THE ARCTURUS OCEANOGRAPHIC EXPEDITION*

BY WILLIAM BEEBE

(Fig. 1 and Plates A. B. C.)

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I. INTRODUCTION

The Arcturus Oceanographic Expedition, the ninth expedition of the New York Zoological Society, sailed from Brooklyn on February 11th, 1925, and returned to New York on July 30th. In the interval we steamed a distance of over 13,600 miles, touching at Norfolk, Bermuda, Panama, Cocos Island and the Galapagos. We brought back 11,000 feet of first rate motion picture film, besides a great many colored plates and photographs. We established one hundred and thirteen stations, made hundreds of hauls with nets and dredges, threw overboard two thousand drift bottles containing the usual data.

The avowed objects of the expedition were the investigation of the Sargasso Sea and the mid and deep sea life beneath it, and the study of the Humboldt Current. Owing to continual storms the former was in such a disintegrated condition that I soon decided to postpone detailed study until a more favorable time. In the Pacific, to our surprise, we found that there was absolutely no trace of the Humboldt Current about the Galápagos. The inexplicable absence of this great, cold, Antarctic current was amply compensated for by the equally unexpected presence of unusual natural events.

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Fig. 1. S. Y. Arcturus.

Among the high lights of the expedition may be mentioned the great volcanic eruption on Albemarle Island, the albatross rookery on Hood, the remarkable results of hundreds of dives in a copper helmet and bathing suit in the shark-infested waters about Cocos and the Galapagos, a current rip, temporary and on an enormous scale in mid-Pacific. The accomplishment which, scientifically, proved to be the most valuable of all, was the result of my decision to make a ten-day stay in one spot in mid-ocean, Station 74, sixty miles south of Cocos where continual dredging yielded very remarkable collections of fish and crustaceans, equivalent to any two months of the less intensive work. The crustacea alone taken at this place equalled eighty percent of all the rest which we took in the Pacific.

Accurate accounts in popular language have already been brought out by me in "The Arcturus Adventure" published under the auspices of the Zoological Society by G. P. Putnam's Sons, New York City, a companion volume to "Galapagos: World's end."

The origin and evolution of life, men and expeditions are interesting. On the very day of my return from the Galapagos in the *Noma*, I was introduced to a recently elected member of the Board of Managers of the Zoological Society, Henry D. Whiton. Mr. Whiton said to me, "You seem tremendously interested in the Galapagos; if you ever want to go back there I will furnish the steamer if you can get someone else to provide the coal." So from this generous, tentative beginning there crystallized the twenty-four hundred ton steam yacht *Arcturus*, the specified coal, a splendid oceanographic outfit, a captain and a crew, and an expedition of six months' duration, which steamed from New York to the Sargasso Sea, thence to Cocos and the Galapagos, and which secured a host of treasures, from the most microscopic beings which contribute to the surface luminescence of the sea, to a giant devilfish weighing more than a ton.

The two chief contributors to the expedition were Henry D. Whiton, who gave the *Arcturus*, and Harrison Williams who provided three-fourths of the entire cost. Other generous contributors were Marshall Field, Clarence Dillon, Vincent Astor, The American Museum, George F. Baker, Jr., Arthur T. Newbold, Thomas S. Yates and Junius S. Morgan. Other gifts to be recorded are a sounding machine from William H. Trotter: Sets of Oceanographic books from Frederic C. Wolcott; motion picture negatives from George Eastman; Flashlights and batteries from the National

Plate A. Atlantic Ocean Stations. Arcturus Oceanographic Expedition.
From a drawing by John Tee-Van.

Carbon Co.; a powerful radio set from the Stromberg-Carlson Mfg. Co. and the launch *Pawnee* from Harry Payne Bingham. To Earnest Lester Jones, Chief of the Coast and Geodetic Survey, I am obliged for a host of kindnesses and the loan of valuable instruments, and to the U. S. Fisheries Bureau for the *Albatross* launch and much valuable gear.

The entire responsibility for the sea-going condition of the *Arcturus*, her complete overhauling and the supervision of the building of laboratories, dark-rooms, refrigerators, and oceanographic apparatus was assumed by Mr. J. R. Gordon and the naval architect, Edwin C. Bennett. Capt. Yates acted throughout for Mr. Williams, and it is to the whole-hearted enthusiasm and interest of these gentlemen that the smoothness of operation and general success of the mechanical basis of the expedition was due.

For Captain Howes and First Mate McLaughlin I have nothing but single-minded praise. No more willing, patient and capable seamen ever existed.

The scientific staff was of my own choosing, each of the seventeen members having a definite field of work, which they filled to the full extent of their ability. Without their loyalty, constant enthusiasm and coöperation, nothing of success could have been achieved.

The scientific working personnel was as follows: William Beebe, Director; W. K. Gregory, Associate in Vertebrates; L. Segal, Associate in Special Problems; C. J. Fish, Associate in Diatoms and Crustacea; John Tee-Van, General Assistant; William H. Merriam, Assistant in Field Work; Isabel Cooper and Helen Tee-van, Scientific artists; Ruth Rose, Historian and Technician; Marie Fish, Assistant in Larval Fish; Elizabeth Trotter, Assistant in Fish Problems; Dwight Franklin, Assistant in Fish Preparation; Jay F. W. Pierson, Assistant in Macroplankton; Don Dickerman, Assistant artist; E. B. Schoedsack, Assistant in Photography; Serge Chetyrkin, Preparator; D. W. Cady, Surgeon.

II. LIST OF STATIONS WITH ACCOMPANYING DATA

The abbreviations used in the individual hauls are as follows:

Station Number	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	V—Vertical net VC—Vertical closing net		D—Dredge RSD—Rope scallop dredge		Depth in Metres
		Lat. North	Long. West					T—Tow net PT—Petersen trawl	OT—Otter trawl BT—Blake trawl			
1	T1	26° 10'	56° 07'	580 m SE of Bermuda		Feb. 23	8.45 A.M.			1	15	0
	PT1						9.16 A.M.					0
	PT2						12.30 P.M.					0
	T2						1.40 P.M.					0
	PT3						1.40 P.M.					0
2	T3	25° 56'	55° 42'	{ 630 m. SE of Bermuda 625 m. NE of Sombbrero		Feb. 23	2.40 P.M.			1	273-0	0
	T4						3.28 P.M.					0
	V1						8.00 P.M.					0
	T5						8.00 P.M.					0
	T1						8.00 P.M.					0
3	T2	26° 19'	54° 53'	650 m. SE of Bermuda	4000	Feb. 24	4.00 A.M.			1	45	0
	T1						4.00 A.M.					0
	T3						6.00 P.M.					0
4	V1	26° 42'	52° 59'	745 m. SE of Bermuda	3000	Feb. 25	5.00 P.M.			1	30	510-0
	T1						6.30 P.M.					0
5	T2	26° 43'	52° 46'	720 m. SE of Bermuda		Feb. 25	6.30 P.M.			1	44	195-0
	V1						1.56 P.M.					357-0
	T1						3.03 P.M.					200
	T2						3.03 P.M.					76.6
	PT						3.24 P.M.					75
6	T3						3.30 P.M.					0
	T1	26° 54'	51° 15'	815 m. SE of Bermuda	3000	Feb. 26	7.50 P.M.			1	40	0
	PT1						7.40 P.M.					30
7	PT1	26° 58'	50° 52'	830 m. SE of Bermuda		Feb. 26	10.51 A.M.			1	640	3000
	T1						8.30 P.M.					0
8	T2						8.30 P.M.			1		0

Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
9	T1 V1 T2 T3 T4 T5 T6	27° 42'	46° 59'	1040 m. ESE of Bermuda	2529	Feb. 28	8.35 A.M. 2.47 P.M. 4.28 P.M.	30 24 1 53	0 66-0 273 500 1000 2000 2500 3000	
10	T1 T2 T3 T4	27° 58'	46° 54'	1040 m. ESE of Bermuda		Mar. 1	8.50 A.M. 8.50 A.M. 8.00 P.M. 8.00 P.M.	2 10 2 10 1 1	0 0 0 0	
11	D1 T1 T2 T3	27° 53'	46° 24'	1070 m. ESE of Bermuda 1070 m. SW of Azores 1115 m. NE of Sombbrero		Mar. 2	12.11 P.M. 7.30 P.M. 7.30 P.M. 7.30 P.M.	1 4 1 30 1 30 1 30	2491 0 0 0	4557 0 0 0
12	V1 V2 VC1 VC2 VC3	27° 58'	46° 52'	1020 m. ESE of Bermuda	2180	Mar. 3	8.59 A.M. 9.22 A.M.	15 37 14 57	109-0 273-0 546-273 1000-500 1093-546 2000-1000 1640-1093 3000-2000	200-0 500-0 1000-500 2000-1000 3000-2000
13	T1 T2	27° 44'	47° 10'	1030 m. ESE of Bermuda		Mar. 3	7.30 P.M. 7.30 P.M.	1 20 1 20	0 0	0 0
14	T1 T2 T3	26° 10'	50° 00'	890 m. NE of Sombbrero		Mar. 4	7.45 P.M. 7.45 P.M. 7.45 P.M.	1 1 1	0	0 0 0
15	PT1 PT2 PT3 T1 T2 T3	{ 12 noon 25° 29'	51° 00'	830 m. NE of Sombbrero	2790	Mar. 5	10.20 A.M. 10.20 A.M. 6.43 P.M. 6.45 P.M. 6.45 P.M. 6.45 P.M.	3 3 3 15 1 12 1 15 1 15 1 15	500 250 250 0 0 0	909 450 450
16	PT1	23° 42'	55° 09'	570 m. NE of Sombbrero		Mar. 7	9.30 A.M.	4	250	450
17	T1 T2	23° 25'	55° 31'	540 m. NE of Sombbrero		Mar. 7	8.00 P.M. 8.00 P.M.	1 1	0 0	0 0
18	T1 T2	22° 13'	57° 44'	380 m. NE of Sombbrero		Mar. 8	8.00 P.M. 8.00 P.M.	1 1	0 0	0 0

Plate B. Pacific Ocean Stations. Arcturus Oceanographic Expedition.

From a drawing by John Tee-Van.

Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
19	OT1 PT1 T1	21° 10'	58° 46'	320 m. NE of Sombbrero	3146	Mar. 9	10.00 A.M. 2.30 P.M. 7.00 P.M.	4 2 2	250 250 0	450 450
20	V1	19° 21'	61° 57'	100 m. NE of Sombbrero		Mar. 12	2.52 P.M.	8	109-0	200-0
21	T1 T2 T3	10° 07'	62° 31'	65 m. NE of Sombbrero		Mar. 12	8.00 P.M. 8.00 P.M. 8.00 P.M.	1 1 1	0 0 0	0 0 0
22	Dip Nets	17° 56'	63° 12'	8 m. S of St. Martin	200	Mar. 13	7.00 P.M.			
23	OT1 OT2 RSD1 RSD2	17° 39'	63° 17'	2 m. SW of Saba		Mar. 14	8.30 A.M. 10.00 A.M. 1.30 P.M. 3.00 P.M.	15 30 1 10	45 250 120 120	82 450 218 218
23a	RSD1 RSD2 BT1 BT2 BT3	17° 39'	63° 16'	2 m. SW of Saba		Mar. 15	1.27 P.M. 2.05 P.M. 3.04 P.M. 3.40 P.M. 4.12 P.M.	10 10 10 9 10	7 54.6 54.6 70 71	12.7 100 100 127 130
23b	RSD1 RSD2 (tangle)	17° 39'	63° 16'	2 m. SW of Saba	478	Mar. 15	9.15 A.M. 10.58 A.M.	10 29	656 820	1200 1500
24	dip nets	9° 22.5'	79° 56'	Colon, Panama		Mar. 21-27				
25	T1 T2 T3	6° 10'	80° 11'	65 m. S of Cape Malo		Mar. 29	7.00 P.M. 7.00 P.M. 7.00 P.M.	1 1 1	0 0 0	0 0 0
26	PT1	5° 03'	81° 18'	120 m. S of Mariato Point	2070	Mar. 30	9.13 A.M. 7.30 A.M. 9.50 A.M. 9.50 A.M. 9.13 A.M. 9.20 A.M.	1 1 20 20 1 40	273 136 19	500 0 0 250 35
27	T1	4° 30'	81° 49'	165 m. SW of Mariato Point		Mar. 30	7.00 P.M.	20	0	0
28	T1 T2			260 m. SE of Cocos	1805	Mar. 31	5.15 A.M. 5.15 A.M.	15 15	0 0	0 0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
29	T3 OT1						8.55 A.M. 9.15 A.M.	15 1	0 273	0 500
	T1 PT1 PT1	3° 23'	83° 33'	240 m. SE of Cocos		Mar. 31	3.50 P.M. 3.50 P.M.	30 30	136 273	250 500
	T1 T2	3° 23'	83° 34'			Mar. 31	8.00 P.M. 8.00 P.M.	20 20	0 0	0 0
	PT1 PT2	2° 36'	85° 01'	215 m. SSE of Cocos	1826	Apr. 1	8.45 A.M. 9.15 A.M.	15 20	0 13.6	0 25
30	PT3 PT4 T1 OT1	2° 8' 2° 4'	86° 17' 86° 31'			Apr. 2	9.00 A.M. 11.00 A.M. 11.00 A.M. 4.00 P.M.	1 2 2 2	0 273 136 0	0 500 250 0
	T1 T2	1° 14'	87° 50'	140 m. N.E of Tower	1462	Apr. 3	5.40 A.M. 5.40 A.M.	20 20	0 0	0 0
	T1 PT1 T2 T3	0° 40'	88° 51'	70 m. NE of Tower	1392	Apr. 3	2.00 P.M. 2.27 P.M. 8.00 P.M. 8.00 P.M.	1 1 25 25	0 700 0 0	0 1274 0 0
	T1 T2	0° 00'	90° 00'	20 m. South of Tower	559	Apr. 4	5.30 A.M. 5.30 A.M.	30 30	0 0	0 0
35				22 m. NE of Indefatig- able	710	Apr. 4				
36	T1 T2	0° 27'	90° 19'	1 m. W of Seymour		Apr. 4-6	9.30 A.M. 4.00 P.M.	30 30	0 0	0 0
37	T1 T2 T3 T4 T5 T6 T7 T8 T9	0° 19'	89° 57'	Darwin Bay, Tower		Apr. 7	7.30 P.M.	30	0	0
						8	7.30 P.M.	30	0	0
						9	11.00 A.M.	30	0	0
						9	7.10 P.M.	20	0	0
						10	7.30 P.M.	30	0	0
						16	7.30 P.M.	30	0	0
						17	7.30 P.M.	30	0	0
						18	7.30 P.M.	30	0	0
						19	7.30 P.M.	30	0	0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
38	PT1 PT2 T1 T2	0° 17'	90° 02'	7 m. W of Tower	448	Apr. 11	12.13 P.M. 3.23 P.M. 6.45 P.M. 6.45 P.M.	1 35 35	300 500 0 0	545 909 0 0
39	T1 T2 T3 PT1 T4 T5 T6 PT2	0° 05'	91° 11.5'	1 m. off NE coast of Al- bemarle	1039	Apr. 12	7.30 P.M. 7.30 P.M. 8.10 P.M.	30 30 30	0 0 0	0 0 0
						Apr. 13	10.48 A.M. 10.48 A.M. 7.15 A.M. 7.15 A.M. 2.57 A.M.	1 1 30 30 57	500 250 0 0 600	909 450 0 0 1090
40	T1 D1	0° 14'	91° 18'	5 m. N of Albemarle	1647	Apr. 14	4.20 A.M. 11.11 A.M.	30 36		
41	T1 T2 T3	0° 31'	91° 00'	13 m. W of Abingdon	1409	Apr. 14	6.45 P.M. 6.45 P.M. 7.55 P.M.	30 30 10	0 0 0	0 0 0
42	T1 T2	0° 32'	91° 06'	20 m. W of Abingdon		Apr. 15	4.50 A.M. 4.50 A.M.	25 25	0 0	0 0
43	D1 PT1	0° 34'	90° 47'	½ m. W of Abingdon	431	Apr. 15	10.48 A.M.	32	225	
44	PT1	0° 27'	90° 42'	Midway between Ab- ingdon & Bindloe	548	Apr. 15	3.10 P.M.	50	250	450
45	OT1 T1 T2 T3	0° 20'	90° 10'	12 m. W of Tower	493	Apr. 15	9.35 P.M. 9.30 P.M. 9.30 P.M. 9.35 P.M.	33 30 30 30	205 0 0 200	372 0 0 363
46				Darwin Bay, Tower						
47	T1	0° 03'	89° 50'	23 m. S of Tower		Apr. 20	9.30 P.M.	20	0	0
48	PT1 T1 T2 T3	1° 20' (S)	89° 33'	12 m. E of Hood	174	Apr. 21	4.18 P.M. 4.10 P.M. 4.18 P.M. 4.30 P.M.	27 25 27 15	50 0 50 0	90 0 90 0
49	PT1			10 m. SE of Hood	401	Apr. 21	7.40 P.M.	55	200	363

