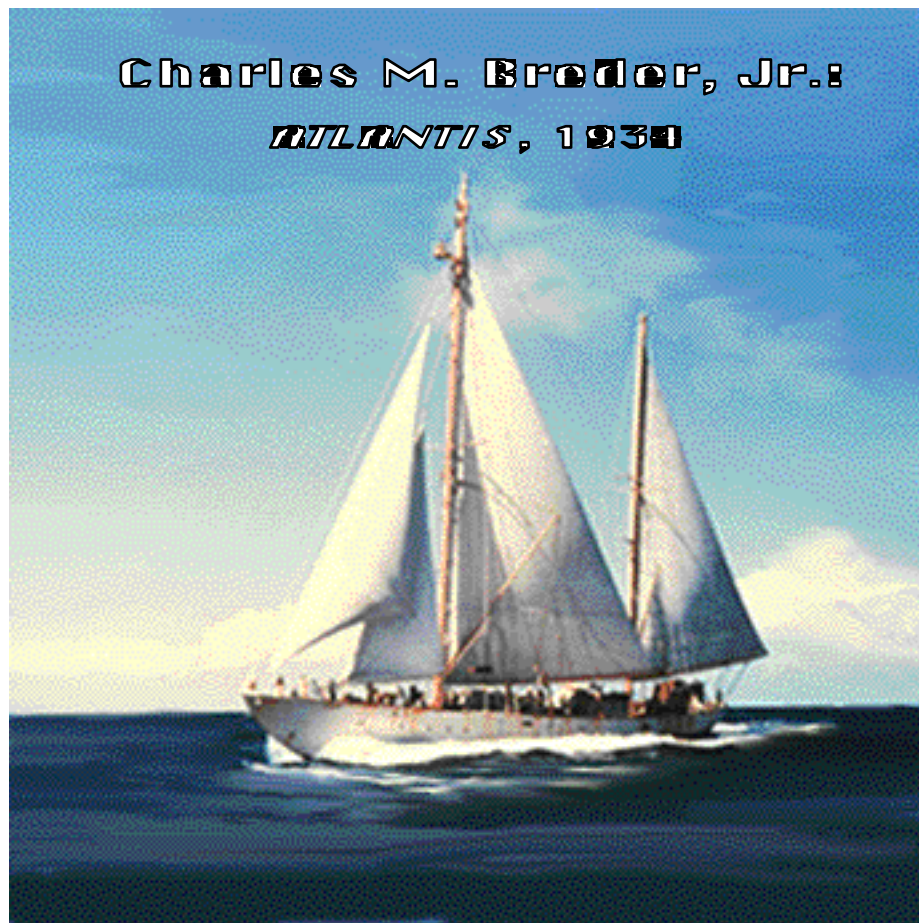


Coastal and Estuarine Data Archaeology and Rescue Program



Woods Hole Oceanographic Institution
Woods Hole, MA

April 2004



US Department of Commerce
National Oceanic and Atmospheric Administration
Silver Spring, MD



Charles M. Breder, Jr.: *Atlantis Expedition, 1934*

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COVER PHOTOGRAPH: Research vessel *Atlantis* (Courtesy of Woods Hole Oceanographic Institution, Woods Hole, MA)

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Charles M. Breder: *Atlantis Expedition, 1934*

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ABSTRACT

Dr. Charles M. Breder participated on the 1934 expedition of the *Atlantis* from Woods Hole, Massachusetts to Panama and back and kept a field diary of daily activities. The *Atlantis* expedition of 1934, led by Prof. A. E. Parr, was a milestone in the history of scientific discovery in the Sargasso Sea and the West Indies. Although naturalists had visited the Sargasso Sea for many years, the *Atlantis* voyage was the first attempt to investigate in detailed quantitative manner biological problems about this varying, intermittent 'false' bottom of living, floating plants and associated fauna. In addition to Dr. Breder, the party also consisted of Dr. Alexander Forbes, Harvard University and Trustee of the Woods Hole Oceanographic Institution (WHOI); T. S. Greenwood, WHOI hydrographer; M. D. Burkenroad, Yale University's Bingham Laboratory, carcinology and Sargasso epizoa; M. Bishop, Peabody Museum of Natural History, Zoology Dept., collections and preparations and H. Sears, WHOI ichthyologist. The itinerary included the following waypoints: Woods Hole, the Bermudas, Turks Islands, Kingston, Colon, along the Mosquito Bank off of Nicaragua, off the north coast of Jamaica, along the south coast of Cuba, Bartlett Deep, to off the Isle of Pines, through the Yucatan Channel, off Havana, off Key West, to Miami, to New York City, and then the return to Woods Hole. During the expedition, Breder collected rare and little-known flying fish species and developed a method for hatching and growing flying fish larvae.

INTRODUCTION by Dr. Kenneth M. Leber[◇]

"And now, Socrates, to make an end my preface, I am ready to tell you the whole tale. I will give you not only the general heads, but the particulars, as they were told to me." – Plato's Timaeus, 360 BC, as Critias introduces the story of Atlantis

Atlantis was the first Woods Hole Oceanographic Institution (WHOI) research vessel and the first ship built specifically for interdisciplinary research in marine biology, marine geology and physical oceanography. Columbus Iselin, her first master and a major influence in her design, felt that speed was not essential; steadiness, silence and cruising range were of primary importance.

The ship was built in Copenhagen, Denmark, in 1931 and was designed by Owen and Minot specifically for WHOI. The ship is 143' 6" in length, a beam of 29', and a draft of 18'. The ship carried a crew of 19 plus 9 scientists.

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[◇] Charles M. Breder, Jr. Chair, Mote Senior Scientist, and Director, Center for Fisheries Enhancement, Mote Marine Laboratory, Sarasota, FL.

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Once built, WHOI searched for an appropriate name for the research vessel. A trustee of the Institution, Alexander Forbes, had recently bought a schooner named *Atlantis* from Iselin. Mr. Forbes re christened his schooner so the new research vessel could be named *Atlantis*. The “A-boat” made 299 cruises and covered 700,000 miles, doing all types of ocean science. In 1966, *Atlantis* was sold to Argentina, refurbished, and re named *El Austral*. It is used today as a research vessel and is crewed by Argentine naval personnel.

This volume chronicles the notes and discoveries of Dr. Charles M. Breder on the *Atlantis* expedition of 1934 from Woods Hole, Massachusetts to Panama and back. Born in 1897, Charles Marcus Breder, Jr. was destined to become a premier scientist. His passion for investigating fishes had already resulted in 15 popular articles and notes by the time he was 21 years old. He was hired at 22 to be a scientific assistant for the U.S. Bureau of Fisheries. From 1921 - 1941, he worked at the New York Aquarium (a branch of the New York Zoological Society) and was aquarist there until 1937, when he was appointed Acting Director, then Director in 1940.

