 cruise.



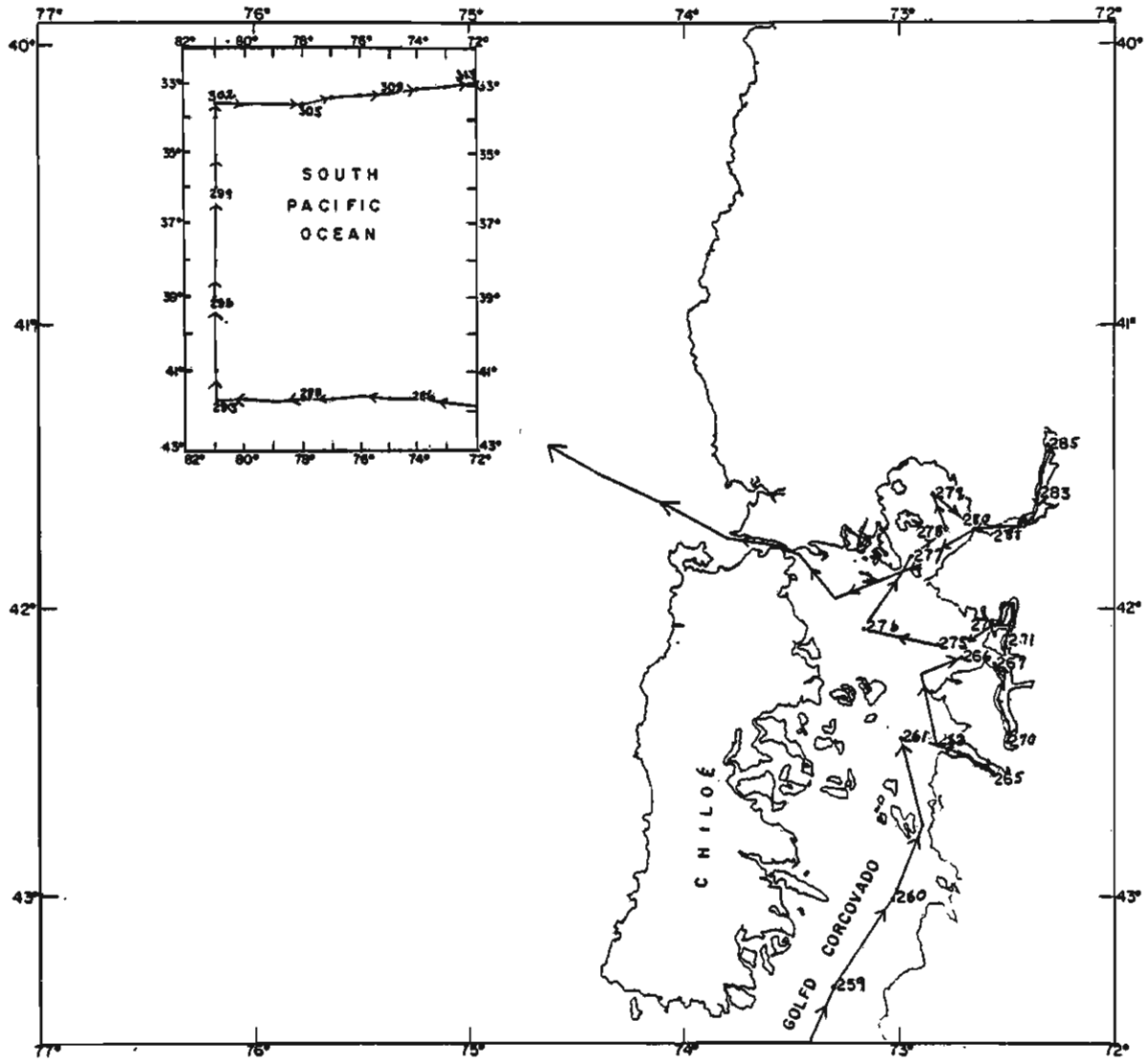
Cruise station numbers during Phase IV of HUDSON 70, Punta Arenas to Valparaiso.



Cruise station numbers during PHASE IV of HUDSON 70, Punta Arenas to Valparaiso.



Cruise station numbers during Phase IV of HUDSON 70, Punta Arenas to Valparaiso.



Cruise station numbers during Phase IV of HUDSON 70, Punta Arenas to Valparaiso.

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

VALPARAISO, CHILE TO PAPEETE, TAHITI

R.C. MELANSON

CRUISE NO. 69-050

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

VALPARAISO, CHILE TO PAPEETE, TAHITI

Local Cruise Designation:	69-050
CODE Reference Number:	10-69-050
Vessel:	C.S.S. Hudson
Dates:	15 April to 12 May 1970
Area:	Valparaiso to Papeete, Tahiti
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain D.W. Butler
Scientific Staff:	
R.C. Melanson Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
R.T. Haworth Assistant Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
A.R. Coote	Atlantic Oceanographic Laboratory Bedford Institute
I.W. Duedall	Atlantic Oceanographic Laboratory Bedford Institute
M. Hughes	Atlantic Oceanographic Laboratory Bedford Institute
P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
W.B. Greifeneder	Atlantic Oceanographic Laboratory Bedford Institute
P.L. Corkum	Atlantic Oceanographic Laboratory Bedford Institute
W.H. Sutcliffe	Marine Ecology Laboratory Bedford Institute
R.W. Sheldon	Marine Ecology Laboratory Bedford Institute

Scientific Staff (continued):

M.A. Paranjape	Marine Ecology Laboratory Bedford Institute
P.J. Wangersky	Institute of Oceanography Dalhousie University
J. Sharpe	Institute of Oceanography Dalhousie University
T. Yoshinari	Institute of Oceanography Dalhousie University
C.S. Wong	Pacific Oceanographic Group
R. Belleguay	Pacific Oceanographic Group
W. von Arx	Woods Hole Oceanographic Institution
J.P. Dean	Woods Hole Oceanographic Institution
C.D. Densmore	Woods Hole Oceanographic Institution
O. Bluy	Defence Research Establishment Atlantic Dartmouth, Nova Scotia
J.G. Gill	Defence Research Establishment Atlantic Dartmouth, Nova Scotia
R. Smith	Queen's University Kingston, Ontario

Summary:

Surface Plankton Tows	25
Vertical Plankton Tows	14
Oblique Plankton Tows	18
Knudsen and Niskin Casts (Surface to Bottom)	10
Special Deep Niskin Casts	3
Expendable Bathythermographs	240
Cones	1
Acoustic Scattering Layer Observations	19

Summary (continued):

Soundings - G.E.B.C.O.	11,800
Gravity and Magnetics (Kilometres)	11,800

Narrative:

The C.S.S. Hudson commenced Phase V of the Hudson 70 cruise at 1140, 15 April, when departure was made from Valparaiso, Chile. The departure was to have been made a day earlier, however a one day delay was caused by difficulties encountered with the offshore fueling arrangements.

The cruise to the first atation of the Phase (consecutive #277), Latitude 65°S, Longitude 150°W, was laid out along the great circle route. However, because of not being able to obtain meteorological reports on weather or ice conditions, it was decided to alter to the rhumb line course at 0000 April 22, therefore, passing further north than the previous course would have placed us, and thus avoiding any unpredicted concentrations of ice. The rhumb line course was held until 0000 April 25, when the course was again altered to due West to avoid ice. Because of heavy weather, the ship's speed was slowed considerably so it was decided, because time was so critical at this stage, to proceed to Latitude 63°S, Longitude 150°W, and observe the first station.

Gravity, magnetics, and bathymetry were commended just outside the 3 mile territorial limit of South America, and carried through in continuous profiles to just off Tahiti. Expendable bathythermographs were commenced at Latitude 40°S and taken every two hours along the route. Continuous analog recordings were made of the temperature and salinity.

The first station was observed at Latitude 63°S, Longitude 150°W; the second station (#278) was observed at Latitude 60°S, Longitude 150°W, and stations observed thereafter at 5° intervals along meridian 150°W to Latitude 20°S. An intermediate station was observed at Latitude 16°37'S, Longitude 150°W, prior to our call at Tahiti. The main stations consisted of a shallow and deep cast, plankton tows, and acoustic reverberations. However, at stations 277, 278, and 284, special deep Niskin casts were made for Dr. Clarke of McMaster University, who is interested in the helium isotopes of sea water. At station 284, 286, and 287, cores of 27½', 37' and 22' respectively were obtained.

Most of the equipment functioned very well; however, there were a few malfunctions.

a) Bathysonde - Both units were tried, however no success was had until station 287. Readings collected on the Tahiti to Vancouver Phase will have to be corrected following calibration of the instrument.

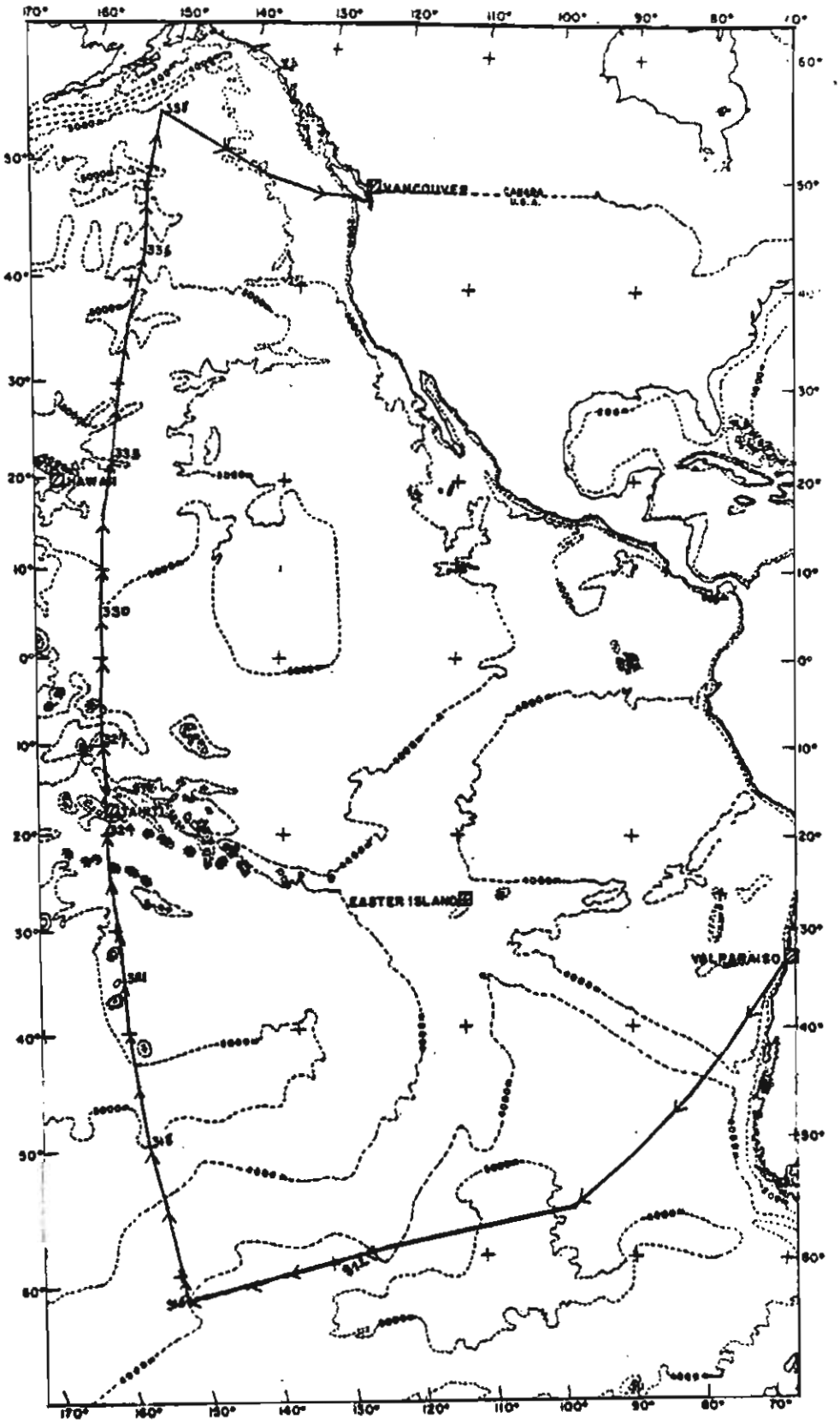
b) Benthos Multi-Plankton Net - This system was tried on three or four different occasions but with little success. It would appear that the power supply is inadequate to make the system operate to depths greater than 500 metres.

c) Acoustic Cone - Unfortunately, the Defence Research Establishment Atlantic cone was lost on station 278, when the ship surged and snapped both lines.

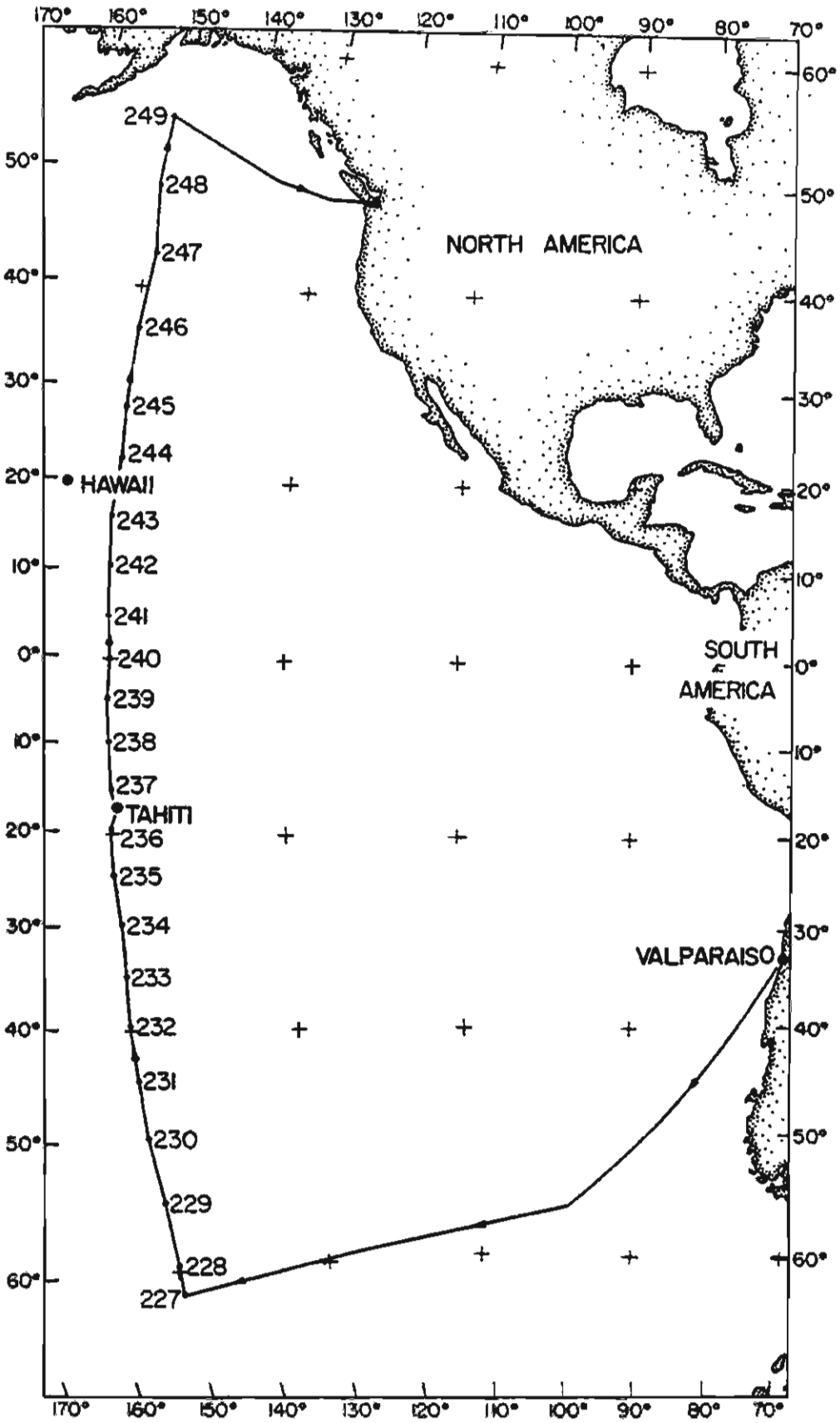
d) Salt Water Loop - Problems were encountered with the small plastic centrifugal pump, in that the pump was too fragile for the job. As a last resort, a bronze pump was substituted and operated trouble free through the remainder of the cruise. Dr. Sutcliffe discontinued using the loop following pump substitution when an experiment, loop vs. bucket sample, indicated the bronze impeller was having an adverse effect on his organic particulate count.