Plate C. Galapagos Islands' Stations. Arcturus Oceanographic Expedition.

From a drawing by John Tee-Van.

Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
50	T1	2° 00' (S)	89° 30'	34 m. SE of Hood	1820	Apr. 22	7.40 P.M.	55	200	363
	T2						8.10 P.M.	20	0	0
	T1						12.40 P.M.	1	0	0
	T2						12.40 P.M.	1	400	727
	T3						12.40 P.M.	1	800	1454
	OT1						12.40 P.M.	1	800	1454
51	T4	2° 33' (S)	89° 44'	67 m. S of Hood	1835	Apr. 23	12.40 P.M.	1	1200	2181
	T5						12.40 P.M.	1	1200	2181
	PT1						7.00 P.M.	30	0	0
	T1						9.00 A.M.	2	273	500
	T2						9.00 A.M.	2	54	100
	T3						9.00 A.M.	2	164	300
52	PT2	2° 00' (S)	89° 48'	34 m. S of Hood	1733	Apr. 23	9.00 A.M.	2	273	500
	T4						2.30 P.M.	1	800	1454
	T1						6.30 P.M.	30	0	0
	T2						7.30 P.M.	30	0	0
	T3						7.30 P.M.	30	0	0
	T4						9.00 P.M.	30	0	0
53	D1	1° 51' (S)	89° 50'	25 m. S of Hood	1733	Apr. 24 Apr. 25	9.40 A.M.	35	1733	3156
	T1						9.40 A.M.	35	1093	2000
	T2						9.40 A.M.	35	800	1463
	T3						7.20 P.M.	25	0	0
	D2						7.00 A.M.	1	1733	3156
	T1						7.20 P.M.	25	0	0
54	T2	1° 22' (S)	89° 39'	Gardner Bay, Hood		Apr. 25 Apr. 26 Apr. 27	7.30 P.M.	20	0	0
	T3						7.30 P.M.	20	0	0
	T1						8.00 P.M.	20	0	0
55	T1	1° 16' (S)	89° 28'	13 m NE of Hood		Apr. 28	8.00 P.M.	20	0	0
56	T1	0° 10'	88° 22'	98 m. E of Tower	1388	Apr. 29	3.04 P.M.	44	400	727
							3.04 P.M.	44	800	1463
							3.04 P.M.	44	800	1463
57	T1	0° 22'	88° 11'	105 m. E of Tower		Apr. 29	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
58	T1	2° 42'	86° 56'	170 m. S of Cocos		Apr. 30	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul		Depth in Fathoms	Depth in Meters
		Lat. North	Long. West					H	M		
69	T2	5° 56'	86° 52' }	20 m. N of Cocos	1334	May 14	9.12 A.M.	1	33	400	727
	T3							1	33	500	909
	T4							1	33	600	1090
	T5							1	33	600	1090
	PT1							1	33	600	1090
70	T1	5° 58'	86° 50' }		1251	May 14	6.45 P.M.	30	35	0	0
	T2						7.55 P.M.			0	0
71		5° 38'	86° 48'	10 m. NE of Cocos	335	May 15					
72		5° 32'	86° 59'	Chatham Bay, Cocos		May 14-24					
73	T1	5° 28'	86° 54'	6 m. S of Cocos		May 24	8.00 P.M.	30		0	0
	T2										
74	T1	4° 50'	87° 00'	60 m. S of Cocos	514-900	May 25	9.30 A.M.	1	30	0	0
	T2						9.15 A.M.	1	33	150	272
	T3						9.15 A.M.	1	30	300	545
	T4						9.15 A.M.	1	30	500	909
	T5						9.15 A.M.	1	33	600	1090
	PT1						9.15 A.M.	1	33	600	1090
	T6						2.00 P.M.	1	47	350	636
	T7						2.00 P.M.	1	47	450	818
	T8						2.00 P.M.	1	47	500	909
	T9						2.00 P.M.	1	47	600	1090
	PT2						2.00 P.M.	1	47	600	1090
	T10						7.30 P.M.	1	30	0	0
	V1					May 26				546-0	1000-0
	V2									273-0	500-0
	V3									164-0	300-0
	VC2									382-273	700-500
	VC3									273-164	500-300
	V4									273-0	500-0
	VC4									273-0	500-0
	VC5									273-164	500-300
	V5									164-0	300-0
	VC6									546-382	1000-700
	V6									382-0	700-0
	VC7									710-546	1300-1000
	V7									546-0	1000-0
	T11						7.15 P.M.		45	0	0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
	T12					May 27	7.15 P.M.	45	0	0
	T13						9.45 A.M.		0	0
	T14						9.08 A.M.	1 37	300	545
	T15						9.08 A.M.	1 37	450	818
	T16						9.08 A.M.	1 37	550	1000
	T17						9.08 A.M.	1 37	600	1090
	PT3						9.08 A.M.	1 37	620	1127
	T18						2.19 P.M.	1 26	300	545
	T19						2.19 P.M.	1 26	450	818
	T20						2.19 P.M.	1 26	550	1000
	T21						2.19 P.M.	1 26	600	1090
	PT4						2.19 P.M.	1 26	600	1090
	T22						7.00 P.M.	30	0	0
	T23						7.30 P.M.	30	0	0
	T24						8.00 P.M.	30	0	0
	T25						8.30 P.M.	30	0	0
	OT1					May 28	9.47 A.M.	58	900	1636
	T26						7.30 P.M.	45	0	0
	OT2					May 29	9.00 A.M.	40	750	1363
	OT3						2.11 P.M.	1 29	833	1514
	T27						2.11 P.M.	1 29	500	909
	OT4					May 30	9.06 A.M.	31	625	1145
	OT5						2.03 P.M.	1 37	625	1145
	T28						7.00 P.M.	30	0	0
	T29						8.00 P.M.	30	0	0
74 cont.	OT6					May 31	lost		844	1534
	D1						7.33 A.M.	27	0	0
	T30						2.00 P.M.	30	0	0
	T31						3.00 P.M.	30	0	0
	T32						4.00 P.M.	30	0	0
	T33						5.00 P.M.	30	0	0
	T34						6.00 P.M.	30	0	0
	T35						7.00 P.M.	30	0	0
	T36						8.00 P.M.	30	0	0
	T37						9.00 P.M.	30	0	0
	T38						10.00 P.M.	30	0	0
	T39						11.00 P.M.	30	0	0
	T40					June 1	12.00 A.M.	30	0	0
	T41						1.00 A.M.	30	0	0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Meters
		Lat. North	Long. West							
	T42						2.00 A.M.	30	0	0
	T43						3.00 A.M.	30	0	0
	T44						4.00 A.M.	30	0	0
	T45						5.00 A.M.	30	0	0
	T46						6.00 A.M.	30	0	0
	T47						7.00 A.M.	30	0	0
	T48						8.00 A.M.	30	0	0
	D2					3	7.00 A.M.	787	1430	0
	T49						9.00 A.M.	30	0	0
	T50						10.00 A.M.	30	0	0
	T51						11.00 A.M.	30	0	0
	T52						12.00 P.M.	30	0	0
	T53						1.00 P.M.	30	0	0
	T54						2.00 P.M.	0	0	0
	T55						3.00 P.M.	0	0	0
	T56						4.00 P.M.	0	0	0
	T57						5.00 P.M.	0	0	0
	T58						6.00 P.M.	15	0	0
	T59						6.15 P.M.	15	0	0
	T60						6.30 P.M.	15	0	0
	T61						6.45 P.M.	15	0	0
	T62						7.00 P.M.	15	0	0
	T63						7.15 P.M.	15	0	0
	T64						7.30 P.M.	15	0	0
	T65						7.45 P.M.	15	0	0
	T66						8.00 P.M.	0	0	0
	T67						8.00 P.M.	0	0	0
	OT7									
	T68					June 2	2.30 P.M.	1	749	1361
	T69						2.30 P.M.	1	300	545
	T70							30	400	727
	T71							30	500	909
	PT5								600	1090
	T72						7.00 P.M.	1	600	1090
	T73						8.00 P.M.	1	0	0
	T74								0	0
	T75					June 3	9.32 A.M.	1	400	727
	T76						9.32 A.M.	1	400	727
	T77						9.32 A.M.	1	500	909
	T78						9.32 A.M.	1	600	1090
	PT6						9.32 A.M.	1	700	1274
	D3						9.32 A.M.	1	700	1274
						June 4	1.45 P.M.	1	765	1390
75		4° 03'	87° 05'	90 m. S of Cocos						