During his tenure at the New York Aquarium, Dr. Breder arranged to spend significant periods of time in the field: including three months in eastern Panama in 1924; two months in the Dry Tortugas in 1929; two months in the Bahamas in 1930, 1932, and 1933; one and a half months aboard the *Atlantis* in the Sargasso Sea and Caribbean in 1934; several months on the Florida west coast, 1938 – 1942; one month at San Luis Potosi, Mexico in 1940; and one month in the Gulf of Guayaquil in 1942.

In 1941, when the aquarium was moved to the Bronx Zoo to make way for a tunnel, Breder was invited to carry on his research in the Department of Experimental Biology at the American Museum of Natural History. The Museum's Director, A. E. Parr, had briefly worked under Breder at the Aquarium when he first arrived in this country. For the next few years Breder remained as Aquarium Director and continued his research at the museum. In 1944, Parr offered Breder Chairmanship of the Department of Fishes and Aquatic Biology at the museum.

From 1947 – 1957, Breder was also administrative director of the Lerner Marine Laboratory, on the island of North Bimini in the Bahamas. He planned its laboratories, established its standard operating procedures and supervised a series of resident directors.

From 1957 on, Dr. Breder spent most if his time on the West Coast of Florida. He settled in Englewood, and became advisor to the Board of Directors of the Cape Haze Marine Laboratory. Later, after the facility was renamed Mote Marine Laboratory, he became a Senior Research Associate at Mote, a relationship he maintained for the duration of his scientific career.

The *Atlantis* expedition of 1934 was a milestone in the history of scientific discovery in the Sargasso Sea and the West Indies. Although naturalists had visited the Sargasso Sea for many years, the *Atlantis* voyage was the first attempt to investigate in detailed quantitative manner biological problems about this varying, intermittent ‘false’ bottom of living, floating plants and associated fauna.

The voyage lasted from January 20 through March 16th. The expedition was led by Prof. A. E. Parr, who was then the curator of the Bingham Oceanographic Collection and Laboratory, Yale University. Charles Breder, who was by this time a Research Associate of the Bingham Laboratory, accompanied Parr on the 1934 cruise in order to study the life history of flying fishes. Breder took great satisfaction in having had a major role in preparing the first Bulletin of the Bingham Laboratory seven years before (1927), and looked up to Professor Parr for his emphasis on excellence in promoting ichthyological publications, collections and programmatic development at the Laboratory.

In addition to Dr. Breder, the party also consisted of Dr. Alexander Forbes, Harvard University and Trustee of the Woods Hole Oceanographic Institution (WHOI); T. S. Greenwood, WHOI hydrographer; M. D. Burkenroad, Yale University's Bingham Laboratory, carcinology and Sargasso epizoa; M. Bishop, Peabody Museum of Natural History, Zoology Dept., collections and preparations and H. Sears, WHOI ichthyologist.

Thus, in January 1934 Dr. Breder, at 36 and in the prime of his professional career, departed with several esteemed colleagues on the auxiliary ketch, *Atlantis*, for the Sargasso Sea and the Caribbean to conduct critical studies of marine life. The cruise covered 5,000 miles, with four ports of call: Kingston, Jamaica; Colon, Panama; Miami, Florida, and New York City. The itinerary included the following waypoints: Woods Hole, Mass, the Bermudas, Turks Islands, Kingston, Colon, along the Mosquito Bank off of Nicaragua, off the north coast of Jamaica, along the south coast of Cuba, Bartlett Deep, to off the Isle of Pines, through the Yucatan Channel, off Havana, Cuba, off Key West, Florida, to Miami, to New York City, and then the return to Woods Hole. Dr. Breder's principal interest on the cruise lay in studying flying fish that were going to be encountered while sailing through the westernmost segment of the Sargasso Sea and passing through the Bermuda Triangle on the leg towards Jamaica.

Shortly after the cruise, Dr. Breder published a brief report of his journey in the Bulletin of the New York Zoological Society (1934, vol. 37, No. 2), where he explained that he'd signed onto this expedition "to obtain further data and specimens of flying fish, especially in connection with their relation to Sargasso weed; to obtain data on open ocean conditions looking towards improvements at (my) home institution, the New York Aquarium, and to obtain such living specimens as might be useful to the collection of the latter place."

Best known for his work on reproductive, schooling, and other social behaviors of fishes, Breder found flying fishes fascinating, making behavioral observations of them on the *Atlantis* cruise by day and collecting them mainly at night. One of his studies on the *Atlantis* involved tedious searching to locate, count and time the flights of flying fishes in different locations and under different atmospheric and wave conditions. For this he also enlisted other members of the scientific team to relieve him in the eye-straining task. Breder found as many as 130 flyers in a half-hour period, and documented their longest flights at just less than 20 seconds.

The actual collections of flying fish could be made only at night with the aid of a waterproof electric lamp lowered from the *Atlantis* to a couple feet below the surface. The flying fish swam up slowly towards the light, with wings spread, and were easily netted with a long-handled dip net.

By this manner, Breder obtained a surprising number of rare and little-known species as no extensive collections of this kind in the West Indies had ever been recorded. Among some of the other unique discoveries Breder made on the *Atlantis* voyage was either a new developmental stage of the flying fish *Cypselurus monroei*, or a new species altogether. Breder and J. T. Nichols had done the original description of this species some years before, but no one had described before the barbeled forms captured from the *Atlantis*. A primitive form of flying fish was also discovered, in which the juvenile stage possessed an elongated lower jaw not unlike a halfbeak.

Breder found on this cruise that he could hatch and grow flying fish larvae (*Exonantes*), using *Artemia nauplii* as a food source, a remarkable finding, which Breder later characterized as "the first case we know of, however, where this method has been used as an aid to the scientific study of the development of ocean fishes." Breder added "It may be pointed out that one of the chief difficulties in rearing pelagic fishes is the matter of supplying the first food to the larvae just after they have absorbed the last of the yolk carried over from the egg. It is suggested that this technique might prove to be a valuable method for other similar fishes. At least it worked exceedingly well in the present case" (Breder, 1934). Feeding *Artemia* to fish larvae has since become one of the principal methods used world wide in modern-day aquaculture of marine fishes.

Given his experience as an aquarist, Breder was able to successfully transport several live specimens of his "scientific plunder" from the *Atlantis* voyage back to New York where the fish took up residence at the Aquarium, including (for the first time in New York) a freshwater pipefish *Oosteus lineatus* that he'd collected during a stopover on the *Atlantis* in Jamaica, and the "handsomely marked" freshwater fish, *Rivulus brunneus*, collected from Gatun Lake in Panama.

The overall objectives of the voyage to Panama, as well as details of the scientific party and operational procedures, can be found in the cruise instructions by the *Atlantis* master, Columbus Iselin, to the captain, F. S. McMurray (WHOI archives). The cruise instructions are reproduced in full below. The cruise track is shown in Figure 1.

A photograph of Dr. Breder examining a flying fish is shown in Plate 1. Photographs of shipboard activities probably aboard *Atlantis* were found among the Breder material at Mote Marine Laboratory and reproduced here (Plates 2 - 3).