This Phase was very straightforward, with a great amount of data being collected. A program was drawn up for each station giving activities and times, and adhered to as closely as possible. The chemists and biologists were busy most of the time either collecting samples, processing, or preserving for return to the laboratories. The geophysical program progressed exceptionally well both in the collection of data and in the implementation of the stringent navigation requirements. GEBCO data were processed daily and a major contribution to the charts will result.

The ship arrived at Papeete, Tahiti at 0930 on 12 May, one day ahead of schedule. This was due to the fairly good weather and fair wind enjoyed on the run north. The responsibilities of senior scientists were turned over to Dr. W.M. Cameron on 14 May for the next Phase, Tahiti to Vancouver.



Cruise track and station numbers during Phases V and VI of HUDSON 70, Valparaiso to Tahiti and Tahiti to Vancouver.



Oceanographic bottle stations occupied during Phase V and VI of HUDSON 70.

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

PAPEETE, TAHITI, TO VANCOUVER, B.C.

W.M. CAMERON

CRUISE NO. 69-050

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

PAPEETE, TAHITI, TO VANCOUVER, B.C.

Local Cruise Designation:	69-050
CODC Reference Number:	10-69-050
Vessel:	C.S.S. HUDSON
Dates:	16 May to 12 June 1970
Area:	Papeete, Tahiti, to Vancouver, B.C.
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain D.W. Butler
Scientific Staff:	
W.M. Cameron Chief Scientist	Marine Sciences Branch, Ottawa
P.J. Wangersky Assistant Chief Scientist	Dalhousie University Halifax, Nova Scotia
A.R. Coote	Atlantic Oceanographic Laboratory Bedford Institute
I.W. Duedall	Atlantic Oceanographic Laboratory Bedford Institute
J. Woodside	Atlantic Oceanographic Laboratory Bedford Institute
Lt. Comdr. P. Probert	Royal Navy
P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
W.B. Greifeneder	Atlantic Oceanographic Laboratory Bedford Institute
P.L. Corkum	Atlantic Oceanographic Laboratory Bedford Institute
A. Prakash	Marine Ecology Laboratory Bedford Institute
M.A. Paranjape	Marine Ecology Laboratory Bedford Institute

Scientific Staff (continued):

C.T. Schafer	Atlantic Oceanographic Laboratory Bedford Institute
J. Sharpe	Dalhousie University
T. Yoshinari	Dalhousie University
C.S. Wong	Pacific Oceanographic Group
R. Belleguay	Pacific Oceanographic Group
W. von Arx	Wood's Hole Oceanographic Institution
J.P. Dean	Wood's Hole Oceanographic Institution
C.D. Densmore	Wood's Hole Oceanographic Institution
O. Bluy	Defence Research Establishment, Atlantic
J.G. Gill	Defence Research Establishment, Atlantic
K.F. Freeman	Marine Ecology Laboratory Bedford Institute
R. Smith	Queen's University
D. Winters	Atlantic Oceanographic Laboratory Bedford Institute
H. Henderson	Atlantic Oceanographic Laboratory Bedford Institute

Narrative:

The C.S.S. Hudson commenced Phase VI of the HUDSON 70 cruise at 0925 hours when the vessel cleared Papeete. The first station of Phase VI was commenced at 2237 hours May 16th.

The routine carried out by the scientific staff was effectively a continuation of the program commenced at station #277, in Phase V. Stations intended to be five degrees latitude apart were occupied with bottle casts, plankton tows, and acoustic reverberation measurements. Gravity, magnetics, and bathymetry were recorded while under way.

Plankton tows were collected with a modified Benthos Multiple Plankton Sampler fitted with 200-micron mesh nets. This type of net is suitable for studying the vertical distribution of planktonic foraminifera because samples can be obtained from specific depth ranges. The device was initially submerged to a depth of 25 m and towed at a speed of about 1.5 knots for 15 minutes. Two additional tows were made during each cast at 350 and 750 m depths respectively. The samples

collected represent planktonic specimens resident in the 0-200, 200-500, and 500-1000 m water layers respectively (Table 1). It is assumed, however, that the concentration of planktonic foraminifera is roughly constant in the water layers and that there is no appreciable diurnal change in the faunal population. The volume of water filtered through the nets was monitored using a Tsurumi-Seiki-Kosakusho flow meter attached to one side of the sampler frame. It was integrated with a Benthos Model 1023 acoustic telemeter. The samples were washed from each net and preserved in 10% formalin solution buffered with hexamethylene tetramine.

The high seawater temperatures near the Equator reduced the ship's engines efficiencies, and the heavy set during stations retarded the speed of advance. It was decided to open the spacing between the stations north of Latitude 10 degrees. This insured appropriate chemistry and biological sampling without reducing the high quality of the geophysics line.

The last bottle station on the north-south line of 150°W., was at 55°N. The geophysics sampling continued north to 57°30'N. Underway geophysical observations continued during the run southwest to Victoria, discontinuing at 48°35'N., 125°W.

The Hudson put in at Victoria to arrange for service to a main generator and proceeded to Vancouver, berthing at the CPR dock at 0810 hours 12th. June.

Table 1 Sampling Depths and General Faunal Details

STA.	DATE	LOCATION LAT. N-S	LOCATION LONG. W	D. of T.(m)	V. of W.F.(m^3)	S.D.(%)	A.A.(1000m^3)	S. to S.R.	P. of K.
1	2	3	4	5	6	7	8	9	10
				0-190	194.2	50.00	8205	547.00	03.01
327	May 8	10°S	150°W	190-460	67.5	30.00	0623	69.22	04.76
				460-760	295.6	30.00	0231	25.6	08.82
				0-200	261.8	53.33	7975	498.44	06.90
328	May 20	5°S	150°W	200-435	878.3	23.33	0036	05.14	06.66
				765-0	730.5	20.00	0057	09.50	04.76
329	May 21	0°	150°	0-800	2483.1	46.66	5487	417.64	16.61
330	May 23	5°N	150°	0-800	1638.5	66.66	3187	159.35	12.77
				0-190	409.6	53.33	1727	107.94	04.52
331	May 24	10°N	150°W	190-460	595.4	53.33	1547	96.81	11.95
				460-750	532.0	46.66	0599	42.78	07.54
				0-170	565.8	63.33	2010	105.79	02.29
332	May 26	15°N	150°W	170-450	426.5	43.33	0156	012.00	09.09
				450-780	553.2	40.00	0481	40.08	06.01
				0-180	384.2	63.33	2319	122.05	04.70
333	May 28	22°N	150°W	180-440	426.5	40.00	0343	28.58	04.11
				440-1050	447.6	26.66	0060	07.50	14.29
				0-160	506.7	36.66	0273	24.81	05.80
334	May 30	29°N	150°W	160-475	536.3	40.00	0263	21.91	05.63
				475-1030	532.1	36.66	0067	06.91	05.88
335	May 31	36°N	150°	0-320	777.0	40.00	0112	09.33	09.30
				0-900	1554.0	30.00	0244	01.39	08.60
				0-185	443.4	30.00	1342	149.11	12.75
336	June 2	43°N	150°W	185-850	2010.1	36.66	0746	67.81	14.44
				185-0	304.0	30.00	0810	90.00	12.19
337	June 4	49°N	150°W	0-1050	3606.4	20.00	1538	256.33	22.19
				0-190	629.2	20.00	0906	151.00	60.48
338	June 5	55°N	157°W	100-700	2326.8	26.66	0241	030.13	36.80
				100-0	312.5	20.00	1439	239.83	43.55

Sta. - Station
D. of T.(m) -Depth of Tows(m)
V. of W.F.(m^3) -Volume of Water Filtered(m^3)
S.D.(%) -Species Diversity(%)

A.A. (1000m^3) - Absolute Abundance (100 m^3)
S. to S.R. - Specimen to Species Ratio
P. of K. - Percentage of Kummerform

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

VICTORIA, B.C., TO VICTORIA, B.C.

C.D. MAUNSELL

CRUISE NO. 69-050 (HUDSON)

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

VICTORIA, B.C., TO VICTORIA, B.C.

Local Cruise Designation:	69-050
CODC Reference Number:	10-69-050
Vessel:	C.S.S. Hudson
Dates:	12 July to 5 August 1970
Area:	Victoria, B.C., to Victoria, B.C.
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain F.W. Mauger

Scientific Staff:

C.D. Maunsell Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
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C.E. Keen	Atlantic Oceanographic Laboratory Bedford Institute
K.G. Shih	Atlantic Oceanographic Laboratory Bedford Institute
D.L. Barrett	Atlantic Oceanographic Laboratory Bedford Institute
P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
T.J. Corbett	Atlantic Oceanographic Laboratory Bedford Institute
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V. Coady	Atlantic Oceanographic Laboratory Bedford Institute

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J.P. Steele	Atlantic Oceanographic Laboratory Bedford Institute
H. Toom	Atlantic Oceanographic Laboratory Bedford Institute
B. Taylor	Atlantic Oceanographic Laboratory Bedford Institute
D. Tiffin	Marine Sciences Branch, Vancouver
L.P. Landry	Marine Sciences Branch, Victoria
C.R.B. Lister	University of Washington, U.S.A.
E. Davis	University of Washington, U.S.A.
A. MacLean	Dalhousie University Halifax, Nova Scotia
M. Purdy	Imperial College, London

Summary:

Gravity, Magnetics, and Bathymetry (G.E.B.C.O.) Data	6933 km
Seismic Reflection Profiling	1675 km
Reversed Seismic Refraction Lines	621 km
Heat Flow Stations	13
Dredging Stations	17

Purpose of Cruise:

The British Columbia coastal leg of HUDSON 70 was designed to apply the geophysical techniques developed at the Bedford Institute and elsewhere to the region west of the southern portion of the Queen Charlotte Islands and of Queen Charlotte Sound. The northern termination of the Juan de Fuca Ridge and the area surrounding the Explorer Trench as well as the existence of the Queen Charlotte Islands Fault were investigated. The program included: bathymetric, gravity,

and magnetic measurements; continuous seismic reflection profiling along selected tracks; two-ship seismic refraction profiling; heat flow measurements at 13 stations; and bottom sampling using dredges.

Narrative and Experiments Conducted:

At 0930 on 12 July 1970, C.S.S. Hudson left Victoria, B.C. to begin the seventh leg of the HUDSON 70 expedition. A day later, C.N.A.V. Endeavour also left Victoria and joined Hudson on 15 July at 52°N, 134°W to conduct the planned seismic refraction experiment. In the sections below, the scientific experiments conducted during the cruise are described. The dredging operation conducted by C.N.A.V. Endeavour is described in Appendix A.

(a) Geophysical Survey---

The ship's tracks along which gravity, magnetic and bathymetric measurements were made are shown in the accompanying chart. Gravity values were measured using two gravimeters: a Graf-Askania Model GSS2-17 mounted on a gyro-stabilized platform and a D4e vibrating string gravimeter also mounted on the same gyro-stabilized platform. The latter was designed and built at the Wood's Hole Oceanographic Institution.

A cross coupling computer was mounted on the platform to measure the cross coupling error for the Askania gravimeter. The total magnetic field was measured using a proton precision magnetometer built by Barringer Research Corporation. The sensing element (fish) of the magnetometer was towed 700 feet astern to minimize the magnetic effect of the ship.

In order to get the precise gravity value in the survey area, it was essential to know the drift of the gravimeter for the duration of the survey. Both gravimeters were calibrated before and after the cruise at Victoria, B.C. (see Appendix B).

Most instruments worked extremely well throughout the cruise except for the Askania Gravimeter Chart recorder which was found to be non-linear in half of its span. Thus a major part of the gravity was recorded on the linear portion of the chart recorded. This gave unwanted gaps in the gravity map of the area. However, the second gravimeter worked well and we hope to get continuous gravity values from this gravimeter's recordings. The PDP-8 computer worked well for majority of the time, but needed constant maintenance.

(b) Navigation---

Primary navigation during the cruise was provided by satellite navigation and dead reckoning. An ITT 4007AB satellite navigation receiver with an on-line PDP-8 computer was used on C.S.S. Hudson to obtain satellite fixes and the conventional bridge dead reckoning was supplemented by data from a Sperry E/M log and gyro repeater

automatically recorded by the BIODAL data logging system. In addition, an attempt was made to use the Motorola RPS equipment recently purchased to obtain accurate range and bearing on C.N.A.V. Endeavour during the seismic refraction experiment. Endeavour carried a Magnavox 702CA satellite receiver and punch lent by Earth Physics Branch (EMR) to enable subsequent accurate positioning of tracks. No computer was installed on Endeavour but pertinent information was passed by radio to enable fixes to be computed on board Hudson. On three occasions when a rendezvous between the two ships was arranged, data from the Magnavox receiver was passed to Hudson for fix computations.

The RPS system required for accurate relative positioning of the two ships during the seismic refraction experiment proved disappointing. The range obtained was less than expected even after resighting the transponder on Endeavour to provide an unobstructed line of sight. However, the experiment was worthwhile in that it indicated that modifications were required for future use and demonstrated the limits of the equipment for deep sea relative navigation.

As the satellite fixes obtained by Endeavour were not available for the control of her lines, requiring computation by the PDP-8 aboard Hudson, she had to rely on poor Loran-A and dead reckoning for track and control. In this respect, the bathymetry chart of the area compiled by Jacqueline Mammerick of Scripps Institution proved extremely useful, particularly in locating station sites for dredging, etc. With aid of the satellite fixes computed on Hudson, the majority of tracks on which Endeavour had collected useful information and all station sites were computed and plotted by the end of the survey period.

(c) Seismic Reflection Profiling---

Seismic profiling was performed with Hudson steaming at about 6 knots. A Bolt Model 1500 air gun with pulse shaper was used as the sound source. It was fixed every 16 seconds at a peak pressure of about 1700 psi. The signals were recorded on magnetic tape and also on an Alpine recorder and an EPC dry paper recorder. The hydrophone array was 400 feet long, in four 100 foot sections. A slacking winch was used to reduce the noise at the eel.

During the cruise, 916 n.m. of reflection data were collected. Most of the track lines cross the continental margin. These were obtained to supplement the gravity and magnetic measurements, to determine the behaviour of the oceanic crust in the vicinity of the continental margin and to determine the depth and nature of the sediments on the shelf and slope. About two days were spent collecting reflection data around the refraction shooting circle to obtain the depth to oceanic basement so that corrections could be applied to the refraction arrival times.

(1) - On continental Shelf near Vancouver Island (48°16'N, 123°52'W to 48°45'N, 126°02'W)

(2) - As for (1) (49°13.5'N, 127°08'W to 49°18'N, 127°13'W)

(3) - As for (1) (50°47'N, 129°18'W to 50°41'N, 130°37'W)

(4) - Two traverses of continental margin off Queen Charlotte Islands (52°10'N, 133°58'W to 52°06'W, 131°24'W to 52°00'N, 131°12'W to 52°01'N, 132°31'W)

(C) - Along refraction circle

(5) - Across Moresby Channel (51°11', 133°35' to 50°21', 131°38')

(6) - Across continental margin north of Vancouver Island (50°21'N, 131°25'W to 51°19'N, 129°29'W)

(7) - Across continental margin to Paul Revere Ridge (50°26'N, 128°19'W to 49°42'N, 129°29'W)

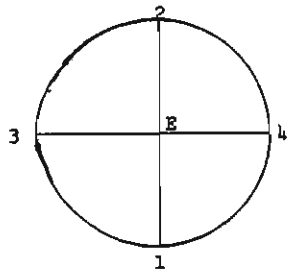
(8) - Across continental margin near Vancouver Island (48°34'N 126°53'W to 49°01'N 126°12'W)

NOTE: The positions are the ends of the line.