Station Number	Individual Haul	Position		General Locality	Nearest Sounding in Fathoms	Date 1925	Time	Duration of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
76		3° 45'	87° 22'	110 m. S of Cocos		June 4				
77	T1 T2	3° 34'	87° 33'	125 m. S of Cocos	1205	June 4	8.00 P.M.	1	0	0
78	T1 T2	2° 12'	89° 01'	125 m. NE of Tower	1322	June 5	8.00 P.M.	1	0	0
79		1° 00'	90° 04'	40 m. N of Tower	1249	June 6				
80	T1 T2 T3	00° 44'	90° 45'	7 m. N of Abingdon		June 6	8.00 P.M.	30	0	0
81		00° 10' (S)	91° 31'	Banks Bay, Albemarle	118	June 7				
82		00° 12' (S)	91° 28'	Banks Bay, Albemarle	953	June 7				
83 84	T1 T2 T3 T4 PT1 T5 T6	00° 16' 0° 17' (S)	91° 23' 91° 34'	Tagus Cove, Albemarle 1 m. N of Narborough	627	June 7-9 June 9	1.45 P.M. 1.45 P.M. 1.45 P.M. 1.45 P.M. 1.45 P.M. 7.30 P.M. 8 00 P.M.	2 2 2 2 2 30 1	300 400 450 500 500 0 0	545 727 818 909 909 0 0
	T7 T8 T9						9.11 P.M. 9.11 P.M. 9.11 P.M.	1 1 1	14 14 450	545 727 818
	PT2 T10 T11 T12 T13 T14						9.11 P.M. 1.55 P.M. 1.55 P.M. 1.55 P.M. 1.55 P.M.	1 1 1 1 1	14 45 400 300 450	545 909 727 545 818
	PT3 T15 T16 T17 T18						1.55 P.M. 7.00 P.M. 7.00 P.M. 8.00 P.M.	1 1 1 1	45 500 500 0	909 909 0 0
	T19 T20 T21 T22 PT4					June 11	8.00 P.M. 2.06 P.M. 2.06 P.M. 2.06 P.M. 2.06 P.M.	1 1 1 1 1	0 400 500 600 700	0 0 828 909 1090 1274 1274

Station Number	Individual Haul	Position		General Locality	Nearest Sound-ing in Fathoms	Date 1925	Time	Dura-tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
94	T1	28° 10'	64° 35'	250 m. S of Bermuda		July 9	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0
95	T1	29° 13'	62° 00'	270 m. SE of Bermuda		July 10	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	6 ft.	
	T3						8.00 P.M.	30	0	0
96	T1	30° 00'	60° 00'	280 m. SE of Bermuda	2875	July 11	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0
	V1	30° 01'	60° 03'			July 12	8.00 P.M.	30	0	0
	V2								546-0	1000-0
	T4						10.36 A.M.	28	1093-0	2000-0
	T5						10.36 A.M.	28	150	272
	T6						10.36 A.M.	28	300	545
	T7						10.36 A.M.	28	500	909
	T8						10.36 A.M.	28	600	1090
97	PT1						10.36 A.M.	28	1200	2181
								2	1200	2181
	V1	30° 49'	61° 21'	190 m. SE of Bermuda		July 13	8.56 A.M.	24	820-0	1500-0
	V2						10.11 A.M.	28	546-0	1000-0
	VC1						11.20 A.M.	23	273-164	500-300
	VC2								478-324	893-593
	VC3						2.20 P.M.	30	546-437	1000-800
	VC4								437-273	800-500
	VC5								820-546	1500-1000
	T1						8.00 P.M.	30	0	0
98	T2						8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0
	VC1	31° 22'	62° 35'	125 m. SE of Bermuda	2587	July 14	10.44 A.M.	51	820-546	1500-1000
	VC2						11.44 A.M.	11	164-0	300-0
	V2						12.52 P.M.		1093-820	2000-1500
99	V3								273-0	500-0
	V4						3.30 P.M.		437-0	800-0
	V5								546-0	1000-0
		31° 57'	64° 00'	45 m. SE of Bermuda		July 15	4.40 P.M.		820-0	1500-0
100	T1	32° 00'	65° 00'	10 m. S of Bermuda		July 15	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
	T3						8.00 P.M.	30	0	0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
101	T4	32° 26'	66° 23'	75 m. W of Bermuda	2624	July 16	8.45 P.M.	1 45	0	0
	D1						8.35 A.M.	6	29	54
	D2						9.28 A.M.	12	29	53
	T5						11.49 A.M.	2 13	300	545
	T6						11.49 A.M.	2 13	400	727
	T7						11.49 A.M.	2 13	500	909
	PT1						11.49 A.M.	2 13	500	909
	T8						8.00 P.M.	30	0	0
	T9						8.00 P.M.	30	0	0
	T10						8.02 P.M.	1 1	200	363
	T11						8.02 P.M.	1 1	300	545
	T12						10.07 A.M.	3 1	0	0
102	T13	32° 26'	66° 23'	75 m. W of Bermuda	2624	July 17	10.07 A.M.	3 1	100	181
	T14						10.07 A.M.	3 1	200	363
103	T15	32° 00'	68° 00'	160 m. W of Bermuda		July 18	10.07 A.M.	3 1	300	545
	T16						10.07 A.M.	3 1	400	727
104	T17	33° 58'	70° 21'	275 m. NW of Bermuda		July 19	10.07 A.M.	3 1	500	909
	T18						10.07 A.M.	3 1	600	1090
105	T19	34° 27'	71° 36'	210 m. ESE of Cape Hatteras	2803	July 20	10.07 A.M.	3 1	700	1274
	T20						10.07 A.M.	3 1	800	1454
106	T1	32° 26'	66° 23'	75 m. W of Bermuda	2624	July 18	8.00 P.M.	30	0	0
	T2						8.00 P.M.	30	0	0
	T3									
	T4									
	T5									
	T6									
107	T1	32° 00'	68° 00'	160 m. W of Bermuda		July 20	1.48 P.M.	1 48	0	0
	T2						1.48 P.M.	1 48	250	450
	T3						1.48 P.M.	1 48	500	909
	T4						1.48 P.M.	1 48	600	1090
	T5						1.48 P.M.	1 48	700	1274
	T6						1.48 P.M.	1 48	800	1454
108	T1	33° 58'	70° 21'	275 m. NW of Bermuda		July 21	1.48 P.M.	1 52	0	0
	T2						1.48 P.M.	1 52	250	450
	T3						1.48 P.M.	1 52	500	909
	T4						1.48 P.M.	1 52	600	1090
	T5						1.48 P.M.	1 52	700	1274
	T6						1.48 P.M.	1 52	800	1454