DIARY AND TRANSCRIPTION

The handwritten diary of Dr. Charles Breder's sampling cruise on the WHOI vessel *Atlantis* was bequeathed to the Mote Marine Laboratory by Dr. Breder's family. The diary was written in a bound black and brown notebook in ink. Illustrations were done in pencil and ink.

The diary was transcribed by hand. Minor editorial changes, such as closing parenthesis, were made. Indecipherable entries were noted with "[?]". Editorial comments were noted in brackets and/or capital letters. Numbers outside the margin of the transcribed text are the page numbers of the original notebook. Species names are as listed in the field diary and may no longer be valid.

The recollections of the trip by Alexander Forbes are included since they provide an additional set of observations on expedition activities (Forbes, 1934?).

ACKNOWLEDGMENTS

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Forbes, A. (1934?) Voyage to Panama on Atlantis, 1934. Unpublished recollections. WHOI, Woods Hole, MA. 34 pp.

January 18, 1934

Captain F. S. McMurray
RS "*Atlantis*"
Woods Hole, Mass.

Dear Captain McMurray:

The main features of the scientific program for Cruise #25 can be outlined as follows:

- 1) Temperature, salinity and oxygen observations at about 70 stations in the Caribbean and the Gulf of Mexico.
- 2) Studies of the distribution of Gulf Weed along the "*Atlantis*" track from Woods Hole to Panama and return.
- 3) Collection and study of surface fish, especially flying fish, which will be caught as opportunity offers by means of the light and dip nets.
- 4) Evaporation measurements and studies of the changes in humidity between the sea surface and the height of the masthead.
- 5) A few mud cores should be collected, especially if possible, from the Bartlett Deep.
- 6) Soundings should be taken each hour as on last winter's cruise.
- 7) Temperature and salinity observations at about 9 stations, on the continental shelf off Chesapeake Bay and off Delaware Bay to be taken on the homeward voyage. On arriving at Miami you will be informed of precise locations of these stations.
- 8) There will be water samples collected for Dr. Rakestraw and sargassum collected for Dr. Waksman, under Prof. Parr's direction.

The scientific party will consist of the following:

Prof. A. E. Parr, scientist in charge

Dr. Alexander Forbes, a Trustee of the Institution who is interested in seeing how we handle the ship and carry out our work. He will leave at Panama.

Charles M. Breder, from the staff of the New York Aquarium, who is anxious to study flying fish.

Martin D. Burkenroad, who will study particularly the Gulf Weed.

Marshall Bishop, Prof. Parr's assistant.

Stephen Lichtblau or R. D. Feiber, meteorologist, joining at Cristobal.

Henry Sears, laboratory assistant.

You will leave Woods Hole, weather permitting, on Saturday, January 20th and proceed to Cristobal, via the Windward Passage. Prof. Parr will advise you of the most desirable track for the Gulf Weed observations, between Woods Hole and the West Indies. You will be furnished with a chart showing the probable locations and the observations to be taken at each station. Dr. Forbes plans to leave the ship at Cristobal. From Cristobal you will sail to Miami, where Mr. Bishop plans to leave the ship, and thence back to Woods Hole by the quickest route compatible with making the observations listed under No. 7. See also supplementary instructions on page 4.

As soon as you are about to leave Cristobal telegraph Dr. Bigelow of the probable date of your arrival in Miami in order that he may communicate with you there.

While it does not seem necessary now for you to plan to stop at other ports beside Cristobal and Miami, something may come up during the course of the trip to make additional stops advisable. This is a matter for you and Prof. Parr to decide. The length of your stay at Cristobal should be governed by the needs of the ship and the scientific party, who have some work to do on shore there. Possibly five days may be sufficient to get the work done and allow everyone enough liberty and rest. Your stay at Miami should be somewhat shorter as there is less reason for delay there.

Although we have planned a ten day cruise in the Gulf of Maine for the last half of March, you should not feel that we are expecting the ship back by any given date. To conserve fuel, I would advise using sail alone whenever there is sufficient wind to allow you to make 5 knots on the source.

Before leaving Woods Hole you should arrange with Mr. Schroeder to provide you with sufficient cash and to have the necessary money waiting for you at Cristobal and Miami. The expenditure of the Institution's money will, of course, be entirely in your hands. It should be decided beforehand how much can be advanced to Greenwood, Sears, and Lichtblau. The other members of the scientific party, except in emergency, should not draw from the Institution's money for their own use. Arrange also with Mr. Schroeder to make payments to the families of the crew as necessary. If any scientific supplies are purchased, secure Prof. Parr's authorization. In order to close the books promptly at the end of our fiscal year, February 28th, Mr. Schroeder will probably require an accounting sent back to him from Panama.

In case any dispute occurs, I will take this opportunity to state again that you are the final authority for all that goes on whether at sea or in port. Concerning your duties and responsibilities as captain no question will probably arise. But in addition, through Prof. Parr, you are also in charge of the scientific party. He will understand that in matters of discipline and behavior, the scientists must conform to your wishes. In short, do not hesitate to call his attention to any question of undesirable behavior on the part of any of the members of the scientific party.

Since the above was written several points have come up in relation to the scientific work. It is hoped that the expedition will be able to catch such sharks as can be obtained. Likewise, there are certain sea birds which it is desirable to shoot and skin. Mr. Sears will have charge of guns. Occasionally it may be necessary to lower a boat to pick up dead birds.

If time allows, Prof. Parr may want to take some tows with two meter nets. This means that the platform and heavy weight must be on board.

Finally, if Mr. Breder has been successful in keeping alive any surface fish, he will want the "*Atlantis*" to call at New York so that the live material may be transferred quickly to the New York Aquarium.