(d) The Seismic Refraction Experiment---

The seismic refraction experiment was designed to measure the anistropy of the mantle P wave velocity. C.S.S. Hudson was used as the receiving station and C.N.A.V. Endeavour as the shooting ship. Two reversed lines, each about 50 miles long were completed, one in the east-west and one in the north-south direction. A 'circle' of shots was then performed, with Hudson in the centre of the circle, approximately at the intersection of the two reversed lines. A radar transponder buoy was moored near Hudson's position from which her drift was determined. The sketch below shows approximately the short lines and the positions taken up by Hudson.

1. 51°12.21'N 134°00.51'W
2. 52°02.9'N 133°56.7'W
3. 51 °32.4'N 134°22.7'W
4. 51°30.32'N 133°07.39'W
E. 51°29.0'N 133°51.0'W



The above positions are satellite fixes. Hudson drifted several miles at each of these stations during the shooting.

It was essential that the azimuth from shot to receiver be determined for each shot around the circle. The two ship Radar Positioning System did not provide sufficient range to be useful. Therefore, Endeavour's position was determined by satellite fixes. These should provide values

of azimuth accurate to + or -2° which is sufficiently precise for this experiment.

The experiment started on July 15 and finished on July 21. A total of 201 explosive shots were fired ranging in size from 50 to 600 lb. The shooting was very successful and there were few misfires. During the reversed lines, shots were fired at intervals of 5 to 20 minutes with charge sizes up to 300 lb. Six-hundred pound shots fired every 30 minutes were used during most of the circle. The charges necessary to obtain good first arrivals were larger than we had anticipated and therefore the shot spacing was larger than we had expected. The 2,000 cu. in. air gun was tried at the beginning of the experiment. We had hoped to use it instead of small explosive charges at close ranges. However, it would not seal and after two hours, and further attempts were not made to use it.

After the refraction experiment was completed, Hudson tried to retrace Endeavour's circle while reflection profiling to measure variations in the depth to basement, which be used to correct the travel times. A part of the time, the two tracks were not sufficiently close for accurate corrections to be applied but otherwise the attempt was successful.

On July 26, a sound velocimeter station was completed within the circle. The velocity of sound in sea water was measured down to 2900 m. The surface velocity is 1.495 km/sec. The position of this station is 51°43.8'N, 135°00.4'W.

Preliminary results suggest that the mantle exhibits a high P wave velocity in the E-W direction - about 8.5 km/sec and a lower velocity - about 8.1 km/sec in the N-S direction. The thickness of layer 3 is about 4.5 km and its velocity, 6.7 km/sec. In general, first arrivals from layer 2 were not observed.

(e) Heat-Flow and Bottom Photography---

Thirteen heat flow stations were attempted and 12 produced useful results. A list of the values and an index map of the Explorer Trough stations are included here. Two measurements were obtained in the northern survey area, one on a ridge extending from the continental rise and one in the refraction anisotropy circle. The rise measurement is normal and the value in the circle, at 2.68, would be considered somewhat high by most workers. However, the oceanic crust in the region is relatively young and is covered by a substantial accumulation of sediments presumably built up over a long period. Measurements in Cascadia basin, another heavily sedimented area, suggest that rapid sedimentation can seal off the oceanic basement for hydrothermal circulation, and thus result in observed conductive heat flow consistent with reasonable boundary layer cooling models. The circle measurement therefore does not indicate that the crust in the area is necessarily abnormal. The presence or relative absence of hydrothermal circulation in the upper crustal layers should not have a significant effect on the mantle interface.

The most important part of the heat flow work was a profile across the northern end of the Explorer Trough and some stations in subsidiary troughs to the north. Application of the plate tectonics concept to the west coast region north of Cape Mendocino suggests that the East Pacific Rise, after disappearing into the Gulf of California, is offset by the San Andreas fault and reappears as the Gorda and Juan de Fuca ridges. The Queen Charlotte fault has the correct orientation

STATION	LATITUDE* N	LONGITUDE* W	DEPTH** fm	HEAT FLOW ucal/cm^2-sec	ESTIMATED ACCURACY
HF-1	50 58.0'	131 54.7'	1403	1.1	.06
HF-2	51 34.7'	134 20.7'	1751	2.7	.05
HF-3	49 58.6'	129 32.6'	1111	3.8	.04
HF-5	50 1.6'	129 43.0'	1253	8.4	.3
HF-6	50 4.4'	129 46.4'	1742	1.3	.08
HF-7	50 7.7'	129 49.8'	1480	1.9	.2
HF-8	50 7.5'	130 1.8'	1116	6.6	.2
HF-9	50 13.2'	130 9.2'	1287	4.7	.07
HF-10	50 15.3'	130 17.8'	1300	1.5	.3
HF-11	50 21.0'	130 6.6'	1413	16.8	.4
HF-12	50 45.9'	130 36.6'	1310	4.8	.1
HF-13	50 39.5'	130 33.0'	1308	4.0	.06
Camera-3	50 16.6'	130 17.7'	1304		

*Location by satellite navigation.
**Depth in uncorrected fathoms.

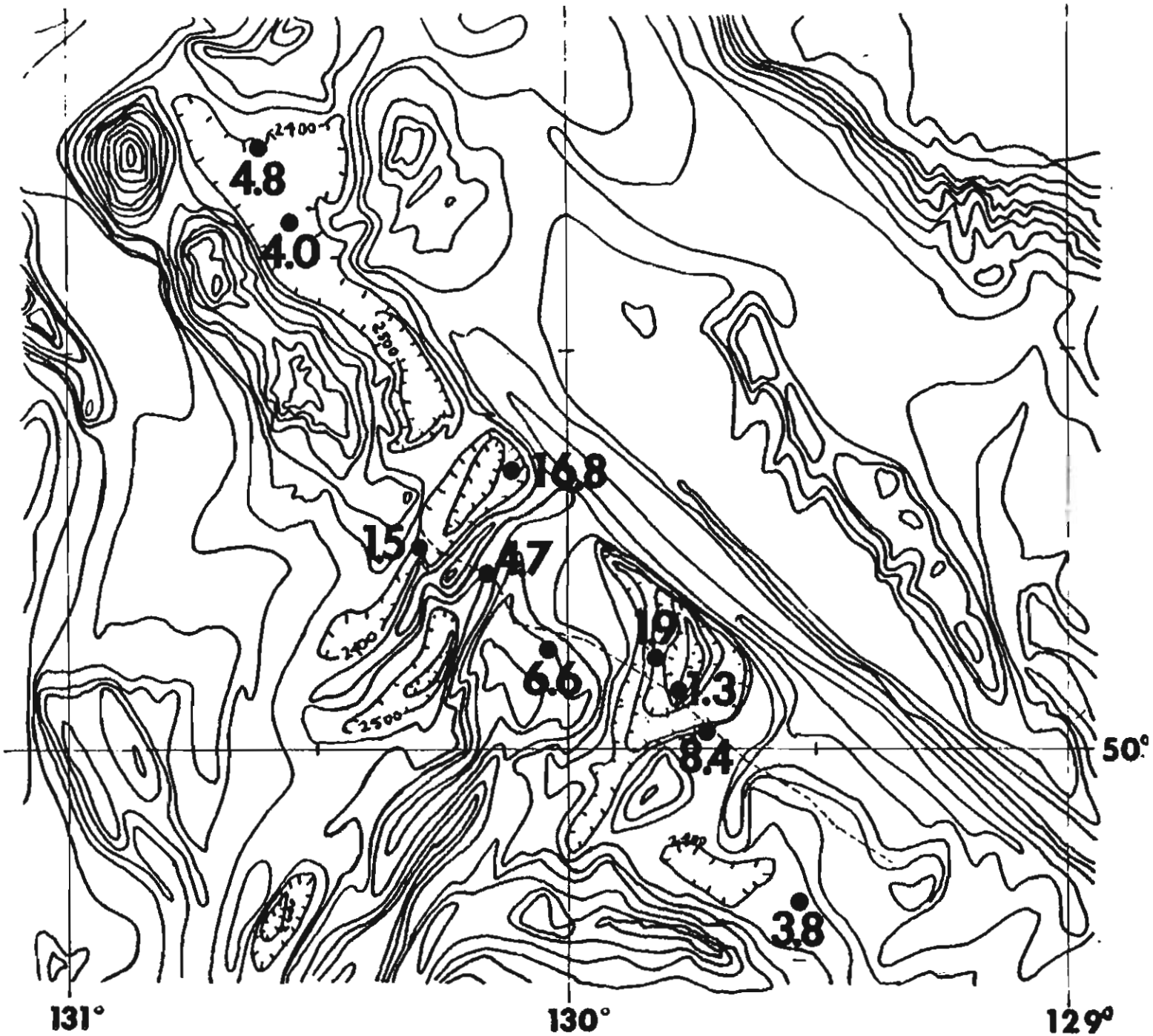
to terminate the rise system and lead the relative plate motion through complications in Alaska into the Aleutian trench. Therefore, the Explorer Trough should be the last expression of the East Pacific Rise spreading center with the possible exception of a small trough northwest of it which has the correct orientation to lead the spreading into the Queen Charlotte Fault. The heat flow stations were sited in an attempt to find out whether thermal anomalies confirm the spreading or not.

Seven stations were occupied across the two trough-like features which terminate at the Paul Revere ridge, a piece of ocean floor

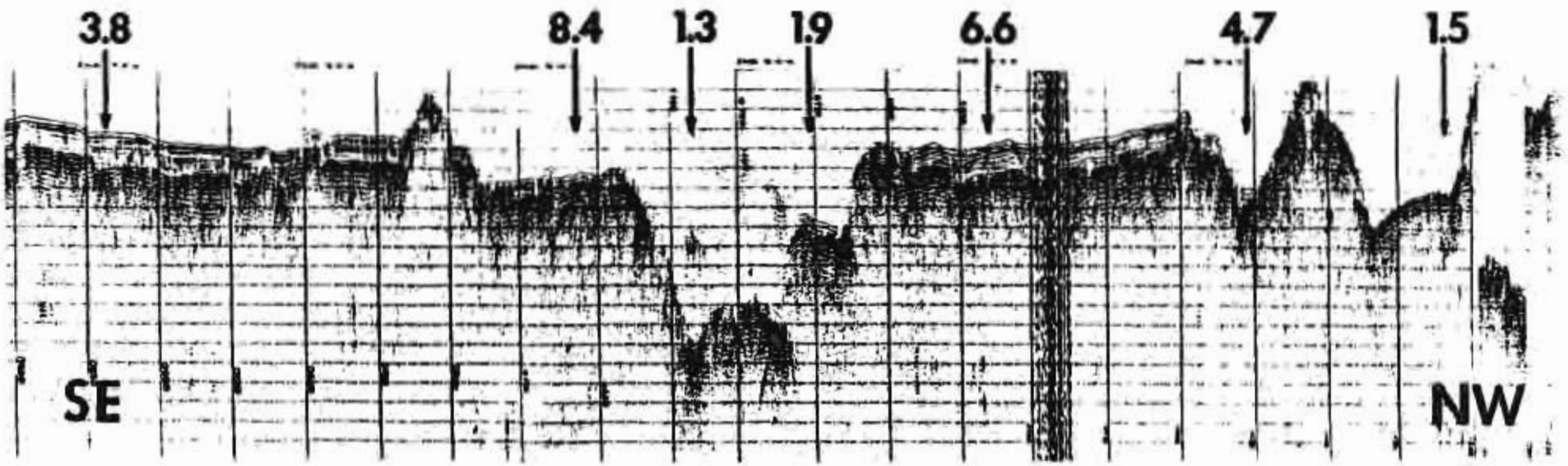
strongly upwarped and dipping northwest away from the trough zone. The stations follow UBC airgun profile 70-16-14 which was used to locate sediment and index the general structure. Two values in the southeasterly trough are low but the trough is flanked by high heat flows on both sides (8.4 and 6.6). A moderately high value (4.7) is observed on a ridge near the northwesterly, or main, trough but another relatively low value is indicated for the valley itself by a partial penetration station (2.4 for 60 cm of sediment). The presence of a large seamount immediately beyond the valley terminated the profile, and the important symmetry station for this trough is missing. However, a measurement was made where the northwestern trough abuts the Paul Revere ridge and produced a record value of 16.8. In short, the heat flow evidence suggests that both troughs are, or have recently been spreading centres and that the low values obtained in the troughs on the profile are the result of the well known but little understood, "valley effect".

Two measurements were made in the subsidiary trough leading northeast from the Paul Revere fault line. Owing to navigational problems they are not sited as was intended and, being approximately equal, do not confirm or deny the existence of spreading this trough. A heat flow of 4½ is rather high, but in view of the other measurement on the same fault line and the undisturbed sediment pond seen by UBC profile 70-16-21, we would guess that active spreading is not occurring. The diffuseness of the earthquake epicenters south of the Queen Charlotte Islands may be real and indicate that the ocean floor between Explorer Trough and the main transform fault is still undergoing general shear.

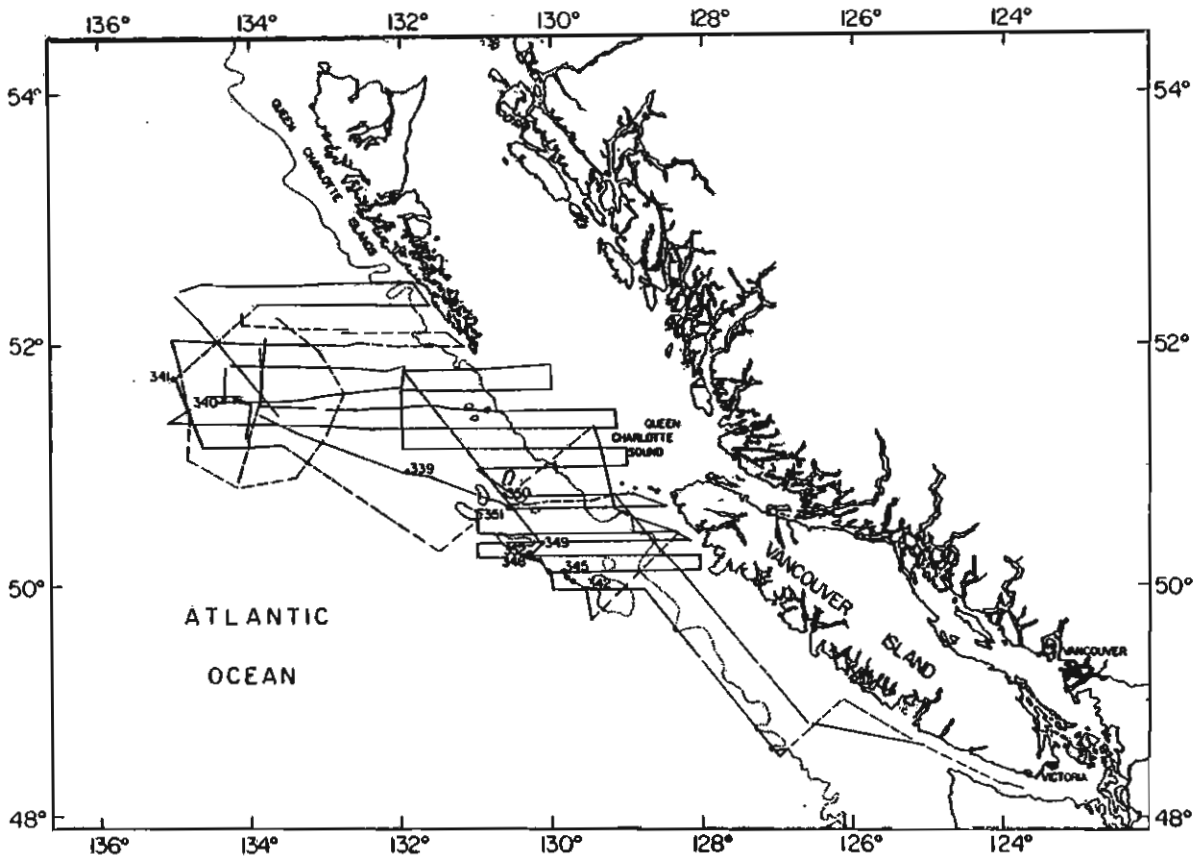
A new underwater cine-camera was brought on the cruise in an attempt to observe the bottom condition in Explorer Trough. Although the instrument had been thoroughly tested in the laboratory, the cold room and in Puget Sound, the pulsed thallium iodide light did not operate on the first two lowerings. Through a decision to modify the firing relay, it was discovered that the relay coil wire was broken in manufacture at one terminal and evidently became a sensitive thermometer after bumping to Victoria in the truck. The third and final lowering produced pictures, but without the expected test of exposure levels, we are not surprised that they are severely underexposed over much of the film. The station was sited close to the partial penetration heat flow measurement in Explorer Trough, whose gently undulating floor has an unusual acoustic signature at this point. The film has not, at this writing, been viewed through a projector, but it appears that the valley floor is a generally flat lava flow covered by some sediment through which rocks outcrop occasionally. The heat flow measurement is therefore likely to be reasonably representative of the conductive surface flow but major hydrothermal vents may not have been covered by the amount of sediment present.