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
108	T1	36° 55'	74° 12'	90 m. E of Chesapeake Bay	1091	July 22	11.12 A.M.	1	0	0
	T2						11.12 A.M.	1	300	545
	T3						11.12 A.M.	1	400	727
	T4						11.12 A.M.	1	500	909
	T5						11.12 A.M.	1	600	1090
	T6						11.12 A.M.	1	700	1274
109	D1	36° 56'	75° 28'	30 m. E of Chesapeake Bay		July 23	8.45 A.M.	20	19	36
	D2						8.45 A.M.	20	32	60
110	T1	30° 16'	74° 58'	45 m. E of Chesapeake Bay		July 23	8.00 P.M.	30	0	0
111	PT1	38° 00'	74° 02'			July 24	9.07 A.M.	20	60	109
	D1						11.46 A.M.	54	0	0
112	D2	38° 31'	73° 12'	100 m. SE of Delaware Bay		July 24			382	694
	T1						8.00 P.M.	30	0	0
113	D1	39° 15'	72° 00'	125m. SE of City Hall, N. Y. City	950-1200	July 25	8.52 A.M.	31	633	1150
	T1						11.35 A.M.	27	300	545
	T2					July 26	11.35 A.M.	1	350	636
	T3						11.35 A.M.	1	400	727
	T4						11.35 A.M.	1	450	818
	T5						11.35 A.M.	1	500	909
	T6						10.00 P.M.	27	0	0
	T7						11.00 P.M.	30	0	0
	T8						12.00 A.M.	30	0	0
	T9						1.00 A.M.	30	0	0
	T10						2.00 A.M.	30	0	0
	T11						3.00 A.M.	30	0	0
	T12						4.00 A.M.	30	0	0
	T13						5.00 A.M.	30	0	0
	T14						6.00 A.M.	30	0	0
	T15						7.00 A.M.	30	0	0
	T16						8.00 A.M.	30	0	0
	T17						9.00 A.M.	30	0	0
	T18						10.00 A.M.	30	0	0
	T19						11.00 A.M.	30	0	0
	T20						12.00 P.M.	30	0	0
	T21						1.00 P.M.	30	0	0
	T22						2.00 P.M.	30	0	0
	T23						3.00 P.M.	30	0	0
								30	0	0

Sta- tion Num- ber	Individual Haul	Position		General Locality	Nearest Sound- ing in Fathoms	Date 1925	Time	Dura- tion of Haul H M	Depth in Fathoms	Depth in Metres
		Lat. North	Long. West							
	T24 T25 T26 T27 T26 T27 T28 T29 VC1 VC2 V1 V2 V3 V4 V5 T30 T31 T32 T33 T34 T35 T36 T37 T38 T39 PT1 T40 T41 T42 T43 T44 T45 PT2 T46					July 27	4.00 P.M. 5.00 P.M. 6.00 P.M. 7.00 P.M. 6.00 P.M. 7.00 P.M. 8.00 P.M. 9.00 P.M.	30 30 30 30 30 30 30 30	0 0 0 0 0 0 0 0 437-273 546-437 546-0 229 164-0 54-0	0 0 0 0 0 0 0 0 800-500 1000-800 1000-0 419-0 300-0 100-0
						July 28	3.20 P.M. 3.20 P.M. 3.20 P.M. 8.30 P.M. 9.29 A.M. 9.29 A.M. 9.29 A.M. 9.29 A.M. 9.29 A.M. 9.29 A.M. 2.04 P.M. 2.04 P.M. 2.04 P.M. 2.04 P.M. 2.04 P.M. 2.04 P.M. 2.04 P.M. 8.00 P.M.	53 53 53 30 31 31 31 31 31 31 44 44 44 44 44 44 44 30	54 109 164 0 500 600 700 800 900 1000 1000 700 800 900 1000 1100 1200 1200 0	100 200 300 0 909 1090 1274 1454 1636 1818 1818 1274 1454 1636 1818 2000 2181 2181 0
	D2 D3 PT3					July 29			69 69 69	127 127 127

Depths Metres	Sta. 50		Sta. 51		Sta. 56		Sta. 59		Sta. 66		Sta. 68		Sta. 74		Sta. 84	
	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.	C.	C.T.
0	0	25.9	-0.05	23.45	0	27.2	0	27.5	0	28.5	0	28	0	27.5	0	22.1
25	0	—	—	22.1	0	23.2	0	27.9	0	26.5	0	28.65	0	27.1	0	20.6
50	—	—	—	—	—	—	—	22.55	—	18.3	—	23.67	0	19.97	—	22.0
75	-0.05	22.45	0	21.47	-0.15	18.75	+0.05	22.55	-0.15	18.3	-0.1	23.67	-0.1	19.97	—	22.0
	—	17.7	-0.05	—	-0.1	—	+0.05	—	-0.15	—	-0.05	—	-0.15	—	—	—
100	-0.15	15.45	-0.05	20.87	-0.1	16.25	-0.2	14.3	-0.2	13.97	-0.25	15.57	-0.25	14.57	-0.05	18.75
150	-0.15	—	0	—	-0.15	—	-0.2	—	-0.2	—	-0.2	—	-0.2	—	-0.05	—
250	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
300	-0.2	11.6	-0.2	11.9	-0.2	12.22	-0.25	11.3	-0.2	11.27	-0.25	11.20	-0.2	11.62	-0.2	11.8
450	-0.2	—	-0.2	—	-0.25	—	-0.25	—	-0.25	—	-0.3	—	-0.2	—	-0.2	—
500	-0.25	8.32	-0.3	7.9	-0.25	8.25	-0.25	8.1	-0.25	7.92	-0.3	8.3	-0.25	8.35	-0.25	7.95
1000	-0.4	4.8	-0.3	—	-0.25	—	-0.25	—	-0.2	—	-0.3	—	-0.25	—	-0.25	—
1500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	-0.5	3.17	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2000	-0.45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	-0.5	2.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2500	-0.45	1.95	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	-0.55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3000	-0.45	1.72	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	-0.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Note: C. = Correction.
C.T. = Corrected Temperature—or average of 2 corrected readings.
* 2 sets thermometers taken at this depth: 1 = first set, 2 = second set.

IV. CHLORINE IN SEA WATER 0/00.

BY TITRATION WITH SILVER NITRATE

MADE BY JOHN B. WILSON, ASSOC. CHEMIST.

Bureau of Chemistry, U. S. Department of Agriculture

Station No.	Surface	25M	50M	75M	100M	250M	300M	450M	500M	1000M	1500M	2000M	2500M	3000M
3.	20.46						19.36							
5.	20.46		19.48				20.11		19.92	19.57				
9.	20.46		20.52		20.64		20.70		20.26	19.74				
15.	20.35				20.60		20.26		19.97	19.46	19.28			
16.	20.00				20.16		20.05		19.51	19.26	19.40			
20.	18.92		19.45		19.37		19.22		19.22					
26.	18.70		19.21		19.38		19.31		19.21	19.17				
28.	18.75	18.74	18.74		18.89				19.23					
31.	18.33		18.80		18.44		19.27	19.33						
31B.			19.47				19.31	19.15						
33.			19.26		19.40									
35.	18.87	18.89	19.26											
38.	18.62	18.76	18.95											
39.	18.66	18.69	19.16		19.36		19.24							
40.	18.46	17.79	19.17				19.29							
50.	18.78	19.12	19.28	19.45	19.34		19.30		19.34	19.06	19.11	19.11	19.14	19.19
51.	18.91	19.45	19.54	19.44	19.48		19.34		19.20					
56.	18.77	18.96	19.44		19.39		19.36		19.04					
59.	17.76	18.17	18.86		19.30		19.17		19.20					
66.	17.79	18.73	19.16		19.27		19.32		19.18					
68.	18.24	18.61	19.06		19.25		19.25		19.16					
74.	17.88	18.25	19.98		19.38		19.25		19.10					
84.	19.32	19.32	19.56		19.45		19.22		19.18					
96.	20.14				20.21		20.23		20.08	20.03	19.39			
98.	20.20				20.20		20.13		20.14	19.59	19.36			
99.	20.19				19.25		20.14			20.15				
101.	20.10				19.85		20.11		20.06	19.58	19.39			
103.	19.97				20.16		20.20		20.18	19.55	19.41			
104.	20.00				20.15		20.14		20.16	19.46				
105.									19.76	19.41				