Sincerely yours,

C. Iselin
In charge of "*Atlantis*"

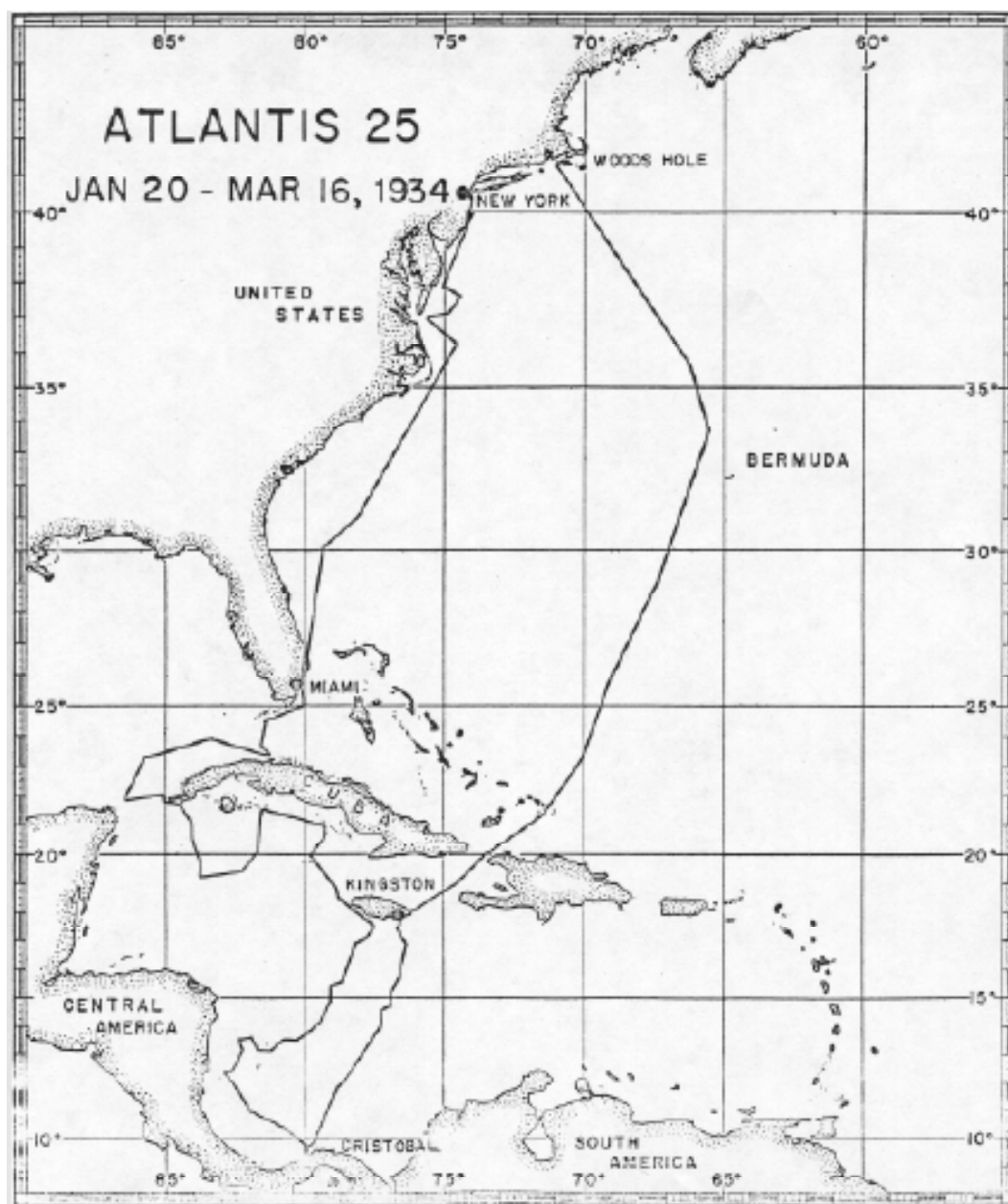


Figure 1. Route of the *Atlantis*, January 20 - March 16, 1934 (WHOI, Woods Hole, MA).



Plate 1. Charles M. Breder, Jr., holding a flying fish. (Photograph labeled "Washington Post, January 14, 1935. Courtesy of the Arthur Vining Davis Library Collection, Mote Marine Laboratory, Sarasota, FL).



Plate 2. Research vessel *Atlantis*. (Courtesy of Woods Hole Oceanographic Institution, Woods Hole, MA).



Plate 3. Deck of the *Atlantis* in rough seas. (Courtesy of the Arthur Vining Davis Library Collection, Mote Marine Laboratory, Sarasota, FL).



Plate 4. Water sampling using a Nanson bottle on a wire, deck of the *Atlantis* [?]. (Courtesy of the Arthur Vining Davis Library Collection, Mote Marine Laboratory, Sarasota, FL).



Plate 5. Taking a sextant reading, deck of the *Atlantis*. (The man in the photograph may be Alexander Forbes. Courtesy of the Arthur Vining Davis Library Collection, Mote Marine Laboratory, Sarasota, FL).

Atlantis Expedition 1934

[TEXT IN TWO-COLUMN FORMAT ARE EXCERPTS FROM FORBES DIARY OF THE EXPEDITION AND ARE INCLUDED TO PROVIDE ADDITIONAL INFORMATION OF ACTIVITIES AND LIFE ABOARD SHIP.]

- Jan 19 Left NY 1⁰⁰ A. M. for Boston. Met Parr and proceeded to Woods Hole. Arrived 11⁰⁰ A. M. 1
and spent rest of day getting established aboard the ketch "Atlantis".
Visited Dr. C. Fish and Mrs. Fish in the evening. Turned in 11⁰⁰.
- Jan 20 Turned out 8⁰⁰. Fine bright weather. Got under way 2⁰⁰ P. M. Sea calm. Turned in 8⁰⁰ on
account of the intense cold.

January 20 (excerpts from Forbes account)

At 2.10 P. M. we cast off from the dock and headed out into Vineyard Sound. At the wharf were Columbus Iselin and wife, and sundry others, including one so picturesque that I diagnosed him as none other than the famous Terry Keough, and so it proved to be. His starboard trouser leg was slashed from end to end and pinned together so loosely as to reveal a welter of bandages through the gape.

The officers, besides Captain McMurray, are, First Mate, Kelly from Nantucket, Second Mate, Potter, Chief Engineer, Backus, Second Engineer, McLuen, Technician, Greenwood. The "scientific" personnel are Dr. Parr, leader, primarily a geologist, Breder and Burkenroad, biologists, Bishop, a technician, and a young red-haired chap named Sears, a make-learn [?] oceanographer, sent by Iselin as from the Institution.

- Jan 21 Weather clear. Turned out 7⁰⁰. Spent the day getting the laboratory equipment in shape.
Under sail. At times made better than 10 knots. Temp. of water rose as high as 15°C in spots
although mostly below that - the ragged edge of Gulf Stream influence. Turned in 8⁰⁰.
- Jan 22 Sargasso weed appearing in scattered patches. No Exocoetids yet. Two very small
Scomberesox (?) caught in dip net. Tow net yielded more and larger as well as young *Mugil*?
Weather overcast and "squally". Seas fairly high. Temp up to 19° C. Air chilly. Got slightly sea
sick in P. M. Turned in 8⁰⁰.

January 22 (excerpts from Forbes account)

Last night my pestilential cold, having definitely abandoned my nose, struck into my chest with a vengeance. The first half of the night an incessant and painful cough racked my thorax and nearly shook my windpipe loose from its moorings. Meanwhile the wind was breezing and hauling to the eastward till the ship was going like hell and rolling fairly hard. She logged over 12 knots one hour. The sky clouded, but in spite of that Kelly, the alert mate,

got a star fix at dawn this morning. At 6 A.M. we changed course to S. At 8 A.M., we had logged 370 miles from Wood's Hole - 238 in the last twenty-four hours. Just after 8 A.M. the mainsail was hauled down to "tow for spinach". Bishop scooped up a beautiful Portuguese Man-of-War and put him in a pail. When the sun came out through a gap in the clouds, I filmed him in color at 2-1/2 foot range. He showed an uncanny faculty for popping across to the shady side of the pail.