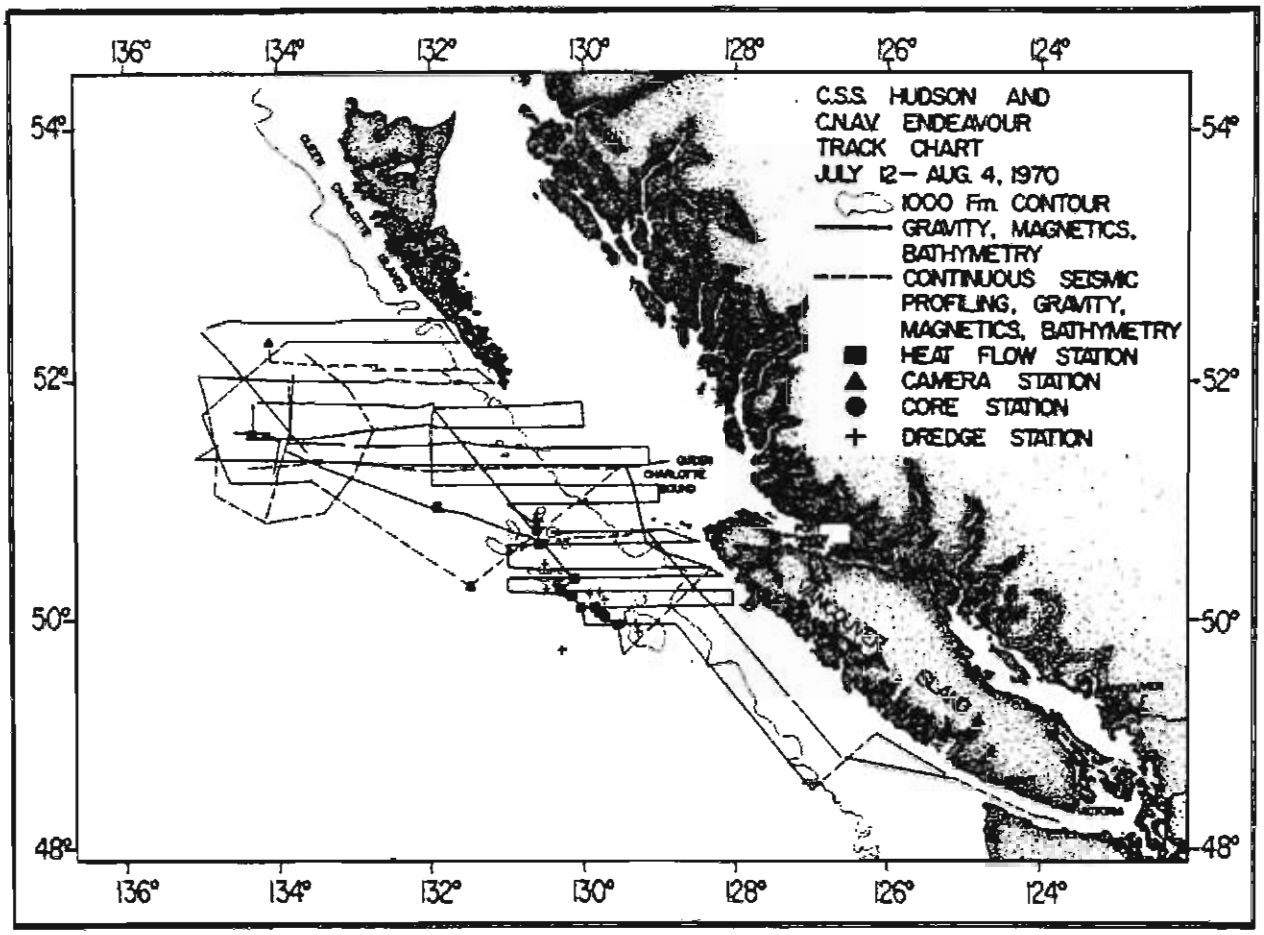
Map of the generalised bathymetry and heat flow values across the northern Explorer Trench system. Heat flow values are in μcal/cm^2/sec. The dashed line here shows the track of the seismic profile (see next illustration). (Contours from Mammerickx).



A continuous seismic profile with heat flow values across the northern Explorer Trench system. The profile is indexed on the preceding illustration and is from the University of British Columbia's airgun profile 70-16-



Cruise station numbers for C.S.S. Hudson and C.N.A.V. Endeavour on Phase VII (Victoria to Victoria) of HUDSON 70.



Track chart and types of data collected at stations on Phase VII of HUDSON 70.

Appendix A

Local Cruise Designation:	69-050
Code Reference Number:	10-69-050
Vessel:	C.N.A.V. Endeavour
Dates:	13 July to 4 August 1970
Area:	Victoria, B.C., to Victoria, B.C.
Responsible Agency:	Atlantic Oceanographic Laboaratory Bedford Institute
Personnel:	Ship's Master, Captain T. Bowles
Scientific Staff:	
K.S. Manchester Senior Scientist	Atlantic Oceanographic Laboratory Bedford Institute
F. Muise	Atlantic Oceanographic Laboratory Bedford Institute
J. Nielsen	Atlantic Oceanographic Laboratory Bedford Institute
A. Thomlinson	Atlantic Oceanographic Laboratory Bedford Institute
R. Hyndman (July 13-24)	Dalhousie University Halifax, Nova Scotia
D. Rankin (July 13-24)	Dalhousie University Halifax, Nova Scotia
K.L. Chase (July 25-August 4)	University of British Columbia
R. MacDonald (July 13-25)	University of British Columbia
R. Davidson	University of British Columbia
W. Bertrand	University of British Columbia
R. Parker	Department of Energy, Mines and Resources, Ottawa, Ontario
G. Rogers	Marine Sciences Branch, Ottawa, Ontario

Summary:

The Endeavour acted as the shooting ship with the C.S.S. Hudson as the receiving ship in completing reversed seismic crustal refraction lines: this portion of the work is described in the preceding cruise report on the Victoria to Victoria leg of HUDSON 70.

Following the seismic refraction experiment, the Endeavour carried out seismic profiling and dredging over the Explorer Trench - Paul Revere Ridge area and neighbouring seamounts, between 49°30' and 51°00'N and 129°00' and 131°00'W. Our intent herein is to report upon the dredging operation conducted from July 26 to August 4, 1970.

Purposes:

Our objective in dredging was to obtain outcrop specimens that could permit:

(1) Determination of relationships between lithology, magnetic properties, and age of basalts from different magnetic anomalies within the Explorer Trench area.

(2) Resolution of stratigraphic and structural relationships between greywackes, siltstones and mudstones, and serpentinite on Paul Revere Ridge. All three rock types were recovered in a single earlier (1969) dredge haul midway along the ridge. The need to resolve the stratigraphy and structure of Paul Revere Ridge is the more pressing because this ridge marks an abrupt northern termination of pronounced magnetic anomalies that characterize the adjacent Explorer Trench area.

(3) Petrographic and age-determinations of basalts of the Dellwood Range of seamounts and, to the northeast, the Dellwood Knolls. The aim was to determine whether or not this portion of the sea-floor is spreading.

Methods and Recovery:

Equipment consisted of chain-bag dredges supplied by the Bedford Institute. At each site (selected with the aid of a bathymetric chart (Mammerickx, 1969, Special Chart No. 1, Scripps Institution of Oceanography), echo-sounder profiles, and continuous seismic profiles), the dredge was lowered from the ship's bow. When the metered wire length indicated the dredge to be on the bottom, the ship moved slowly astern, paying out additional wire in amounts of approximately 50% of the water depth, to permit dredging with wire angles ranging from 0° to 45°. At all sites, we attempted to place the dredge low topographically and to dredge in the "uphill" direction. Beginning depths for dredging ranged from 1475 m on a seamount to 3200 m in Explorer Trench. Dredge-site locations and depths are listed in the accompanying table.

Locations and Depths of Dredge Sites

Dredge Site	Location of Start of dredge haul °N Lat.	°W Long.	Geographic Feature	Depth (m) From	To
1	Dredge did not touch bottom				
2	50°53.7'	130°35.0'	Dellwood Knolls (N.W.)	1900	1500
3	50°46.0'	130°24.0'	Dellwood Knolls (S.E.)	1900	1500
4	50°14.1'	130°15.4'	Explorer Trench	2500	2000
5	49°55.7'	129°20.7'	Paul Revere Ridge (South slope)	1800	1700
6	49°58.0'	129°17.7'	Paul Revere Ridge (crest)	1600	1500
7	50°17.9'	130°24.6'	Dellwood Range (S.E. end)	2000	1900
8	50°27.2'	130°32.5'	S.E. Dellwood Seamount	1475	1300
9	50°36.0'	130°45.5'	Middle Dellwood Seamount	1800	1500
10	50°14.5'	129°49.9'	Paul Revere Ridge (crest)	1800	1700
11	50°14.2'	129°54.7'	Paul Revere Ridge (S. slope)	2300	2200
12	Approx. 50°10.0'	Approx. 129°45'	Paul Revere Ridge (S. slope)	2200	2000
13	Approx. 49°46'	Approx. 130°18'	Explorer Trench (E. Wall)		
14	"	"	" "		
15	"	"	" "	2100	2000
16	Approx. 50°13'	Approx. 130°14'	Explorer area (N.W. Part)	2100	1900
17	Approx. 50°5.5'	129°44.5'	Explorer area (N.E. deep)	3200	2400

The method of dredging from the bow was time-consuming and inconvenient as it necessitated hoisting the dredge between the well-deck and the bow by crane, and attendant attaching and detaching of the winch wire at the beginning and end of each haul. Moreover, lack of lighting foreward of the ship precluded dredging with safety after dark, and under some wind and sea conditions the ship was incapable of maintaining the desired heading while steaming astern.

Despite the admittedly inefficient dredging technique, dictated by the ship's gear, in only 3 out of a total of 17 attempts, the dredge returned empty. As indicated in the second table, recovery ranged from a single fragment to several hundred pounds of rock in the other 14 hauls.

Dredge Hauls

Dredge Site	Recovery (Weights are estimates, descriptions are preliminary and tentative.)
1	Nil - dredge apparently did not reach bottom.
2	250 lbs. 90% angular fragments of vesicular pillow basalt, many with fresh glassy rind; 10% pebble size glacial erratics of dioritic to granitic composition.
3	100 lbs. 40% glacial boulders and cobbles, 60% pillow basalt. Generally thin manganese coating but one sample with 2 cm. thick crust of manganese oxides.
4	125 lbs.; fresh, ropey, vesicular basalt with glassy rind.
5	One 13 cm fragment of porous, low density, manganiferous mudstone.
6	600 lbs.; 10% glass sponges, infilled with clay and manganese oxide; 25% glacial pebbles and cobbles; 65% basalt with weathered, palagonitized glassy rind.
7	500 lbs.; mainly vesicular pillow basalt some with glassy rind. No glacial erratics.
8	600 lbs.; one large glacial boulder (80 lbs.) and few glacial pebbles and cobbles; remainder is vesicular pillow basalt. Many large samples with weathered glassy rind, some with manganese coating about 2 mm thick.
9	400 lbs.; 20% glacial pebbles and cobbles and iron oxide-stained volcanic ash; 75% basalt with manganese oxide coating to 3 cm thick. 5% manganese nodule fragments. Weathered glassy rind on some basalt fragments.
10	One glacial cobble of intrusive rock.
11	100 lbs.; vesicular olivine basalt, apparently from weathered talus, coated with manganese oxides.
12	300 lbs.; 50% green, partly serpentinized rock (basalt and/or peridotite); 50% greywacke and interbedded mudstone and siltstone, contorted and sheared, containing carbonized plant fragments and lenses of coal up to 8 mm thick. Uniform weathering of all sides of most rock fragments indicates a probable talus-slope as their source.

13	Nil
14	Nil
15	200 lbs.; pillow basalt with palagonitized glassy rind; one glacial cobble.
16	650 lbs. pillow basalt with glassy rind.
17	One angular fragment of fresh, dark green volcanic rock.

APPENDIX B

CALIBRATION OF GRAVIMETERS

The two gravimeters were calibrated at Graving Dock, Esquimalt, Victoria, B.C. before and after the cruise. The results of these calibrations are given in the following tables:

Note that the drift rates of the Askania Gravimeters depend on the MSD value considered in their compilations. A drift of -7.7 mgal results if the high MSD 6700 is used and of -12.9 mgal if the low MSD 6300 is used. The difference between the two is significant. What causes this non-linearity is not clear at the moment.

Variations in VSA readings

Time/Day	Old MSD	New MSD	Gravity VCO	C.C. VCO	Gravity CHART	C.C. Chart	VSA
0800/193	6300	6700	66777	65444	88.2	66.5	980969.5
0830/193	6700	6300	60991	65278	10.7	64.3	980970.7
0900/193	6300	6700	66769	65430	88.0	66.3	980970.2
0930/193	6700	6300	60987	65281	10.7	64.3	980970.0
1000/193	6300	6700	66766	65438	87.9	66.3	980969.5
1030/193	6700	6300	60989	65293	10.7	64.4	980970.5
1100/193	6300	6700	66764	65403	87.9	66.4	980969.4
1130/193	6700	6300	60985	65297	10.7	64.4	980970.2
1200/193	6300	6700	66760	65454	87.8	66.5	980970.5
1230/193	6700	6300	60987	65299	10.7	64.5	980970.4

Place: Esquimalt Graving Dock, Victoria, B.C.

Base Gravity: - 980976.1 mgal
Roll: - 0.5
Pitch: - 6.8
Lamp Current: - 165 ma
Erection: - Fast

Time Constant: - 6 sec.
Room Temp.: - 13.3°C.
Internal Temp.: - 40°C.
Sea State: - 1
Lower Spring: - 2100

Gravimeter Calibration after the Survey

Time/Day	Old MSD	New MSD	Gravity VCO	C.C. VCO	Gravity CHART	C.C. Chart	VSA
1820/218	6300	6700	66399	65484	83.0	66.7	980963.6
1900/218	6700	6300	60768	65257	07.7	63.7	980964.4
1940/218	6300	6700	66399	65460	83.0	66.4	980961.2
2020/218	6700	6300	60767	65229	07.7	63.4	980966.3
2100/218	6300	6700	66397	65403	83.0	66.0	980966.0
2140/218	6700	6300	60772	65220	07.7	63.4	980964.7
2220/218	6300	6700	66400	65417	82.9	63.0	980969.7
2300/218	6700	6300	60769	65211	07.7	63.0	980969.7

Place: Esquimalt Graving Dock, Victoria, B.C.