Land-locked Lagoon, Tower Island April 17, '25 Surface. Edge 22.14

Land-locked Lagoon, Tower Island April 17, '25 Surface. Center 25.40

Green Water, near Volcano, Albemarle Island 18.72

V. RÉSUMÉ OF STATION AND HAUL RESULTS

As introduction to this preliminary survey of the plankton hauls of the *Arcturus* Expedition it may be worth while to quote a few paragraphs from one of my recently published popular accounts.*

One dark, moonless evening I put out a silk surface net the mouth of which was round, and about a metre, or a yard, in diameter.

At the further end of the net a quart preserve jar was tied to receive and hold any small creatures which might be caught as the net was drawn slowly along the surface of the water. This was done at the speed of two knots, and, as I have said, was continued for the duration of one hour. When drawn in, the net sagged heavily and we poured out an overflowing mass of rich pink jelly into a white, shallow tray. This I weighed carefully, and then took, as exactly as possible, a one-hundred-and-fiftieth portion. I began to go over this, but soon became discouraged, and again divided it and set to work on one-sixth of the fraction on which I had first started. After many hours of eye-straining and counting under the microscope, I conservatively estimated my one-hundred-and-fiftieth part of the hour's plankton haul as follows:—

Feathery copepods—Candace-like	7,920
Bright blue copopods—Pontella-like	71,400
Other copopods—Calanus-like	139,320
Bivalve crustacea—Ostracods	4,920
Short-eyed shrimps	720
Siphonophores	14,400
Heliced snails	8,880
Purple <i>Ianthina</i> snails	13,440
Egg masses of snails	1,080
Free eggs, various	5,280
Clio-like pteropods	2,520
Limacina-like pteropods	240
Cavolinia-like pteropods	960
Total of specimens	271,080

If we multiply this by one hundred and fifty we get forty million, six hundred and sixty-two thousand individuals. Please remember that this is a very conservative estimate of only a few of the more easily counted groups in one small haul of an hour's duration, and the magnitude of the life of the sea will begin to dawn

* *The Arcturus Adventure*, pp. 199–200.

upon our minds. Twelve hours later—in full daylight—I repeated the haul as closely as possible and, instead of forty million, I captured about one thousand individuals of the corresponding groups.

The above figures give a more vivid meaning to the terms of relative occurrence, such as Abundant, Common and Many, which I have used in the following data. At my suggestion Dr. C. J. Fish kept a relatively accurate tally of the more easily recognizable groups of invertebrates of the plankton hauls, while I made a corresponding catalogue of the fish. For this purpose there was no attempt at specific identification, but the mere listing, in relative abundance, of the hundred-odd groups which leaped to the eye out of the quarts of millions of living organisms.

Reference to the Station data given in preceding pages will furnish the details of each haul, which can then be correlated with the present scheme. Future papers will present the exact identification of the various components.

As regards the symbols of relative abundance and rarity, after considerable thought, I have altered the scheme which I use in ecological work in the jungle,* and have made a compromise with that of Dr. Fish. This is as follows:—

A—Exceedingly Abundant

C—Common; Abundant

M—Many

F—Few

R—Rare; Very Few

Applying this to the count made on page 27 I should adopt the following:

A—Calanus copepods	139,320
C—Pontella copepods	71,400
M—Siphonophores	14,400
F—Limacina pteropods	240

The sequence of groups under each haul is by relationship. In the case of unidentified species I have sometimes used arbitrary popular names which at least indicate the general group.

* *Zoologica*, VI, No. 1, p. 43.

VI. PACIFIC DEPTH PLANKTON HAULS

As closing nets were not used, there is, in the following tables, a small percentage of error, from the organisms, however few in number, which entered the nets during their comparatively rapid ascent to the surface. Rather than attempt to orient these I have chosen to include the sporadic occurrence of such obviously out-of-place organisms as *Halobates* at 300 and 600 fathoms and *Glaucus*, *Ianthina* and *Pontella* at 600 and 800 fathoms.

20—Fathom Plankton

Station and Haul	26 OT1
Siphonophores (transparent)	M
Jellyfish (transparent)	F
Sagitta (large)	A
Firola	M
Copepods	R
Eucalanus	R
Amphipods	M
Hyperid Amphipods	M
Lucifer	M
Macruran larvae	M
Bachyura megalops	1
Squilla larvae	C

50—Fathom Plankton

	48 T2
Hydromedusae	M
Sagitta (small)	C
Tomopteris	1
Creseis acicula	C
Cresia conica	C
Cavilina uncinata	2
Copepods (small pink)	C
Eucalanus	F
Hyperids (yellow)	F
Euphausids (young)	F
Porcellana larvae	1
Halobates	1

100—Fathom Plankton

	59 T2	86 PT1	87 T1
Heliozoans (red)	M		
Radiolarians			M
Liriope			1
Tomopteris	1		
Gastropods	F		
Atlanta	2	1	
Cymbulia sibogae	1		
Copepods (small pink)	F		
Caligus (brown)			F
Hyperids (yellow)			1
Gnathophausia willemoesia		F	
Euphausids	F		
Macrurans (red)		R	

150—Fathom Plankton

	26 T4	29 T1	31 T1	51 T2	59 T7	61 T2	74 T2
Siphonophores	M		M				C
Pleurobrachia (small)						F	
Beroe (pink)						F	
Annelids	1						R
Tomopteris	R						
Sagitta	C		F		F	R	F
Clio	C						
Firola	F			R		F	F
Hyalocylix striata		F	C		M	M	M
Creseis		R	C				R
Cavolina longirostris			M				
Atlanta				R			
Clionopsis grandis				R			
Diacra quadridentata						R	R
Limacina inflata							A
Cymbulia sibogae					A		

150—Fathom Plankton (*Continued*)

	26 T4	29 T1	31 T1	51 T2	59 T7	61 T2	74 T2
Glaucus			2				
Ostracods (small white)						C	F
Ostracods (orange)	F				F	F	F
Copepods (small pink)				C	F	M	
Eucalanus elongatus	A			M			R
Pontella			C		R		
Sapphirina	F		R				F
Mysids			R		R		
Candace					R		
Hyperids	M		A				
Phronima					M	M	M
Oxycephalids							R
Gammarids (orange)							F
Other Amphipods	R	R	A	F	F		
Euphausids		C				A	R
Brachyura megalops		1					
Nauplius		1					
Phyllosoma			3				
Squilla larvae	F						
Salpa			C				R

200—Fathom Plankton

	49 PT1
Sagitta (large, transparent)	R
Limacina inflata	C
Limacina lesueuri	C
Creseis acicula	M
Creseis conica	M
Copepods (Small pink)	M
Pontella	M
Mysids	R
Euphausids (small, white)	C
Euphausids (pale pink)	1
Megalops	A
Phyllosoma	Z
Squilla larvae	C