- Jan. 23 Sea still high. Reached the latitude of Bermuda at about noon. Saw only two Exocoetids
(close together). Parr saw 6 or 7. Water 20°C. 10:30 A. M. *Parexocoetus*? Consider all A. M. to
12⁰⁰ as observations of half hour duration. Got 2 young Exocoetids in Set 1. A small puffer
Spheroides sp. The only other fish (*Exonastes rondeletti*?)
A second set yielded no fishes. Turned in 10⁰⁰. Rain squalls.

2

January 23 (excerpts from Forbes account)

Failing to sleep last night, I got the Captain to give me two tablets of Dover's powder. This was followed by three or four hours of restless sleep mixed with coughing so violent that when I waked at 1.30 my throat was sore and aching from the sheer mechanical jarring. Then followed a respite with sleep, pure and refreshing and enhanced with dreams of joy and beauty.

Soon after noon we passed about 60 miles west of Bermuda and are now headed for Turk's Id. Passage, about 700 miles away.

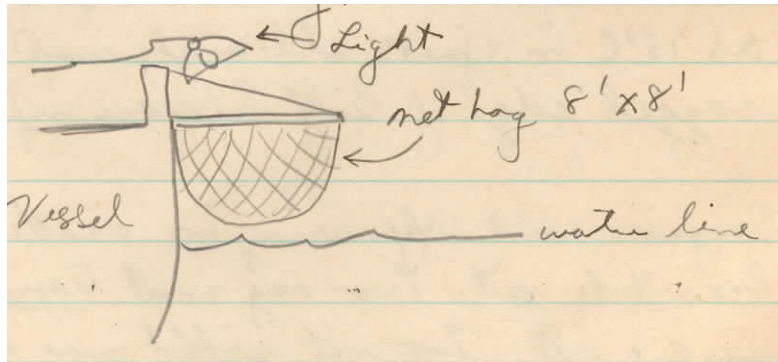
The noon to noon run was 237 miles - said to be a record for this ship. N. B. yesterday's was the record; both beat previous records.

Jan 24

Turned out 7⁰⁰. Clear. Sea falling. Men on watch reported a single large school of flying fish. The first set of the Sargasso tow held one *Kyphosus sectatrix* only. Sears reports having seen during the entire morning about 10 Exocoetids, but not put up by the boat. Flying 200 or 300' from the vessel.

No fish in Sargasso trawl #2.

Saw about 10 *Halocypselus*? far off the starboard. Rigged a device to attempt to catch Exocoetids under way.



Set 3 contained a single *Pterophryne*.

Set 4 contained no fish.

Fished with the above net from 6 to 8⁰⁰. Then a sea tore the net. Left the light (150 Watts).

Set 5 contained about 8 Leptocephali (European eel?), 1 *Pterophryne* and 1 Myctophid.

Turned in 10³⁰.

Spent the entire night under power and rolled uncomfortably.

3 Jan 25

Turned out 7⁰⁰. The Exocoetid trap failed to work.

In set 1 of the Sargasso trawl got a number of *Leptocephalus*, 2 larval (*Isospondyli*?) and 1 young *Parexocoetus (mesogaster?)* and 1 Myctophid. The crab *Planes* has mostly been replaced by *Porturus*. The fish recognized as *Parexocoetus* was a deep brilliant blue, brighter than those taken at Portugal.

Up to 9³⁰ no Exocoetids had been reported by anyone. One reported by Dr. Forbes about 10⁰⁰.

Set 2 contained a single *Kyphosus*.

Set 3 contained a small *Parexocoetus*.

At 11¹⁵ Sears reported 3 flying fish far off to one side.

Set 4 contained 1 *Pterophryne*.

One of the seamen reported seeing a large shark in the early A. M.

Set 5 contained no fishes at all. ditto Set 6.

Hove to 6⁰⁰ - 7⁰⁰ to try under water light. Sky well clouded. A single *Coryphaena* came to it about 2' long. No plankton gathered at all, either to be seen or to be caught in a bolting dip net. This area seems to be particularly barren.

The sea is becoming more and more calm.

Turned in 10⁰⁰.

January 25 (excerpts from Forbes account)

Last night the net was hauled in at about 9 o'clock and the weed sorted by electric light on deck. The game is to sort it into the two species abounding here, picking out the crab, shrimps and larval eels as you go, and putting them in finger bowls; then to weigh the two weed masses for a record of their relative abundance.

It occurred to me that these shrimp, small, numerous and almost transparent, might prove excellent material for observing the formation of "soup in the synapse" (chemical mediators in the nervous system).

I turned in for the first time feeling convalesced enough from my infernal cough to enjoy a sound sleep, but the heavy rolling of the ship proved quite disturbing and interfered. I got my prime numbers up to a new high - 331 - before dropping off for my final nap at 6.45 A.M.

This morning, January 25, is fine, and they've got the mainsail and stopped the engine. Just before it was shut down some soot in the exhaust stack became ignited and sparks fell into the engine room, which made the chief engineer buzz around a bit, but those of us at breakfast remained nonchalant as we tucked away our fried eggs.

After towing 20 miles, the net was pulled in with a huge load. After the sorting, I took a close-up Kodacolor strip of the crabs and shrimp in their finger bowls. The crabs show interesting color patterns and dance nicely; the shrimps are mostly

dead and don't dance, but there's a pleasing color scheme in the ensemble. 5

This afternoon, having doped out the main point of technique from Lee's Microtome's Vade Mecum, with Breder's aid, I started to collect shrimps for histological material. So many from the big net are dead when found, that I started scooping up weed on my own with a hand net. But my shrimp farm didn't seem to pay dividends, and I accepted contributions from other scoopers. Finally with about three dozen, including the big and little species, I prepared vials of Zenker and Bouin's solutions and popped them in. They mostly splashed about a bit when put in their new bath, and two were clever enough to jump out. But now they are all preserved for some unwitting histologist, whom I hope to find.

6.20 P. M. They have just hove to under jumbo and mizzen and dangled a bright electric light on a waterproof cable several feet under water, in hopes of luring flying fishes within reach of the scoop nets. It's a fine night with the moon about at the zenith and scattered clouds.

After an hour of this and no fish, we sit the mainsail and went on our way with a nice, steady east wind.

Kelly, First Mate, went over certain points in my navigation manual, which he had kindly looked over. While this was going on, Field Marshal Microbe, who had been essaying guerilla warfare all day about the entrance to my starboard antrum, made a sudden flank attack on my digestive tract. This disturbance over, I turned in and finding the ship steadier than any night since the first of the voyage, I slept soundly for more than nine hours - a rare treat and one calculated to rout the forces of Field Marshal Microbe.