Base Gravity: - 980976.1
Roll: - +4.0
Pitch: - -6.5
Lamp Current: - 164 ma
Erection: - Normal

Time Constant: - 6 sec.
Room Temp.: - 13.3°C.
Internal Temp.: - 40°C.
Sea State: - 0
Lower Spring: - 2100

Drift Rate Calculation

For MSD = 6700, Average VCO = 60769.0

Computed gravity value of the vax station = 980968.4 using the calibration constants based on calibration performed on day 193. Measured gravity value of the base station = 980976.1

For MSD = 6300, Average VCO = 66397.75

Computed gravity value = 980963.2 based on calibration constant obtained on day 193; hence the drift for MSD = 6700 is -7.7 mgal and for MSD = 6300 is -12.9 mgal.

VSA Mean Gravity Values obtained at Graving Doc, Esquimalt, Victoria, B.C.

Time Interval	No. of Data	Mean Gravity	Standard Dev.
2021/191 - 0245/192	10	980970.6	.42
1540/192 - 2005/192	7	980969.2	1.03
0800/193 - 1230/193	10	980970.1	.45
1721/217 - 2314/217	10	980967.3	2.01
0146/218 - 0446/218	2	980969.3	.30
1820/218 - 2340/218	9	980964.7	2.59
0840/219 - 1000/219	11	980965.4	2.57

The total drift of the VSA gravimeter is the difference of the mean gravity values between day 193 and 217. Hence, the drift rate was obtained as -0.116 mgal/date. This is close to the drift correction rate -0.1 mgal/day used in the computation of VSA free air gravity.

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

VICTORIA TO RESOLUTE BAY

B.R. PELLETIER

CRUISE NO. 69-050

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

VICTORIA, B.C., TO RESOLUTE BAY, DISTRICT OF FRANKLIN

Local Cruise Designation:	69-050
CODC Reference Number:	10-69-050
VESSEL:	C.S.S. HUDSON
Dates:	14 August - 30 September 1970
Areas:	(a) Northwest Pacific Ocean (b) Chukchi Sea (c) Beaufort Sea (d) Northwest Passage (Canadian Arctic Archipelago)
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain D.W. Butler
Scientific Staff:	
B.R. Pelletier Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
G. Vilks Assistant Chief Scientist	Atlantic Oceanographic Laboratory Bedford Institute
C.J. Yorath	Geological Survey of Canada, Calgary
C.J. Havard	Geological Survey of Canada, Calgary
D.J. Faber	National Museum of Canada, Ottawa
F.J.E. Wagner	Atlantic Oceanographic Laboratory Bedford Institute
W.J. Whiteway	Atlantic Oceanographic Laboratory Bedford Institute
J. Bruce	Atlantic Oceanographic Laboratory Bedford Institute
M. Gorveatt	Atlantic Oceanographic Laboratory Bedford Institute
W. Pinner	Highland Helicopter Ltd., Vancouver
J. Strad	Highland Helicopter Ltd., Vancouver

Scientific Staff (continued):

B.D. Loncarevic	Atlantic Oceanographic Laboratory Bedford Institute
J.R. Belanger	Atlantic Oceanographic Laboratory Bedford Institute
B.D. Carson	Atlantic Oceanographic Laboratory Bedford Institute
J. Shearer	Atlantic Oceanographic Laboratory Bedford Institute
R. Smith	Queens University, Kingston
A. Harding	Hunting Ltd., U.K.
C.R. Mann	Atlantic Oceanographic Laboratory Bedford Institute
H.A. MacPherson	Defence Research Establishment, Atlantic
P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
H. Henderson	Atlantic Oceanographic Laboratory Bedford Institute
K.G. Shih	Atlantic Oceanographic Laboratory Bedford Institute
G.M. Purdy	Atlantic Oceanographic Laboratory Bedford Institute
V.F. Coady	Atlantic Oceanographic Laboratory Bedford Institute

Summary:

Soundings G.E.B.C.O.	9653 km
Gravity Records	9653 km
Magnetics	9653 km
Seismic Reflection Profiling	2194 km
Side Scan Sonar	1200 km
Surface Plankton Tows	94

Vertical Plankton Tows	116
Surface Biological Tows	117
Vertical Biological Tows	113
Van Veen Grabs	116
Sediment Dredges	11
Cores	71
Camera Stations	7
Knudsen Casts	41
Biological Sled Trawls	1
Underwater Television Stations	4
Oblique Biological Tows	2

Narrative:

On the morning of 14 August 1970, Hudson proceeded northwest out of Victoria, B.C., to begin Phase VIII of her journey around the Americas. All scientific hands for the Arctic voyage were aboard, exclusive of a few personnel who joined the ship in the Beaufort Sea. While steaming across the Pacific Ocean, some coring and station work was undertaken as part of a shakedown for the staff; also, these people were instructed in watchkeeping duties on the satellite navigator and the geophysical console. On the second day out, an emergency call was received from divers in trouble and Hudson altered course to render assistance as a doctor with experience in diving medicine was aboard. However, the Canadian Air Force participated shortly after so Hudson was relieved of her rescue mission.

During the next few days, heavy seas troubled the ship. Gear had to be made even more secure because of the heavy rolling and pitching of the vessel. For a few hours, the ship hove to until all moorings were checked. At times, seas poured over the foredeck. On 20 August at 1232 hours, an explosion occurred in a generator but at 1300 hours the ship was underway again as Captain Butler decided to continue on course. This action was crucial because it avoided abandoning HUDSON 70 and her circumnavigation of the Americas. The remainder of her passage to the Arctic Ocean through the Aleutian Islands was unimpeded. Along this track from Victoria, the acoustical records revealed the precipitous edge of the Pacific Continental Shelf and numerous rectilinear ridges and troughs comprising fracture zones in the ocean floor.

During the afternoon of 21 August, the ship anchored in the lee of St. Lawrence Island to replace a hatch cover over the sounding well of the variable depth transducer and thus be prepared for steaming through Arctic ice. She proceeded north through Bering Strait, with Siberia to

port and Alaska to starboard. In this region, on 22 August at 1700 hours, Hudson made her first crossing of the Arctic Circle and this message was piped to the ship's company. In the wheelhouse, the bridge log at the end of the watch read: "Navigation lights checked. Cloudy and clear. Vessel steady."

In the Chukchi Sea, loose floating ice was encountered that confined the steaming route to the coastal shipping lane lying within a few kilometres of shore. Proceeding on a northeasterly course along this coast, the ship was literally flagged down by a priest and an Inuit party in an outboard motor boat, who asked for assistance in the search for three walrus hunters from a nearby village who went missing on the ice. At this time, the U.S. Coast Guard and Alaskan State Police had contacted the ship, and later thanked the captain for his help. They relieved Hudson from the search. Hudson left Wainwright on 23 August.

Off Point Barrow, Alaska, the ship met with heavy ice; however, once clear, Hudson steamed down the coast past Barter Island toward Canadian territorial waters and arrived off Herschel Island on 26 August. Here, J.M. Shearer and A. Harding, who had been carrying out seismic profiling and side-scan sonar surveying in the Beaufort Sea from C.S.S. Richardson were picked up by helicopter and joined Hudson immediately. Two others, B.D. Loncarevic and J.R. Belanger, also joined the ship from Herschel Island, having come aboard in the helicopter. That day, the fog was too thick to permit safe flying for any distance over the ocean, so Hudson steamed within sight of land thereby bringing the airport to the pilot. From here, business commenced.

The plan was to run geophysical lines in the evening along 14 transects across the shelf, and along one tie line to the transects at mid-shelf locations parallel to the coast. During the day, station work would be carried out according to the schedule of operations prepared in the prior evening. (See accompanying example - next page.) By this means, all hands were alerted to the equipment and duties required, as well as the location and time for the work to be undertaken. The geophysical work revealed the form and structure of the seabed and continental shelf, while the bottom sampling recovered material that indicated the nature of the sediments and animals on the seafloor itself. Old beaches and ancient river valleys were located, but other significant discoveries were to come. The revelation of deep and profuse ice-scouring of the sea bed to water depths of 60 m and the existence of dozens of underwater ice-cored mounds (the so-called pingos) occurring 35 to 100 km from shore presented a two-fold obstacle in the safe development of resources and the secure protection of the environment.

New concepts on the water mass, particularly its microstructure, continued to develop from ocean-sampling operations. The relationship of the ocean to biology on the one hand, and sedimentology on the other were recorded and studied. Soon, it was learned that radically different life zones existed in the ocean; for example, planktonic foraminifera were offshore dwellers strictly speaking, and muddy sediments were deposited or transported mainly inshore where such faunal life was inhibited from growing.

WORKING SCHEDULE FOR SEPTEMBER 9, 1970

Continue Geophysical Survey along cross line X-9 to 0730 hours at 71:12N, 134:25W. Retrieve gear and steam to sampling station.

STATION NO. 407

Arrive on station 0800 hours, 71:12N, 134:25W
Operations:- Vertical Plankton Tow 864
- Surface Plankton Tow 649
- Vertical Biological Tow 860
- Surface Biological Tow 867
- Core (40 foot barrel) 833
- Van Veen Grab 864

STATION NO. 408

Arrive on station 1030 hours; 71:01N, 134:10W
Operations:- Vertical Plankton Tow 865
- Surface Plankton Tow 650
- Vertical Biological Tow 861
- Surface Biological Tow 868
- Core (40 foot barrel) 834
- Van Veen Grab 865

STATION NO. 409

Arrive on station 1230 hours; 70:55N, 133:55W
Operations:- Vertical Plankton Tow 866
- Surface Plankton Tow 651
- Vertical Biological Tow 862
- Surface Biological Tow 869
- Core (20 foot barrel) 835
- Van Veen Grab 866

STATION NO. 410

Arrive on station 1415 hours; 70:47N, 133:45W
Operations:- Vertical Plankton Tow 867
- Surface Plankton Tow 852
- Vertical Biological Tow 863
- Surface Biological Tow 870
- Core (20 foot barrel) 836
- Van Veen Grab 867

STATION NO. 411

Arrive on station 1615 hours; 70:36.5N, 133:30W
Operations:- Vertical Plankton Tow 868
- Surface Plankton Tow 853
- Vertical Biological Tow 864
- Surface Biological Tow 871
- Core (20 foot barrel) 837
- Van Veen Grab 868

STATION NO. 412

Arrive on station 1815 hours; 70:24N, 133:10W
Operations:- Vertical Plankton Tow 869
- Surface Plankton Tow 854
- Vertical Biological Tow 865
- Surface Biological Tow 872
- Core (20 foot barrel) 838
- Van Veen Grab 869

Steam to tie line C and commence Geophysical Survey 3 miles west of cross line X-9 at 1930 hours; 70:21.5N, 133:20W. Continue survey along tie line C to cross line A-10 at 70:31N, 132:20W and alter course to north and proceed along cross line A-10.
Operations:- Stream Seismic gear, Side Scan Sonar, Hydrophones and Magnetometer
- Watchkeeping on Geophysical Console and Satellite Navigation

B.R. Pelletier

B.R. Pelletier, Senior Scientist

The work proceeded daily in an unbroken routine, punctuated only by ice-reconnaissance helicopter flights. At times, parties visited shore in order to sample coastal features or examine geological formations inland. A brief respite from daily operations was gained when the oil barge arrived off Tuktoyaktuk in order to refuel Hudson for the remainder of the cruise to Dartmouth, N.S. The crews of both ships entertained for several hours in typical fashion while at anchor. In the late evening of 10 September, the oil barge cast her lines off and returned to harbour. Again, the work proceeded with daily regularity, while samples and records were examined and then stowed until the ship reached home port. The survey lines were quickly reduced in number in this race against the onset of winter. And now, the pace was beginning to tell physically, but the success of the work kept all spirits buoyed.

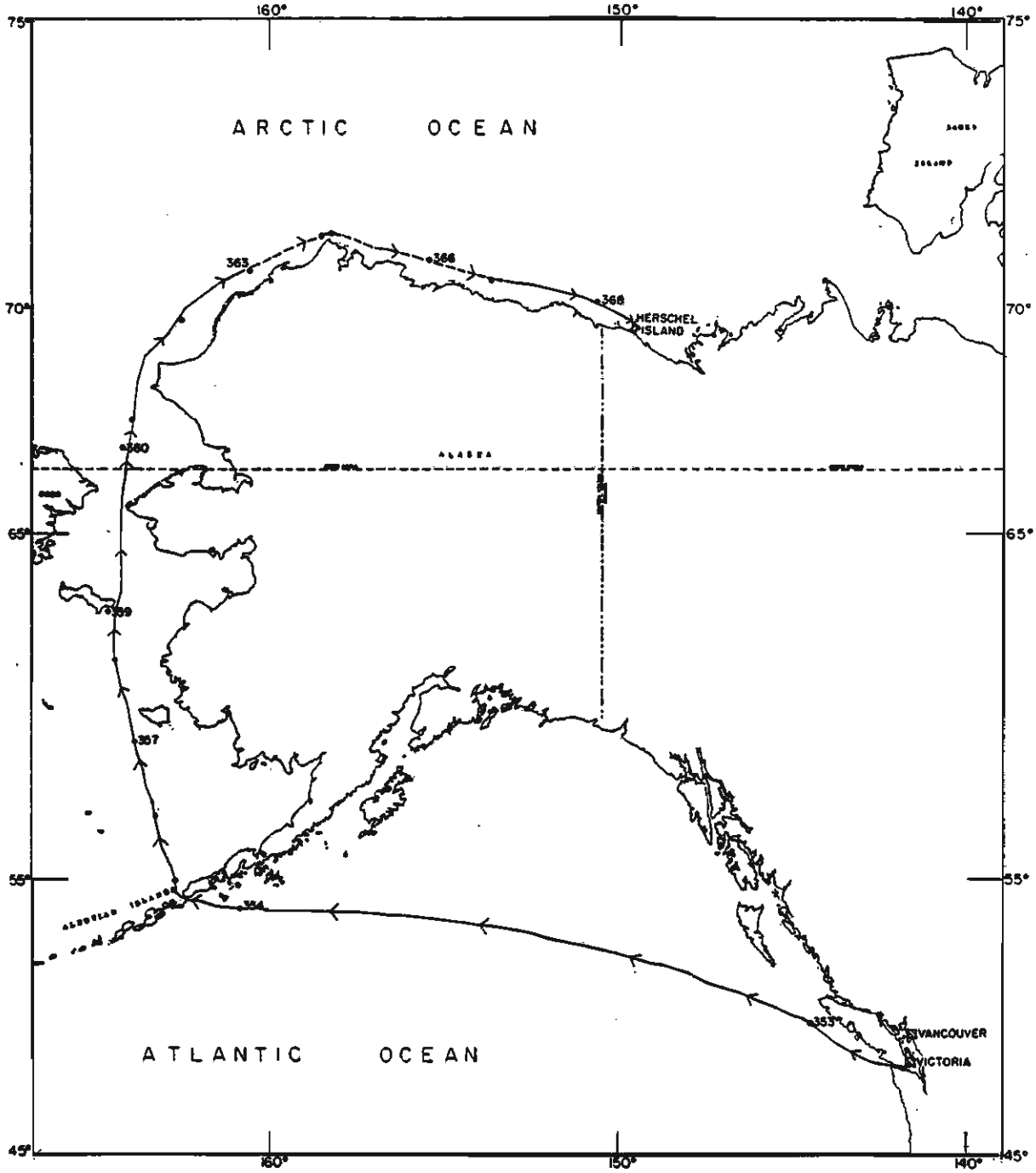
During the four weeks spent in the Beaufort Sea, sea conditions were unusually good. Only once, in early September, was the work routine interrupted when gale force winds required the ship to hove to for the night. However, the survey continued on course the next morning, but drifting pack ice indicated that the polar pack was moving south into the survey area.