300—Fathom Plankton

	26 PT1	28 PT1	51 T3	51 PT1	59 T3	59 T8	61 T3	66 T1	68 T2	74 T3	74 T14	74 T18	84 T1	84 T7	84 T11
Medusae (transparent)							R								
Beroe (small)									R					R	
Pleurobrachia									R						
Atolla														R	
Diphyes															R
Siphonophores							C				R		R		
Pelagothuria															R
Annelids (brown)														R	
Annelids (pink)						R								F	
Sagitta (large white)	C			M	R			R						F	F
Sagitta (pink)			R		R			R							
Firola	M	F	F		R		R	R							R
Clio	M									R					
Diacra quadridentata										R					
Diacra trispinosa			R	R											
Cavolina uncinata			R								R				
Clionopsis grandis			R												
Cymbulia sibogae					R	F									
Creseis acicula								R							
Hyalocylix								R					R		
Atlanta								R		R					
Glaucus							R ¹								
Ostracods (orange)					R			R		C	R				
Copepods (small pink)					A			R				F		F	

300—Fathom Plankton (Continued)

	26 PT1	28 PT1	51 T3	51 PT1	59 T3	59 T8	61 T3	66 T1	68 T2	74 T3	74 T14	74 T18	84 T1	84 T7	84 T11
Copepods (large red)	F			F	F										
Eucalanus					A	A	A	A	M	A		M	F	F	A
Pontella													F		
Lucifer										R					
Gnathophausia (small red)					R									R	
Phronima			R	R	F	R									
Amphipods (orange)				F	F				R						R
Hyperids					R										
Oxycephalids										R			R	R	
Gammarids (orange)													F		
Amphipods (transparent)							F								
Amphipods (pale slate)							M								
Euphausiids (pink patches)			R			C		M	A	C	R	F			F
Euphausiids (small white)						M					C	F	A		
Other Schizopods	C														
Macrurids (red and white)														R	
Megalops (red)															R
Shrimps (scarlet)	M				F										
Shrimps (orange)	F														
Salpae	M									R					
Doliolum	A				M										
Pyrosoma					R										
Halobates									R ¹				R ⁸		

400—Fathom Plankton

	50 T2	56 T1	68 T3	84 T8	84 T19	86 T1	87 T2
Ctenophores (orange)		R		F			
Beroe (pink)				R			
Atolla				R			
Actinarians (orange)				F			
Siphonophores	R						
Porpita	R ²		R ¹				
Pelagothuria						R	R
Annelids (large white)				R			
Sagitta (large white)	R						F
Eukrohnia (pink)	F	M		R	R	F	F
Firola			R				
Cymbulia		R			R		F
Clio pyramidata	F				F	R	
Clionopsis krohni					R		
Limacina	F						
Hyalocylix	F						
Creseis conica	F						
Creseis acicula	R						
Atlanta	R						
Limacina	R						
Cavolina	R						
Diacra trispinosa	R						
Cymbulopsis	F						
Glaucus	R ³		R ²				
Ianthina	R ¹						
Squids			R				
Ostracods	F		F				
Copepods (large red)	F			M	F	F	M
Eucalanus	A		A		M	C	F
Pontella	R						
Gnathophausia willemoesia		R				F	R
Isopods (black)						R	R
Hyperids	F	F					
Phronima	F			R			
Gammarids (pink)						M	
Oxycephalids			R	M		F	R
Other Amphipods (white)	M						

400—Fathom Plankton (*Continued*)

	50 T2	56 T1	68 T3	84 T8	84 T19	86 T1	87 T2
Amphipods (orange)					R	R	
Euphausiids (adults)	M	M	M	F	M	C	M
Macrurids (red)		F			F		F
Lucifer	M						
Eryoneicus						R	
Squilla (larvae)	R						
Salpa			R				

450—Fathom Plankton

	74 T7	74 T15	74 T19	84 T3	84 T9	84 T13	87 T3
Actinians (orange)					R		
Periphylla					R		
Hydromedusae (white)	R						
Hydromedusae (yellow)			R				
Siphonophores		R		R			
Ctenophores		R					
Beroe				R			R
Annelids (orange)		R			M		
Eukrohnia (orange)	F		F		R		
Clio balantium	R						
Cymbulia	R						
Diacra quadridentata		R					
Peraclis			R				
Firola				F	R		
Ostracods (red)	F		R	R			
Copepods (red zone)	M	F		C		C	
Eucalanus		A	M			A	
Mysids (red)	R						
Gnathophausia (small red)			R	F	F	F	
Hyperids (small pink)		R					
Gammarids (orange)					R		
Phronima	R	R	R				
Oxycephalids	R	R		R	R		
Amphipods (large red)	F	R	F				R
Euphausiids (red)	R	F	F				
Euphausiids (small white)		A					
Eucopa (deep red)							R
Macrurids (red and white)					F	F	

450—Fathom Plankton (Continued)

	74 T7	74 T15	74 T19	84 T3	84 T9	84 T13	87 T3
Megalops (pink)				F			
Lucifer				F			
Shrimps (small red)			R				
Benthophausia (orange)					F		
Squilla (larvae)				R		R	
Isopods (brown)	R		R	F			

500—Fathom Plankton

	59 T4	59 T9	61 T4	66 T2	74 T4	74 T8	74 T27	84 PT1	84 T10	84 T14	84 PT3	84 T20	86 T2
Medusae (small white)		M											
Pleurobrachia (pink)		C	F		R								
Beroe (pink)			R			R		R	F	R			
Periphylla			R										
Atolla					F	R							
Actinians (larval scarlet)										M			
Annelids (yellow)										F			
Annelids (orange)	F												
Sagitta (salmon)	M	M	M	M	F	F	F	R				F	R
Sagitta (transparent)	R		F										
Planarians (orange)		R											
Nemertians													R
Firola	R		F	F	R			R		R	R		R
Peracelis													
Creseis conica				R									
Creseis acicula				R									
Atlanta				R									
Clio pyramidata				R								F	
Clio balantium			R										
Hyalocylix				R									
Peracles			F				F						
Clionopsis krohni								R					
Cymbulia												R	
Octopus (fragile red)			R										
Ostracods (orange)	F		F		M					R			
Gigantocypris (small)													R G
Copepods (pink, red)	M	R	F	M	F	M	F	F				C	F
Eucalanus	M			C	C		C			C		M	C

500—Fathom Plankton (*Continued*)

	59 T4	59 T9	61 T4	66 T2	74 T4	74 T8	74 T27	84 PT1	84 T10	84 T14	84 PT3	84 T20	86 T2
Calanids (small)	C												
Mysids (orange, red)			R		M							R	
Gnathophausia					R			C		C	C		R
Isopods (black)		R			F	F		R	F			R	F
Phronima		R		R				R					
Gammarids (orange, pink)		R		F		F	F			R			M
Gammarids (slate color)		R											
Oxycephalids						R	R						M
Euphausiids (white)	C	M					F						C
Euphausiids (pink patches)	F			F	M								
Schizopods (scarlet)								M					
Porcellana (larvae)								R					
Macrura (red and white)								C			C	F	R
Macrura (large, snow white)											F		
Eryoneicus								R					
Magalops (black, red)			R									R	R
Shrimps (small red)	R		F	F	R					R			
Shrimps (large red)	F		F		F								
Squilla (post larval)											R		
Salpa (small blue)													A
Salpa zonaria			R										
Doliolum	F												

550—Fathom Plankton

	74 T20
Atolla	F
Eukrohnia (red)	F
Diacra quadrilentata	R
Eucalanus	A
Gnathophausia (small)	R
Mysids (red larvae)	R
Isopod (black)	R
Oxycephalids	R
Amphipods (fragile pink)	R
Euphausia (pink and white)	M
Benthophausia	F
Shrimp (small red)	R

600—Fathom Plankton

	59 T5	59 PT1	59 T10	59 PT2	61 T5	61 PT1	66 T3	66 PT1	68 T5	68 PT1	74 T5	74 PT1	74 T9	74 PT2	74 T16	74 PT3	74 T21	84 T21	86 T3	87 T5
Ctenophores											R				R					R
Hydromedusae (pink)											F									
Bolina											R									
Periphylla					R				R		R			R						
Pleurobrachia						F	F													
Atolla												R								
Siphonophores											R									M
Diphyes													F						R	
Actinians (small pink)																			R	
Annelids (orange)					F						R								R	
Annelids (white)							R													
Sagitta (transparent)			F		F				F						F					
Sagitta (pink)	F	C	M	M	M	C	M	M	F		M	R	F		F		F			F
Tomopteris											R									
Nemertians (orange)																	R			
Firola			R			F	F	R		R	R				R					R
Atlanta	R						F	R												
Cymbulia			R	F				R										R		R
Hyalosyllis striata			R																	
Olio pyramidata																	F			
Creseis acicula							F													
Cavolina uncinata							R	R				F				R	R			
Peracles															R	R	R			