Jan 26

Turned out 7³⁰. Flying fish dashing out from under bow. The first count yielded 3 *Cypselurus vitropinna* (?). The Sargasso net caught a different type of epizoon fauna - also a number of flying fishes (set 1). Apparently there has been a faunistic break since yesterday. That is the first observations all agreed in being somewhat different from that of yesterday, i. e., Exocoetids in statistical counts; young more numerous in tow; and Sargasso organisms (epizoa) different. Set 1 contained 2 *Parexocoetus* (?) 1 *Coryphaena* of a size to feed on the Exocoetids, *Kyphosus* (1) *Syngnathus* (1). Some of the weed bunches were held together by threads (like spider web). Old Exocoetid nests (?) (one bunch). Also a young *Canthidermis* (?) A very thick bodied Balistid seeming to approach *Lactophrys*.

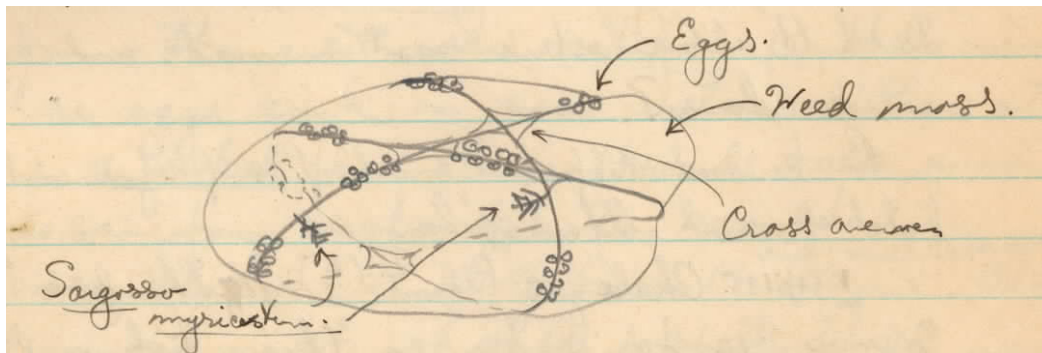
Flying fishes numerous - *Cypselurus* and *Halocypselus*.

Set two contained 3 *Syngnathus*, 1 *Pterophryne* 1 *Coryphaena* 3 *Parexocoetus*? and 1 *Isospondyli*? 4

Flying fish nest taken (No 1). Eggs in an eyed condition all on a central cord remarkably tough and elastic. Some teased out and preserved. Others preserved *in toto*. Others set aside for hatching. The strands of eggs all seem to be wrapped about the weed as a ball of twine is wound. Where they cross they adhere. The separate strands tend to pull out and anastomose as do the egg tendrils on the leaves giving in spots where eggs are numerous a matted appearance. The eggs seem to be attached to the central cord only in spots. The weed used was *Sargassum natans* (*Sargassum* 1) with several fragments of *S. myriocystum* wound in.

Winge O. 1923 writes "It is of the species here described [*S. myriocystum*] that small fragments have been found knitted together with species I [*S. natans*] in the aforementioned algae - balls made by flying fish (?)."

The general conformation of the mass is somewhat as below.



The weed bunch collected in Set I is a nest of hatched eggs - some empty shells were found attached. The Entire Weed mass *S. natans* was preserved with the included *S. myriocystum* in a vial (Nest "O").

Set 3 brought in no nests but two young Exocoetids that were in pretty fair shape. The life colors follow.

Cypselurus furcatus (?) the colors are much brighter than those studied in Tortugas. There were six bright red cross bars in the body. The two short barbels were black at their proximal parts and pale cream distally. The iris silver and the tail and anal clear. The pectoral had 2 diagonal varicolored bands - predominantly brownish. The ventrals were crossed by 3 bars that matched body bars when pressed to it. The first at the base of the fin matched in shade and from bar 3, the second in the middle of the fin bar 4 and the third at the tip bar 5. Dorsal marginal anteriorly with reddish snout and chin pale.

Halocypselus evolans (?) All over blue including the iris, very like *Parexocoetus*. Fins clear. Does *E. obtusirostris* root in weeds and have weed colors?

Burkenroad dipped a small *Pterophryne* with a batch of weed about 3/4" long.

1(1):135. Challenger Report (?) W. Thompson "The Atlantic Fringe" : 12 for data on flying fish nests.

Set 4 contained one small fish (*Coryphaena*) and a single broken strand of Exocoetid nest (mat saved).

Burkenroad dipped up a complete nest but with the eggs all hatched (empty shells).

Tried the underwater light again. Drew to it one *Seriola* (6") and a large porpoise (sp?) and a number of small red nereids.

The above mentioned *Coryphaena* is blue all over, very like *Halocypselus* or *Parexocoetus* of similar sizes.

Turned in 10⁰⁰.

January 26 (excerpts from Forbes account)

Two hauls of the net have shown changes in fauna. Several young flying fish were found, about 1 cm long, and in the haul just after lunch a young dolphin about 1 inch long, and a "glad-hand fish" a little larger, together with two long pipe-fishes and some "fon-fons". The "glad-hand fish" is what I call the beast with pectoral fins built like a human hand, with which to crawl through the weed, since I can't recall the name Parr told me. "Fon-fon" is what the gang called some pale jelly-like fishes presumably not identified. Breder also found a great cluster of flying fishes eggs entangled in the weed.

General Microbe's forces are still operating in the starboard sector, but have abandoned the offensive in the southern zone (digestive).

It is heavenly on deck now, the air balmy, the sea, a marvelous blue and quite comfortably smooth, though still much rougher than on our calmest days on the Ramah last June.

Wading once more through the monograph after supper, I become aware that we were heaving to and went on deck. Numerous flying fish having been seen today, (not by me) they were encouraged to try luring them again with lights. This time a search light was thrown out abeam, its rays striking the water about 50 yards away, and under it the submerged light was dangled. The blue color where the search light's rays played on the water was exquisite. It's not a real search light but a powerful bulb backed by a focusing reflector. Some lively red worms rallied round the lights and one was caught. Twice a large creature, said to be 8 or 9 ft. long and of wonderful iridescent color, cruised around the stern. Some thought him a shark, and some giant squid, but presently he blew and revealed himself an a porpoise.

Burkenroad demonstrated the luminescence of some hydra growing on the wood by pinching them in the dark with forceps. The light seemed to travel over a colony.

Jan 27 Turned out 7:30. Exocoetids numerous. Do they fly more abundant in the early hours? Many 7
seen before the first statistical count.

Water accidentally turned off on Eggs 1. Perhaps they will develop a little too fast.

Set 1 contained 2 small *Halocypselus* and 3 *Myctophids*.

Set 2 contained 2 small *Halocypselus* and 1 *Canthidermis* and one fragment of an Exocoetid nest no. 5 (not saved).

The eggs of Nest 2 (Eggs 1) are incubating. The embryos are well sprinkled with black chromatophores and the heart is beating. A few were preserved at noon. The rest were set for further incubation. These eggs sink in sea water, either attached or detached from their threads - a good reason for anchorage to weed !