At the start of the survey, the geophysical lines were run to points about 200 km offshore. Here, the presence of the polar pack ice prevented further surveying to the north. All through September, snow flurries continued and the ice began moving shoreward on a latitude-wide basis. By the third week in September, Hudson was restricted to surveying at locations over the shelf-slope break at distances of only 70 to 100 km from shore. New ice was forming in the Archipelago's channels as well, and old ice was blocking much of the proposed route in the Northwest Passage. Decisions would soon have to be made on the time to vacate the Arctic Ocean and on a choice of the route to take for the eastbound passage through the Arctic islands. On the latter count, the ship could proceed north through Prince of Wales Strait, or she could sail the alternate southern route along the mainland. In the evening of 22 September, after a personnel change at Tuktoyaktuk and a media crew joined the ship, Hudson sailed out of the Beaufort Sea to begin work in Amundsen Gulf.

The seafloor of Amundsen Gulf was once an outlet for tongues of ice that were spawned from the great continental ice sheets. Thousands of years earlier, rivers flowed in valleys that had been oriented by massive dislocations in the earths crust more than 20 or 30 millions of year ago. Such was the nature of the undersea features that Hudson's tracks would cover. Here, while the new ice was forming and snow falling steadily, Hudson began her transect of the Northwest Passage. To the north, heavy sea ice had been moving south all week so that choke points to navigation were expected between Banks and Cornwallis islands. With the prospect of CCGS Sir John A. MacDonald steaming from Resolute Bay in order to escort both Baffin and Hudson, it was decided to carry out station work en route. This was done during the night, and at 0740 on the morning of 25 September, Hudson reached the northern end of Prince of Wales Strait. At this point, the ship reached a major milestone in her journey around the world, but the ships terse log merely read: "Completed station work. Set course toward Sir John A.MacDonald. Overcast with frequent snow flurries".

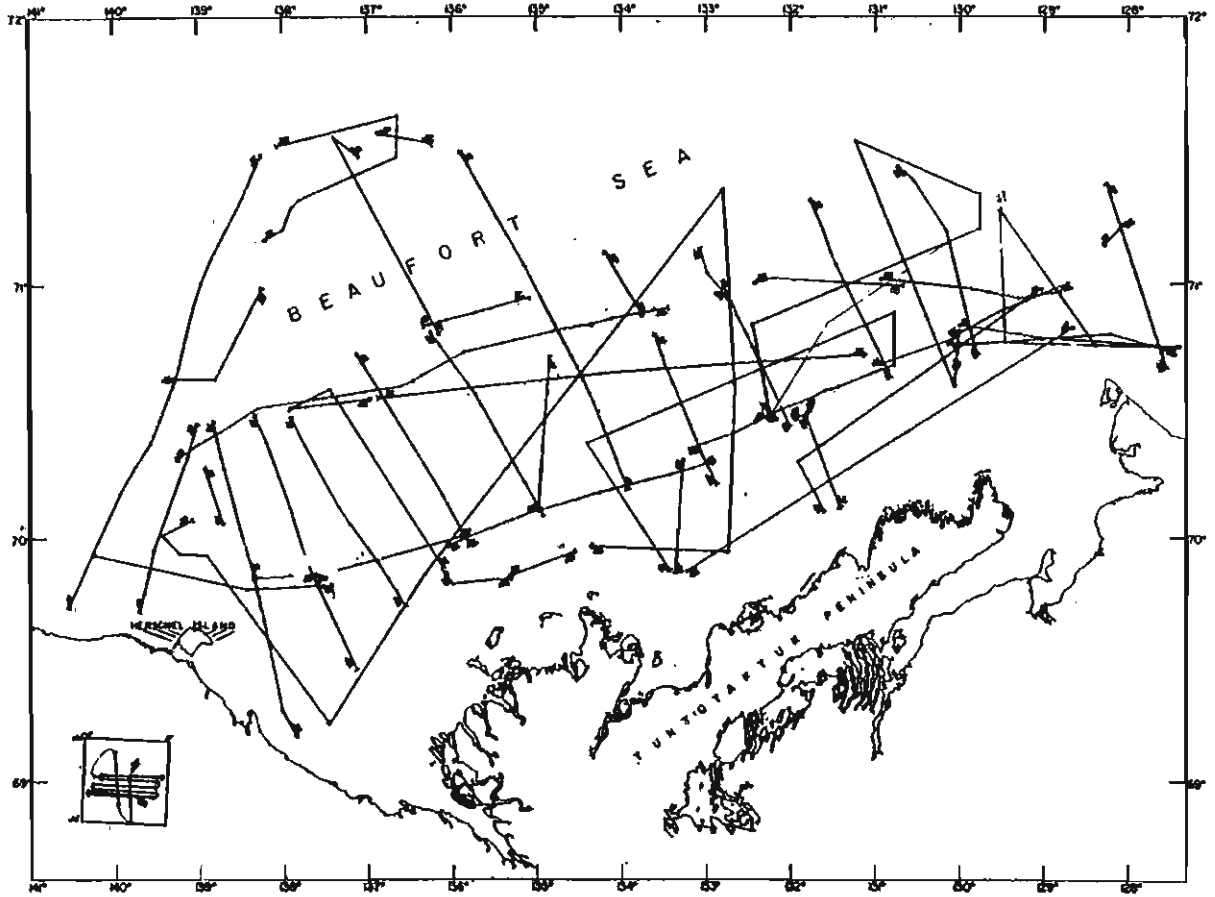
Over the next few days on the passage to Resolute, the ship was stopped several times by heavy ice. On one occasion, she rode up onto a particularly hard floe and slid off one side thereby heeling to port so abruptly and steeply that her guardrail almost touched the broken sea ice. Work continued, though in order to maintain the ocean and biological stations around the Americas, the geophysical surveying had to be abandoned. At evening, the ship stopped in the thick commonly 10/10 ice pack, with heavy snow falling and new ice forming constantly. From the sounding records, old watersheds were observed, which had been submerged throusands of years ago. Even the passage of ancient glaciers could be deduced. The station work continued over Barrow Strait and Lancaster Sound. From an onboard analysis of the plankton tows and cores, it was noted that some species failed to move westerly from Baffin Bay and the Atlantic Ocean. This migration was inhibited by the stronger residual current emerging from the Arctic Ocean.

At 0800 on 30 September, the helicopter began moving personnel, equipment and supplies between Resolute and Hudson. Meanwhile, a shore party comprising Bosun Joe Avery, Photographer Roger Belanger, and Chief Scientist B.R. Pelletier erected a plaque commemorating HUDSON 70 at the most northerly point of the cruise. Phase VIII had ended, and a new scientific staff was in place. At dinner in the evening before the ship lay at anchor off Resolute, the old scientific staff toasted the ship's company and wished them good sailing for the final leg of HUDSON 70 and the voyage home.

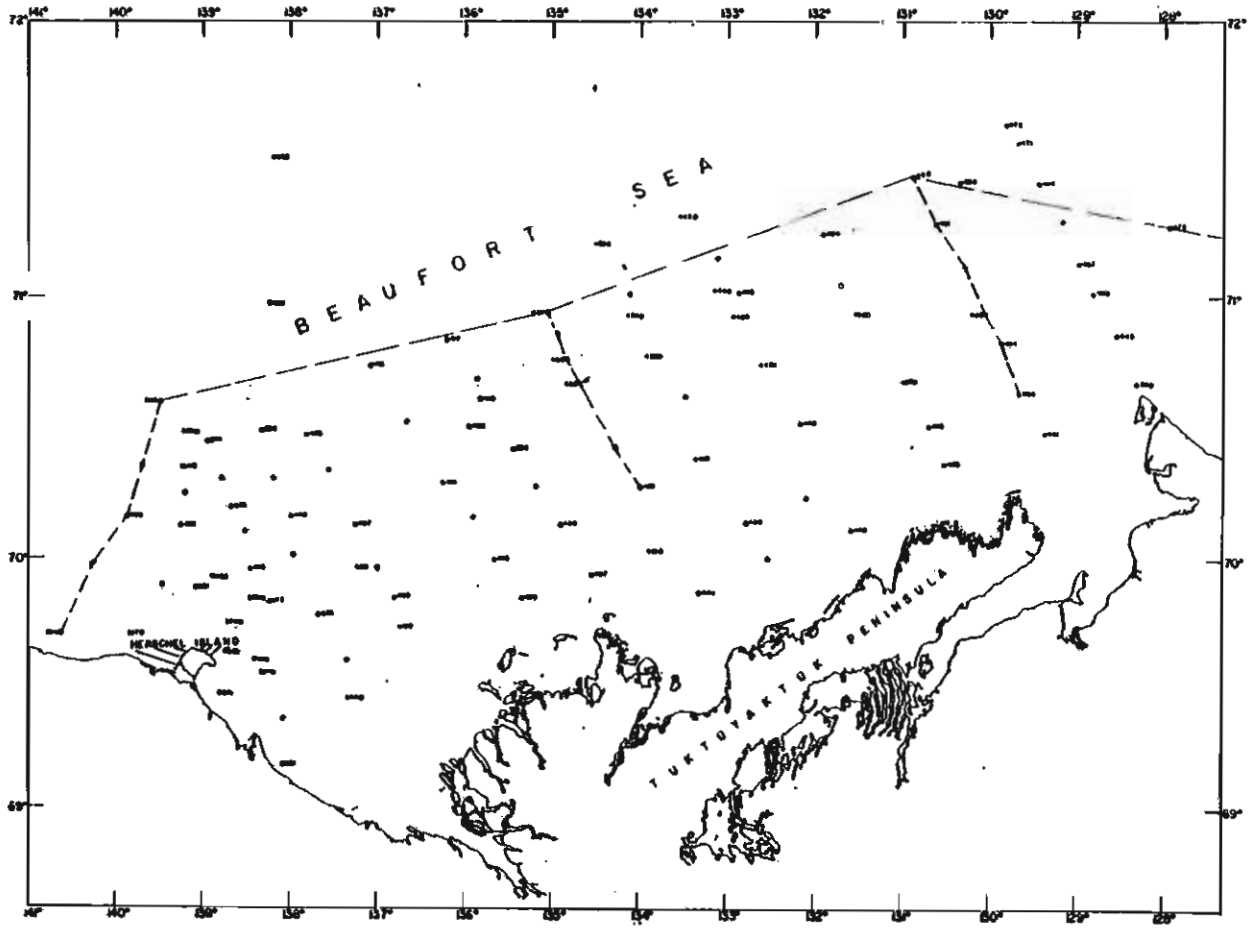


Track chart and cruise station numbers for Phase VIII

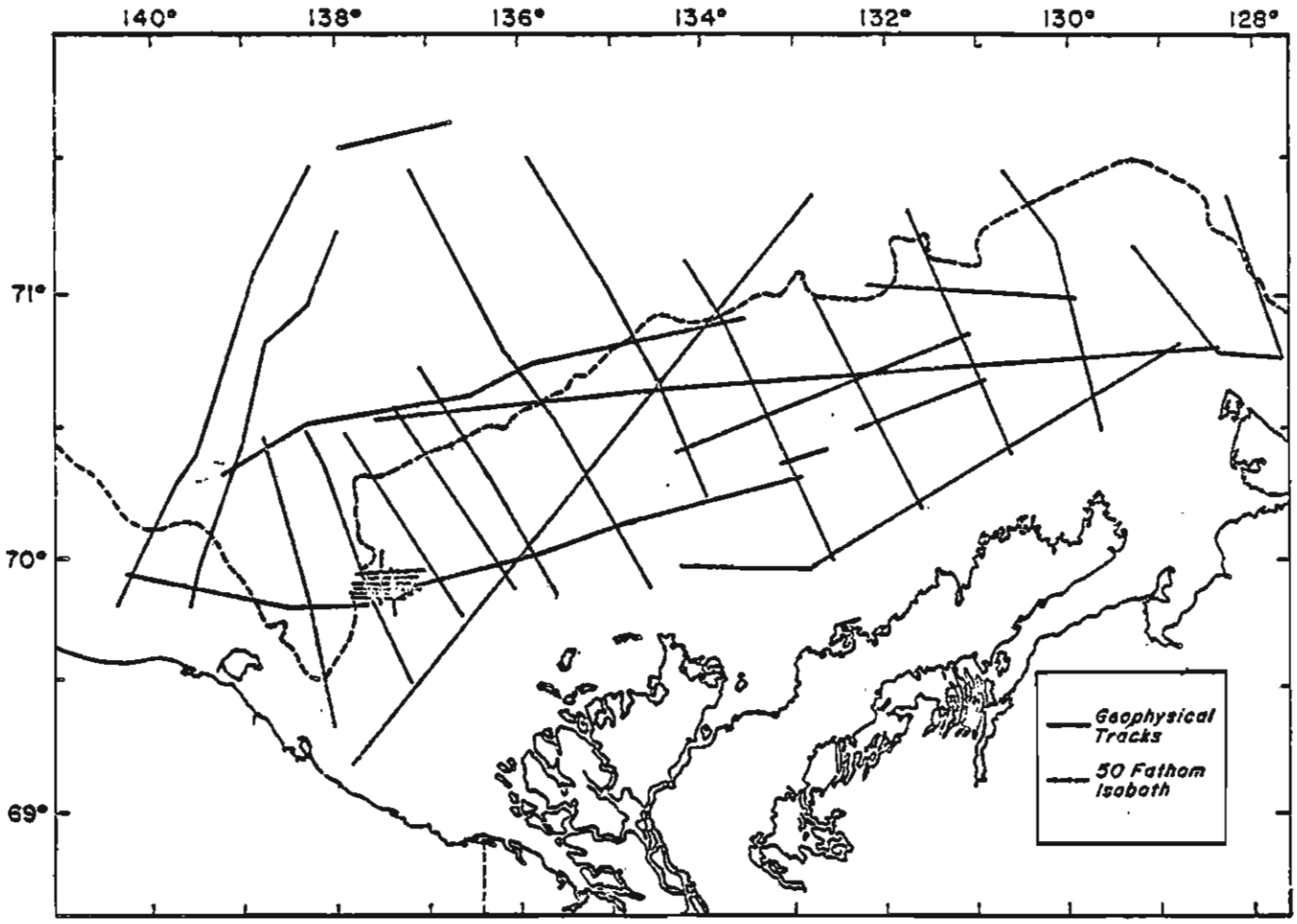
(Victoria to Resolute Bay) of HUDSON 70.