600—Fathom Plankton (Continued)

	59 T5	59 PT1	59 T10	59 PT2	61 T5	61 PT1	66 T5	66 PT1	68 T5	68 PT1	74 T9	74 PT1	74 T9	74 PT2	74 T16	74 PT3	74 T21	84 T21	86 T3	87 T5
Phyllosomes							R													
Macrurans (red)						R					R						R			F
Benthophausia (red)																		R		
Shrimps (large red)	R	M		M			M	C	F	C	F	F		R	R	R	R			
Squilla (larvae)				R				R		C		F				F				
Doliolum						F				F										
Appendicularia						F														
Salpa zonaria (purple)																				
Halobates	R ¹						R ¹					R	R	R						

700—Fathom Plankton

	33 PT1	83 T22	84 PT4	87 T6	87 PT1
Actinians (larvae)		R			
Siphonophores					
Eucopa (deep wine color)				R	
Atolla wyvilli	R				
Halicrecas papillosum	F				
Homoconema typicum	R				
Aequorea globosa	R				
Siphonophore	R			M	
Annelids (yellow)		R			
Sagitta (transparent)	M				
Sagitta (salmon)	C	F		M	
Nemerteans		R			
Firola	R		R	R	R
Atlanta	R	R	R		
Cavolina tridentata				R	
Cavolina uncinata			R		
Clio pyramidata	R	F	C		
Clio cuspidata				R	R
Cymbulia		F	F		
Squid (red)		R		R	
Ostracods (pink)	R				
Gigantocypris agassizi			R		
Copepods (large pink)	M			F	
Eucalanus		M		M	
Gnathophausia			F		
Gnathophausia brevispinis				R	F
Mysis		R			
Amphipods (pink)	F				
Hyperids	R				
Oxycephalids			R		
Gammarids (pink)				F	
Macrurus (red and white)			M		R
Megalops (large)	R				
Porcellana (zoea)	R				
Zoea (long-spined)	R				
Benthophausia		R			
Shrimp (red)					R

700—Fathom Plankton (*Continued*)

	33 PT1	83 T22	84 PT4	87 T6	87 PT1
Squilla (larvae)	R	R	R		
Salpa cylindrica	R				
Euphausids		M	M	F	M

800—Fathom Plankton

	50 T3	50 OT1	53 T2	56 PT1	86 T4
Ctenophores					R
Annelids (pink)	R				
Sagitta (large transparent)	R		M	R	
Sagitta (pink)	F		R	R	F
Creseis conica	M		M		
Creseis acicula	F				
Clio pyramidata	F		R		
Clio balantium			R		
Hyalocylys	R		R		
Firola			R		F
Cymbulia					R
Ianthina	R ¹				
Squid					R
Ostracods (small orange)			R		
Gigantocypris			R		
Copepods (red)	M		M		M
Eucalanus	A				
Pontella	F				
Gnathophausia (red)			R	F	F
Isopod (black)	R			R	
Hyperids (white)	M				
Hyperids (red)				R	
Oxycephalids					R
Gammarids (orange)					M
Euphausids (red)			M	F	M
Schizopods (pink)	M				
Macrurans (red)			R	R	R
Benthophausia (orange)			R		
Shrimp (red)	R	R		F	
Squilla (larvae pink)		R			
Salpae	F				

1000, 1100, and 1200—Fathom Plankton

	1000 fathoms 86 T5	1100 fathoms 53 T1	1200 fathoms 50 T4
Beroe (small pink)			R
Atolla	F		
Pelagothuria	F		
Sagitta (large transparent)		F	M
Sagitta (pink)	F	F	
Firola	R		
Atlanta		R	
Cavolina longirostris		R	
Creseis conica		R	
Creseis acicula		R	
Notabbranchia		R	
Hyalocylix striata		R	
Clio pyramidata			A
Eucalanus	C	A	
Gnathophausia (large red)	F		R
Isopods (black)	R		
Amphipods (pink fragile)			F
Gammarids (pink)	C		
Gammarids (orange)	F		
Oxycephalids	M		
Euphausid (pink)			R
Euphausids (white)	C	F	F
Porcellana (large)			R
Benthophausia (red)	F	F	
Shrimps (large red)		M	F
Squilla (post larva)			R
Ostracods (scarlet)	R		

VII. RELATIVE ABUNDANCE OF FIFTY-SEVEN GROUPS OF INVERTEBRATES IN
PACIFIC SURFACE HAULS

	Number of Occurrences in 47 Hauls	Abun- dant	Com- mon	Many	Few	Rare	Relative Abundance based on 10-7-5-3-1 Ratio
Siphonophores	14	2	2	2	3	5	58
Porpita	13		1	2	8	2	43
Hydromedusae	6	1		1	3	1	25
Ctenophores	8	1		1	5	1	31
Liriope	5		2		2	1	21
Stomatoca derissa	3			1	2		11
Mneopsis	1	1					10
Pleurobrachia	1		1				7
Physalia	1					1	1
Sagitta	31	7	8	7	7	2	184
Annelids	3				2	1	7
Creseis conica	17		5	2	8	2	71
Creseis acicula	12		5	3	3	1	60
Atlanta	9	1		3	1	4	32
Glaucus	12			2	6	4	32
Ianthina	11			2	5	4	29
Diacra quadridentata	7	1		1	2	3	24
Firola	7		1	2	1	3	23
Gastropod larvae	2	2					20
Limacina	4	1	1			2	19
Hyalocylix striata	5			1	4		17
Squid	8			2		6	16
Clio	5			1		4	9
Cavolina uncinata	5				1	4	7
Cavolina longirostris	2				1	1	4
Cymbulia	2					2	2
Peracles	1					1	1
Pneumoderma boasi	1					1	1
Euphausiids	30	6	9	4	11		176
Pontella	30	2	6	11			117
Copepods, small	13	7	4	1	1		106

Relative Abundance of Fifty-seven groups (*Continued*)

	Number of Occurrences in 47 Hauls	Abundant	Common	Many	Few	Rare	Relative Abundance based on 10-7-5-3-1 Ratio
Megalops	19	3	1	4	8	3	84
Phyllosomas	18	2	3	3	5	5	76
Hyperids	17	1	3	3	7	3	70
Squilla larvae	15	1	2	2	5	5	54
Lucifer	12	1	1	4	5	1	53
Zoea	10	2	1	1	2	4	42
Amphipods	8	1		2	5		35
Eucalanus	10	1		2	4	3	35
Mysids	6	1	2		3		33
Calanus	3	3					30
Monops	7		2		4	1	27
Schizopods	3	1	1		1		20
Sapphirina	3		1	1	1		15
Macrurus larvae	3		1	1	1		15
Candace	3		1		1	1	11
Acartia	1	1					10
Ostracods	1		1				9
Isopods	4				1	3	6
Gammarids	1				1		3
Hippa larvae	3					3	3
Sergestes larvae	2					2	2
Phronima	1					1	1
Halobates	27			5	21	1	89
Salpae	13	3	5		4	1	78
Doliolum	1				1		3
Pyrosoma	1					1	1

VIII. RELATIVE ABUNDANCE OF SIX MAJOR GROUPS OF INVERTEBRATES IN FORTY-SEVEN SURFACE HAULS IN THE PACIFIC

Crustacea	1033	52.4 per cent
Mollusca	367	18.7 per cent
Coelenterata	207	10.5 per cent
Annelida	191	9.7 per cent
Insecta	89	4.5 per cent
Urochorda	82	4.2 per cent

Beebe, William. 1926. "The Arcturus Oceanographic Expedition." *Zoologica : scientific contributions of the New York Zoological Society* 8(1), 1–45.

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