Set 3 contained 2 small *Pterophryne* and 1 small Carangid. Also 2 Exocoetids nests with hatched shells. These were smaller than the others and seemed to be woven through the weed instead of around it. Another species (?) preserved. There were also fragments of a third nest.

Set 4 contained 3 good sized young *Coryphaena*, 2 *Pterophryne* and a *Carangid*. Nothing of Exocoetid nests were found.

The *Coryphaena* are predominantly yellow the cross bars of the smaller specimens largely disappearing. The yellow nearly matches the weed and remnants of the cross bars seem to act as rupture marks.

Set 5 contained a wide variety of fishes: a large *Myctophid*, a *Pseudomonacanthus amphioxys*. This is quite silvery and according to Parr is common and is probably an off shore form. A hatchet fish at the surface! A young *Lagocephalus* (green above with a boundary of irregularly placed black spots - silvery below) 2 *Cantherhines*, a small carangid, 2 *Pterophryne*, 1 *Antennarius* and 1 *Coryphaena*, 1 *Euleptorhamphus*, 1 *C. furcatus*, 3 *Halocypselus*, 1 *Exonastes* (black wings)?, 2 small fishes?

Tried the overboard light 8⁰⁰ - 9⁰⁰. A single *C. furcatus*? seen. Bright, nearly full moon - responsible?

Turned in 10⁰⁰.

January 27 (excerpts from Forbes account)

As I read in bed before breakfast, the ship's cat called on me, leapt into my bunk and lay down beside me, rather a cozy bedfellow.

After breakfast, Parr, Breder, Burkenroad and I met in the laboratory for a while, discussing the breeding peculiarities of fishes. It seems they show far more variation in this respect than any other class of vertebrates.

The sea horses, for instance, have the eggs incubated in a pouch on the body of the male. Another fish can only reproduce with the aid of a certain mussel. The eggs and sperm are deposited in the current of water sucked into the body of the mussel, and the fertilized eggs develop in the shelter of the mussel's gill aloft. The male, brightly colored, displays his finery and lures the female to where the necessary mussels grows.

The net was then pulled in and the routine sorting commenced. The crabs included some hungry specimens. One of them was dancing round and round the pail with half a shrimp in each claw. He waved the front end triumphantly with one claw while he stuffed the rear end into his mouth with the others looking for all the world like a holiday-maker on a picnic. I hope to get a close-up movie of such a scene before the cruise ends.

Put in an hour and a quarter editing the batch of Biological Abstracts which landed on my straining

back just before we sailed; got through nearly one-third of the pile. Then I went on deck for a sun bath, the sky being clear again and the soft, a marvelous blue. Sat in the bow for a while and saw a considerable group of flying fish take off. Twice I had a good chance to see the technique which Breder describes in one of his papers. When the fish loses flying speed he stalls in till his tail dips, then sculling rapidly he accelerates enough to take off again. The sculling and acceleration were distinctly visible.

Under power all day. In the afternoon, at Breder's suggestion, I took station in the bow with a stop watch and timed the flights of as many flying fish as I could see. This was difficult, for they went in groups and on disappearing behind the crest of a wave it was hard to tell when they reappeared, if I was still watching the fish I had timed on the take-off. But I got them spread over a range of from 1/2 second to 13 seconds.

This afternoon there was a voracious crab in the pail where they were collected from the haul. He dashed about seizing the smaller crabs and devouring them; but the tragedy of it was that he would drop maimed ones in order to catch newer, livelier and busier ones. Finally he forgot his destructive rage in the gentler joy of courtship.

Jan 28

Turned out 4⁰⁰ to see catch in Set 6 of yesterday pulled and to work overboard light. About 10 min off Turks Island Light. The overboard light drew numerous small *Mugil*, very silvery and rather long bodied. A single squid was caught. A large *Cypselurus furcatus* nearly caught just before sunrise. A porpoise and a whale both banging about ship.

Set 6 yielded the following. 1 large *Myctophid* 3 small, 1 Carangid, 6 *Pterophryne*, 1 *Antennarius*, 1 *Syngnathus* (The *Mugil* taken at light preserved in general bottle for Parr.)

Also 1 *Coryphaena*, 1 *C. furcatus*, 1 *Euleptorhamphus* and 1 *Dactylopterus*. This specimen entirely silver.

Set 1 brought up 3 *Pterophryne*. This is the last placed in the first bottle of mixed fishes. A boat came off from Turks Island and took mail. Got under way immediately thereafter. At Sand Cay a boat came out to inquire of our home port and destination. Flying fish scarce in Turks Island Passage.

Set 2 brought up 1 *Canthidermis* (?) saved alive 1 *Pterophryne* and 1 Carangid - Beginning of Parr's second bottle.

Set 3 brought up 1 *Canthidermis* (?), 7 *Pterophryne*, 1 *Kyphosus*, 1 *Pseudomonacanthus*, 1 *Spheroides*. Also 1 *Hemiramphus*, 1 *C. furcatus* (very bad shape), 3 *Parexocoetus*.

The Eggs 1 are still incubating and are now very dark. Occasionally an embryo moves. Preserved some. The threads spin out like spider web - caught on the intake pipe and accumulate all manner of debris.

Exocoetids alternately common and rare all P. M. - see statistical note book. Likewise with the Gulf Weed which seem to run together - check with Parr's quantity.

Set 4 contained Syngnathus (1), Carangids (3), Spheroides (1), *Pterophryne* (1) (2 kept alive in aquaria). Also 1 *Hemiramphus* 2 *Parexocoetus*. The *Hemiramphus* had a red tail especially the lower portion and red beak. Black bands across body.

Set 5 contained 1 *Myctophum* (large), *Pterophryne* (1), *Canthidermis* (1) and *Parexocoetus* (1).

Tried the night light 8⁰⁰ - 9⁰⁰. A few fishes came about - small Myctophids (2) *Sardinella* (1)? and a young *Istiophorus* (1). Placed all but the last in the Parr's general bottle. Saved the last alive. One large *Myctophid* and a small *C. furcatus* (?) was seen but not caught.

Turned in 10⁰⁰.

January 28 (excerpts from Forbes account)

About 2.30 A.M. the light on Grand Turk was sighted, and at 4 A.M. we have to wait for dawn and to lure fishes again with the lights. A squid was caught, and a flying fish cruised round and round the submerged light but stayed too deep to be caught by the scoop net. The Captain showed me the Southern Cross close to the horizon in the south. Fantastic ragged clouds in the north looked like a portent of something never known before. The Captain predicted a northern in the next day or two.

This afternoon they found in the haul a "glad-hand" fish, the first one alive. They put him in the aquarium where he swam around, looking very wise, paddling with his huge pectoral flippers, but not entering the weed to show us his special technique in crawling.

About 8 o'clock we hove to for the regular submerged-light fishing party, and we are lying still in the moonlight about 33 miles from Tortuga Id. off the north coast of Hayti.