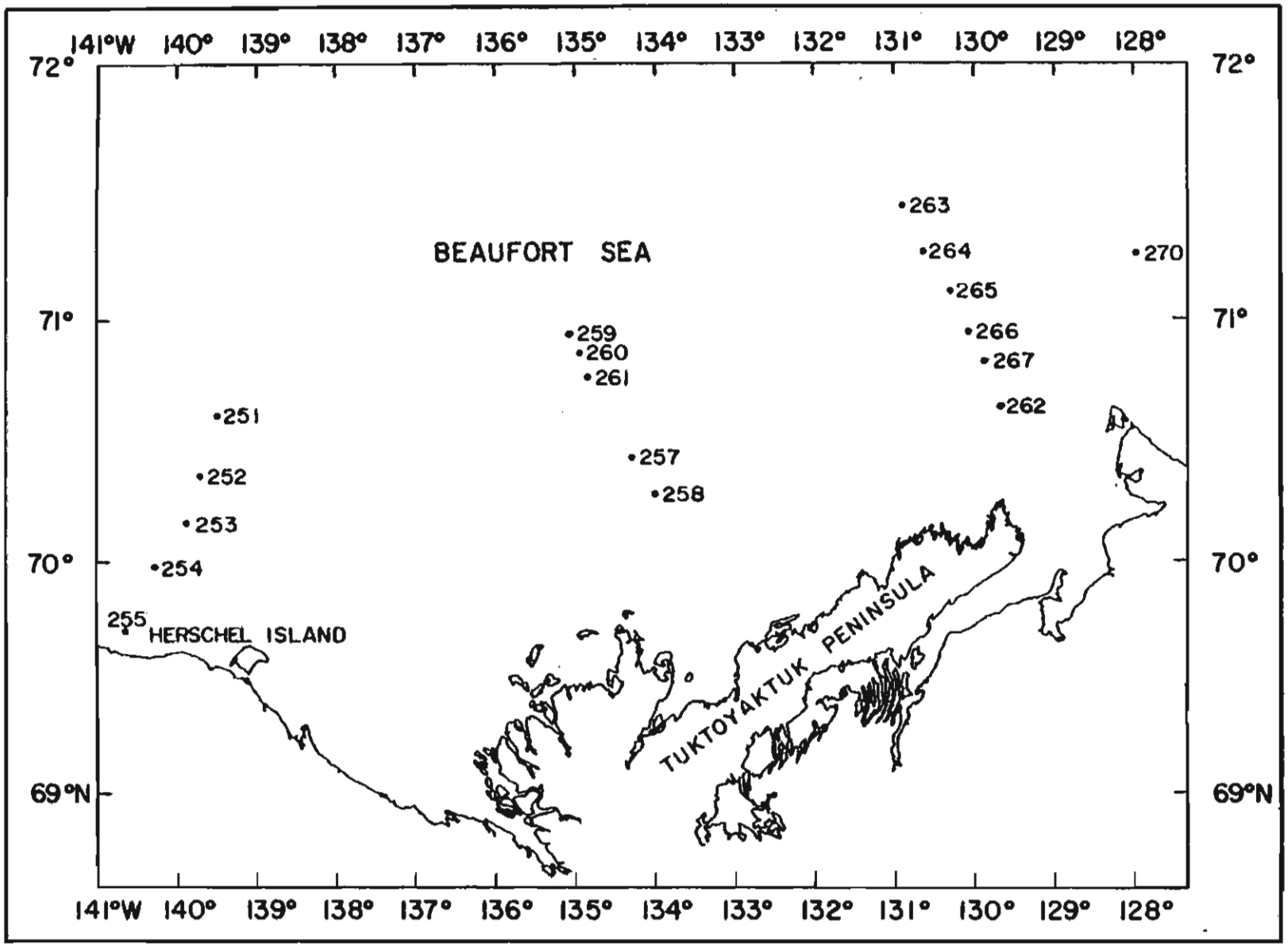
Cruise tracks and stations in the Beaufort Sea during Phase VIII. Note that cruise stations are more clearly depicted in the next illustration.



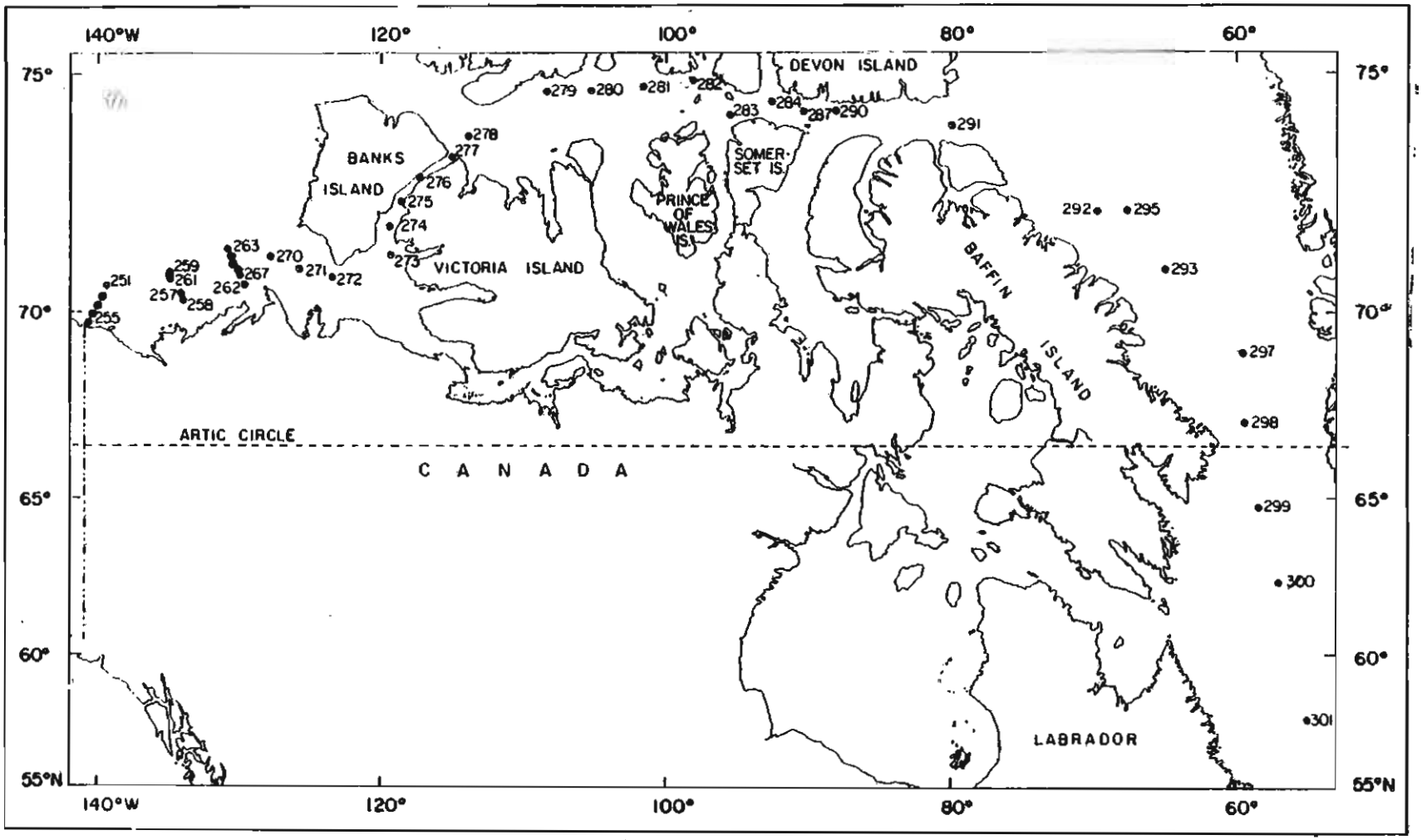
Cruise stations in the Beaufort Sea during Phase VIII.



Geophysical tracks in the Beaufort Sea during Phase VIII.



Oceanographic bottle stations occupied in the Beaufort Sea during Phase VIII.



Oceanographic bottle stations occupied in the western Arctic region during Phase VIII of HUDSON 70.

A T L A N T I C O C E A N O G R A P H I C L A B O R A T O R Y

B E D F O R D I N S T I T U T E

"HUDSON 70"

INTERIM CRUISE REPORT

EASTERN ARCTIC - BAFFIN BAY, LABRADOR SEA

D.I. ROSS

CRUISE NO. 69-050

CRUISE REPORT NO. 69-050

"HUDSON 70" - INTERIM CRUISE REPORT

EASTERN ARCTIC - BAFFIN BAY, LABRADOR SEA

Local Cruise Designation:	69-050
CODC Reference Number:	10-69-050
Vessel:	C.S.S. Hudson
Dates:	30 September to 16 October 1970
Area:	Eastern Arctic - Baffin Bay, Labrador Sea
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain D.W. Butler

Scientific Staff:

D.I. Ross Senior Scientist	Atlantic Oceanographic Laboratory Bedford Institute
C.R. Mann	Atlantic Oceanographic Laboratory Bedford Institute
B.R. Pelletier	Atlantic Oceanographic Laboratory Bedford Institute
C.E. Keen	Atlantic Oceanographic Laboratory Bedford Institute
D.L. Barrett	Atlantic Oceanographic Laboratory Bedford Institute
R.M. Eaton	Atlantic Oceanographic Laboratory Bedford Institute
D.M. Garner	Atlantic Oceanographic Laboratory Bedford Institute
P. Wadhams	Atlantic Oceanographic Laboratory Bedford Institute
G.M. Purdy	Atlantic Oceanographic Laboratory Bedford Institute
J.A. Nielsen	Atlantic Oceanographic Laboratory Bedford Institute

Scientific Staff (continued):

T.F. Courtney	Atlantic Oceanographic Laboratory Bedford Institute
H. Henderson	Atlantic Oceanographic Laboratory Bedford Institute
J. Bruce	Atlantic Oceanographic Laboratory Bedford Institute
V. Coady	Atlantic Oceanographic Laboratory Bedford Institute
P.A. Solowan	Atlantic Oceanographic Laboratory Bedford Institute
K.S. Manchester	Atlantic Oceanographic Laboratory Bedford Institute
B.L. Johnson	Atlantic Oceanographic Laboratory Bedford Institute
P.J. Bhattacharyya	Dalhousie University Halifax, Nova Scotia
H. MacPherson	Department of National Defense Halifax, Nova Scotia
R. Parker	Department of Energy, Mines and Resources, Ottawa, Ontario

Summary:

Seismic Reflection Profiling	420 nm
Reversed Seismic Refraction Line	137 nm
Gravity, Magnetics, and Bathymetry Data	2500 nm
Core Stations	3
Bottle Casts	10
Plankton Tows	15

Purpose of Cruise:

1. To investigate the structure of Baffin Bay and its relation to continental Canada and Greenland.

2. To complete the continuous transect of plankton tows and bottle

Purpose of Cruise (continued):

casts from the Pacific through the Arctic Ocean commenced on the earlier phase of the cruise.

3. To obtain geophysical data on one of two parallel lines run by Hudson and Baffin through Davis Strait and Labrador Sea.

Narrative:

At 1500 on 30 September, C.S.S. Hudson left Resolute Bay on the last phase of HUDSON 70. Ice conditions in Barrow Strait and western Lancaster Sound prevented the streaming of equipment for the first 20 hours although they presented no problem to the passage of the ship. Gravity data obtained was very poor along the entire line in Lancaster Sound because of course changes to avoid heavy ice. Plankton tows and bottle casts were obtained at two stations (85°W and 80°W) in the Sound.

Once clear of the heavy ice, the magnetometer and seismic reflection gear were streamed and the ship proceeded at 6 knots along a line out of Lancaster Sound and into the deep water of northern Baffin Bay. Apart from minor problems with the seismic equipment resulting from having been packed away since Victoria, all equipment operated well until the magnetometer fish was lost in a string of ice across the entrance to Lancaster Sound. This resulted in a loss of magnetic data on the remainder of the line into the Bay while a new fish could be spliced onto the existing cable.

A regular daily R/T schedule was set up with C.S.S. Baffin, participating with Hudson during this phase (AOL Cruise Report) to discuss progress of work on lines proposed in earlier discussions and to consider any changes to the program that might be desirable. On 2 October, contact was made with USCGC Edisto. Edisto was to act as shooting ship during the seismic refraction work scheduled for 5 to 8 October and was to embark two persons from Bedford Institute and the Department Seismic Shooter at Frobisher Bay on 2 October (Appendix A). A regular R/T schedule was set up for communication with Edisto and the rendezvous of the two ships was set for midnight on 4 October.

The easterly line out from Lancaster Sound into northern Baffin Bay was terminated on the evening of 3 October in 660 fathoms of water and the ship proceeded SSW across the area east of Bylot Island surveyed by C.S.S. Dawson earlier in the summer (AOL Cruise Report) as far south as 72°10'N. Seismic reflection data were collected along the northern half of this line at 6 knots. Magnetic, gravity, and bathymetry data were collected along the entire line, the second half at 12 knots.

There remained some 36 hours at the end of the line before the rendezvous with Edisto which had by now been shifted till the early morning of the 5th. Hudson therefore steamed four miles west across the 100 fathom depth on the edge of Baffin Island and then proceeded to run a further seismic reflection line across the shelf edge of Baffin Island out into the deep Bay at the same time collecting gravity, magnetic, and

bathymetry data to correlate with the reflection records. The reflection record on this line showed a deeply dipping faulted boundary of the Baffin Island gneiss structure at a depth of 160 fathoms and a distance of 27 miles from the nearest coast. The feature correlated exceedingly well with anomalies on the gravity and magnetic records. These anomalies were typical of those found along the continental margins of eastern North America. This line into the Bay was terminated at a depth of 1020 fathoms. After retrieving the gear, a core station was taken prior to proceeding at 12 knots on a southeasterly course to the edge of the ice lying along the centre of the Bay at approximately 65°W then south through 4/10th ice to rendezvous with Edisto at 71°N, 65°W.

After its rendezvous with Edisto, Hudson took a second core station and proceeded to prepare the seismic refraction cable for streaming. An attempt was made to lay the refraction cable in a comparatively clear area within the ice finger lying through the central Basin. This proved disastrous as the drift of the ice proved far greater than that of the ship resulting in the ice pack drifting onto the ship and causing serious problems with the streamed cable within a period of two hours. At least 12 hours listening period was required to complete the line so attempts to keep station at this point were abandoned and Hudson and Edisto streamed northwest 42 miles to clear water on the western side of the ice edge.

The refraction cable was successfully streamed in the early afternoon and Edisto commenced shooting along a line bearing 350° from two miles north of Hudson. A total of 54 shorts was fired and received along the 37 nm line, the shorts ranging from 50 lb. charges while the two ships were close, to 500 lb. charges towards the end of the line.

The first line was completed at midnight on 5 October and after recovering the cable, Hudson proceeded towards the northern end of the line so that it could be reversed the following day. On meeting up with the Edisto again, a core, plankton, and bottle station was taken while waiting for daylight to lay the cable. Daybreak showed a number of growlers and small icebergs in the vicinity of the station so the two ships steamed west seven miles before laying the cable and commencing the reversed line. Shooting recommenced by 10 a.m. with Edisto steaming along the reciprocal course of the previous day. The only problems encountered were due to charge misfires resulting from a new type of booster supplied by C.I.L. and the line was completed by late afternoon. This completed the refraction work with Edisto. The two ships met for the last time three hours later to transfer the Departmental personnel onto Hudson. Edisto then left for Boston while Hudson continued with its program.

The seismic refraction work proved extremely successful. Three layers were detected between the surface sediment column and the mantle with a total thickness of 6 km. Velocities of 3.34, 5.85, and 7.14 km/sec were obtained for the three layers. Although some dip of the individual layers was indicated, the overall dip of the mantle interface was very small. The measured mantle velocity was 8 km/sec at a depth of approximately 8 km below the surface of the sea floor. The work proved conclusively that Baffin Bay has an oceanic structure.

Having proved Baffin Bay to be oceanic, it then became important to try to get a complete reflection line across the Bay to pick up any evidence of a buried oceanic ridge and to look at the transition from oceanic to continental type structure on both sides of the Bay. We had already obtained a line out from Baffin Island so it was sensible to continue this line across to the Greenland side. Hudson therefore steamed west to pick up this line as close as possible to where it had been left off as time permitted, and then proceeded east at 6 knots recording reflection, magnetic, gravity, and bathymetry data. The line was continued across the central Bay and broad deep shelf area off the west coast of Greenland terminating in 120 fathoms of water some 25 miles west of Svartenhuk Peninsula. This line showed a remarkable difference between the east and west sides of the Bay and also evidence of a deep rugged reflector in the central area. On the Greenland side there was no marked evidence of the transition from oceanic to continental structure so apparent off Baffin Island. Instead, the deep shelf appeared to consist of considerable thickness of gently dipping sediment beds exhibiting a very broad positive gravity anomaly of around 70 mgals.

At the conclusion of the line, Hudson turned SW towards 71°N, 60°W to rendezvous with Baffin when the Hudson's helicopter exchanged one slightly used teletype for one apparently operational magnetometer fish and cable. The latter was to replace the repaired cable and fish being used by Hudson which had been giving considerable noise spikes during operations at full speed. During the rendezvous, a further plankton tow and bottle cast station was taken.

After parting company, both ships then started the long trip home--Hudson proceeding due south along longitude 60°W with Baffin some 15 miles to the west until latitude 66°N then along a course 160° through Labrador Sea to the northeast continental margin of Newfoundland. Six plankton tows and bottle casts were taken along the track to complete the transect from the Pacific through the Arctic Ocean and Baffin Bay to the Labrador Sea. Gravity, magnetic, and bathymetry data were collected along the entire length of this line.

Hudson rounded Cape Race, Newfoundland, mid-day on 13 October and proceeded across the southern Grand Banks, Laurentian Channel, and Scotian Shelf to the Dominion Observatory gravity range located 50 miles south of Halifax. Two traverses of the NW-SE range line were run before heading back to Halifax to arrive on schedule off Georges Island on 16 October.

APPENDIX A

Local Cruise Designation:	69-050 (HUDSON 70)
Code Reference Number:	10-69-050
Vessel:	USCGC Edisto
Dates:	2 October to 6 October 1970
Area:	Davis Strait and Baffin Bay
Responsible Agency:	Atlantic Oceanographic Laboratory Bedford Institute
Personnel:	Ship's Master, Captain Brazier
Scientific Staff:	
K.S. Manchester	Atlantic Oceanographic Laboratory Bedford Institute
B.L. Johnston	Atlantic Oceanographic Laboratory Bedford Institute
R. Parker	Department of Energy, Mines & Resources, Ottawa, Ontario

Summary:

The Edisto acted as the shooting ship with the C.S.S. Hudson as receiving ship in completing a reversed seismic crustal refraction line in central Baffin Bay. Fifty-four explosive charges were set off ranging in size from 33 lb. to 750 lb.

Equipment and Methods Used on the Ship:

Nitrone S.M. super explosive manufactured by C.I.L. was supplied in 33 lb. and 50 lb. cans. These cans were strapped together using conventional 3/4" steel strapping to make up the required charge size of up to 750 lb. The charges were ignited by using three feet of C.I.L. black Clover safety fuse, a standard blasting cap, and a nitrone S.M. booster. The fuse was lit using a conventional 12 volt automobile cigarette lighter and the charge was allowed to roll down a conveyor over the side of the ship into the water. The charge usually exploded about one minute and fifteen seconds after it hit the water. Ship's speeds of six to twelve knots were used depending on the charge size. The time of each shot was accurately determined by using a chronometer, U.V. recorder, and a time break oscillator (T.B.O.). The direct shock wave from each explosion was picked up by a geophone on the deck of the ship. This signal from the geophone caused a tone that was being generated by

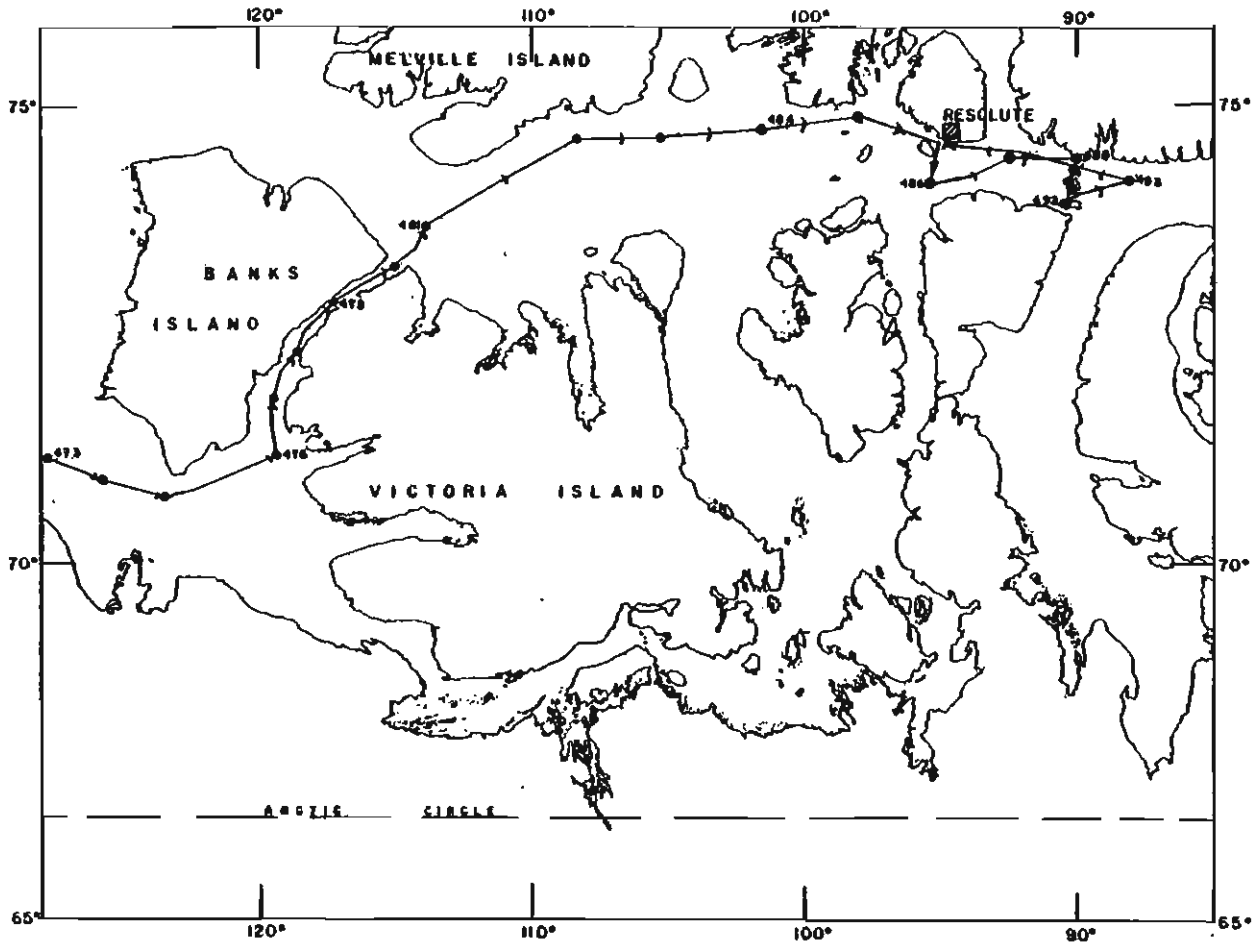
the T.B.O. and transmitted by radio to the receiving ship to be cut off for fifteen seconds. The time that the tone was cut off was the shot instant with only a convection for the shooting ship's distance from the explosion needing to be applied. As a precaution in case of T.B.O. or radio failure, the geophone signal of each shop was also recorded simultaneously on the U.V. recorder with a chronometer time signal and a time standard signal such as W.W.V. or C.H.U. The ship's position and the depth of water at each shot point was also recorded in a log.

Discussion and Comments:

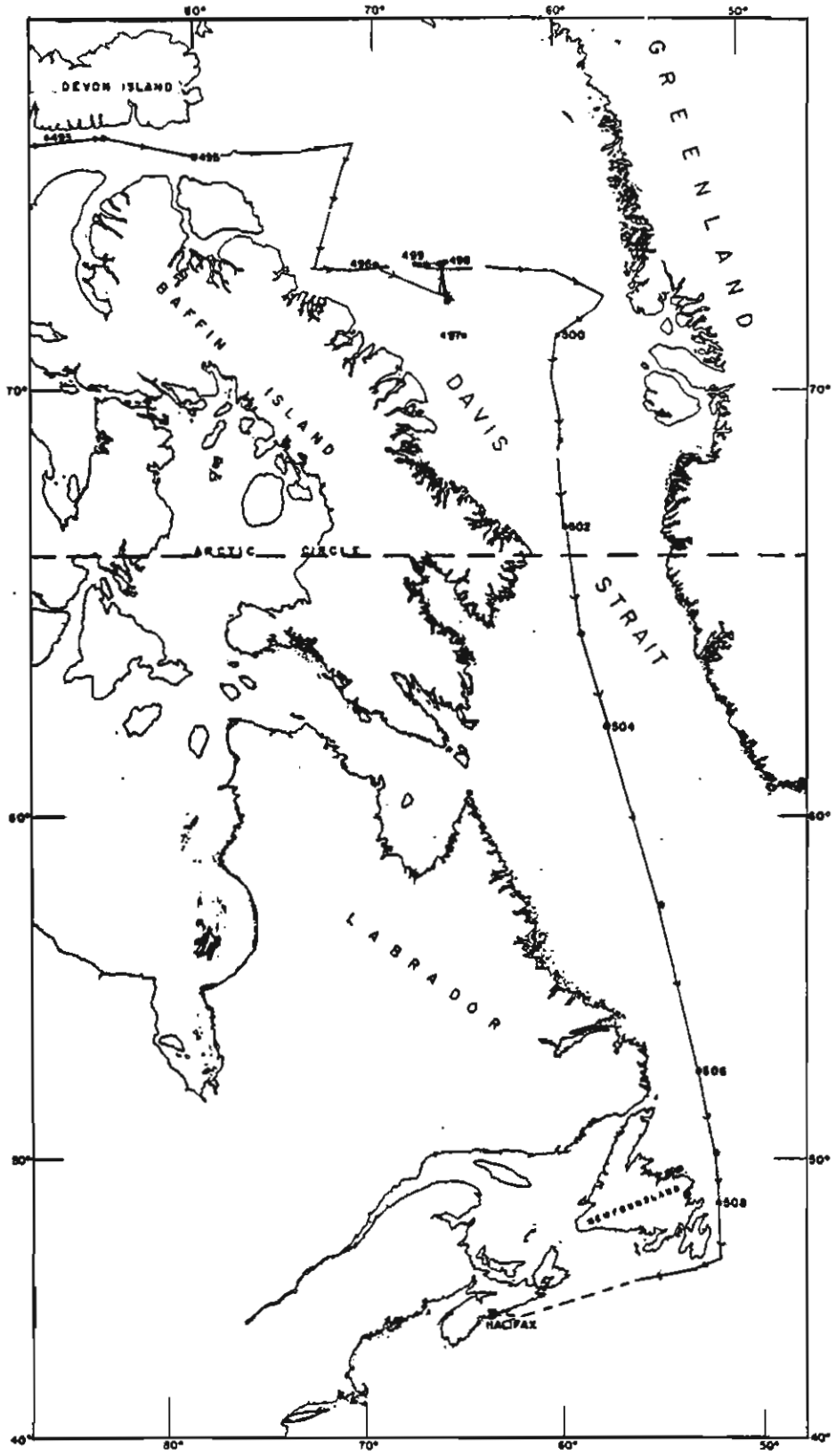
The use of the USCGC Edisto as a shooting ship in the Arctic was very satisfactory. The facilities were excellent and the ship's crew very helpful. Seventy-two charges were made up and put over the side; however, only fifty-four of these exploded with the others being misfires. This can be attributed to either the wrong type of boosters or a newly designed booster that is unsatisfactory for this purpose. Previously, the boosters were encased in copper and we would average about 1% misfires. The boosters we had this time were encased in plastic and we had about a 30% misfire average. As everything was similar to previous experiments except the booster, it is logical to state the booster was at fault. Most of the misfires were in charges over 150 lb. in size which apparently sink faster and greater water pressure is encountered before the charge explodes. This was partially remedied by using one-half pound TNT blocks and three pound C-3 demolition charges in place of the boosters. In the future, it should be mandatory that a few hundred pounds of geogel explosive should be available in case the boosters supplied do not work.

Preliminary Results:

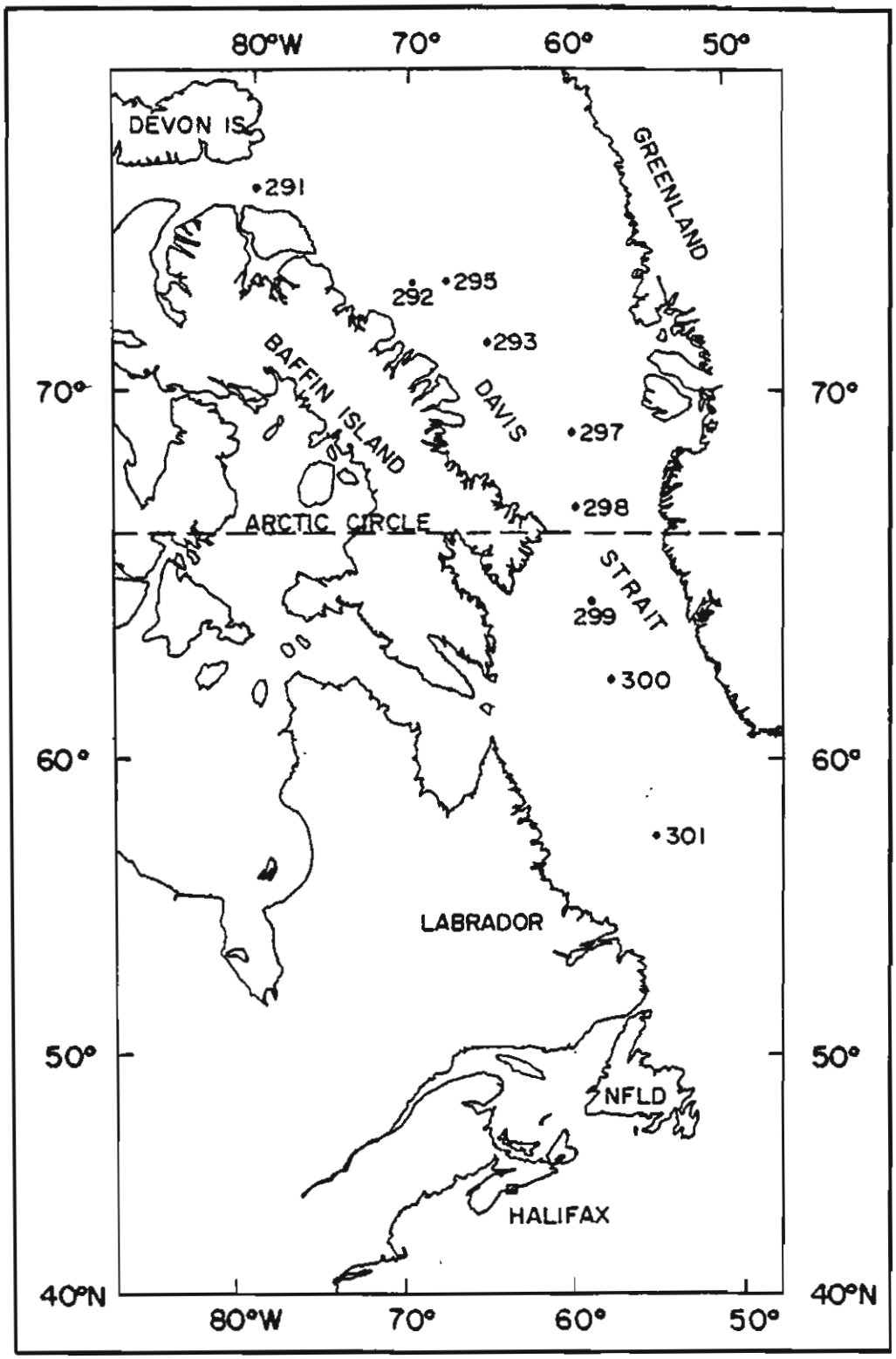
The preliminary results of this crustal refraction experiment indicate that there is a rather typical oceanic type crust underlying central Baffin Bay.



Cruise track and stations occupied up to Resolute during HUDSON 70.



Cruise track and station numbers during the final Phase (IX) of HUDSON 70 Resolute Bay to Halifax (BIO).



Oceanographic bottle stations occupied during the final phase of HUDSON 70