Jan 29 Turned out 7³⁰. Passing the western end of Haiti. The eggs #1 are hatching. Most are still unhatched but the advanced ones are out. Preserved a few. The larvae are heavy and sink rapidly when they stop active swimming. When striking the bottom of the jar or a dish they rest quietly. When falling they swim actively. It would seem that the reaction to falling is to swim upward and to stop when striking an object. This should keep them up, resting in weed clumps. The tip of the tail is clear and the rest of the body heavily pigmented. The larvae still in the eggs beat their free pectoral (inner) rhythmically. The yolk sac is prominent. This is almost surely some species of *Cypselurus*. 10

Set 1 yielded *Pseudomonacanthus* (2) (less silvery and more strongly spotted than the others). Carangids (2) Myctophids (small 10), *Spheroides* (3) (pea size), *Leptocephalus* 10±, *Pterophryne* (1). Also *Dactylopterus* (2) *Parexocoetus* as (2 large and 10 small) *C. heterurus*? (3).

The following notes on the larger Exocoetids:

Parexocoetus

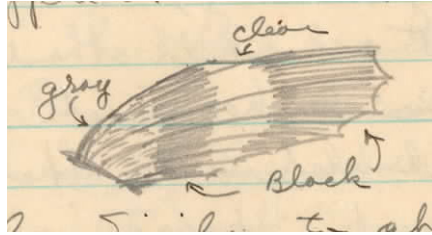
108 mm s.l. Blue and silver only except for black on fins - no barbels but 2 black marks on chin where barbels could grow - undeveloped sexually.

90 mm s.l. Blue and silver only as above but with 2 well developed black barbels (like Brunn's figure). Undeveloped sexually.

Cypselurus (*heterurus*?)

63 mm s.l. Blue and silver like *Parexocoetus* - no barbels, dorsal tipped with black. Pectorals barred as diagram. Ventrals black.

11



50 mm s.l. Similar to above (in bad condition).

43 mm s.l. Body below with 3 black girdles, one a pectoral base point and partial, one half way to ventrals strong and dark, one at ventral base point and partial like first.

In passing through the windward passage both Haiti and Cuba are visible. No flying fish seen by any one up to 10³⁰. Weed also very scarce.

Flying fishes appeared late in the day.

12

Set 2 yielded 2 *Seriola*, 11 *Pterophryne*, 2 *Canthidermis*, 1 Myctophid, 3 *Spheroides*, also 1 *Istiophorus* 1 *Coryphaena* (very dark - almost black).

Set 3 contained 3 *Psenes*-like fishes, 2 Sparoids, 6 Myctophids, Diodon 1. Also 1 *Coryphaena*, 1 *Dactylopterus*, 1 *Halocypselus evolans* (3 faint vertical darker bars between ventrals and caudal).

Lay to to give water to Grand Cayman schooner. Ten days out on route to Haiti.

Turned in 12⁰⁰.

January 29 (excerpts from Forbes account)

Yesterday everyone was talking about how nice it would be to stop at Kingston, Jamaica, which we are due to pass early tomorrow morning. We cleared for Christobal, and there we are supposed to go without stopping. But everyone wants to see Kingston and is racking his brains for excuses to stop there. Last night the engineer was worried because a second feeder pipe in the engine had begun to leak. (He has been patching one of them with solder over since we started.) He said he could get new and stronger pipes in 36 hours at Kingston. Last night the Captain said seriously he thought it might be well to stop there, especially as we are ahead of our schedule, and the only hitch was the expense of pilot fees, etc. He seemed hesitant to take that responsibility unless I would back him up. Someone said to me, "You are the only one that can make him stop there." They all seem to lean on me as a trustee. So I talked with Parr, the leader of the expedition, and he seemed to think it would be all right to stop. This morning, I said to Parr, "What about Henry Bigelow, will he think we're a bunch of quitters not to follow our schedule?" Parr smiled and said, "I think he would enjoy the joke."

Later when Backus was explaining to Parr the risk of further leakage, Parr intimated that he considered the reasons for stopping adequate, but he remarked, "But the suspicions will never die down". I had slyly asked Backus if he hadn't been chipping away at the solder while we weren't looking. He stoutly denied such duplicity, but he showed us where "Old Faithful" had begun to gush again.

Of the many ingenious reasons for stopping, the best that has been advanced is that the cat's sand box is running short of sand.

Breder's flying fish eggs have started to hatch in the aquariums. This consists of a row of large tanks and on a rack above them a row of large glass jars fitted with glass intake and overflow tubes. Both rows are constantly fed with running seawater, which floods that part of the deck with a wide, shallow stream.

For a time Breder, Parr and I sat in the bow discussing Plato and Aristotle (apropos of Count Korzybski). At sundown the wind died altogether, and after supper we had a gorgeous twilight with a myriad opal tints reflected from a glassy sea. We are pushing on at about full speed, 7-1/2 knots, with the mainsail down, in order to reach Kingston before dark tomorrow.

The weed to getting scarce, but in a small haul they found a trigger fish. Breder demonstrated the neat mechanical device whereby a sharp spike on his dorsal fin is thrust out and looked in place like a bayonets thus becoming a strong defensive weapon. There's also a little trigger behind it, which releases the hooking device and enables the spike to drop back out of the way. I asked what was the use of the trigger being placed so that external contact would house the spike. The savants were stumped until I suggested it might enable his wife to render him less truculent by tickling him in the right spot. That seemed to satisfy them.

Jan 30 Turned out 7³⁰. The larvae from eggs #1 that hatched yesterday are up and feeding on *Artemia* (prepared yesterday). Others have hatched in the night and still others are unhatched. There seems to be much spread in the rate of development. Those hatched yesterday show much spread in color - some nearly pale cream and others nearly black - tail clear in all colors.

Set 4 of yesterday contained the following Myctophid (1) large, *Psenes* 4, *Pseudomonocanthus* 1, *Diodon* 2, *Hippocampus* 1, *Canthidermis* 1 and various mangled small Sparids etc. Also *Dactylopterus* 5, *C. furcatus*? (with yellow belly bands) 2, *Halocypselus* 3, *Parexocoetus* 2, *Hemirhamphus* 2, *Coryphaena* 2, *Istiophorus* 2, *Tylosurus raphidoma* 1, (very dark - nearly black).

A fragment of an Exocoetid nest was also brought up. It contained only the remnants of thread - no eggs.

Jamaica in sight.

Set 1 contained 1 *Balistes vetula* and 1 *Spheroides*. Much shore litter.

Got to Jamaica (Kingston Harbor) in the late P. M. and after passing the usual customs spend the evening ashore.

13

Jan 31 Planned to drive across the island but wasted the entire A. M. because of the failure of the hired car.

Poked about town in the P. M. with Bishop - did some shopping, etc.

In the evening visited a small creek just east of Kingston. It contained the mountain mullet (*Joturus*?), *Eucinostomus*, *Eleotris*, *Gambusia*, *Linia* (?) and *Strongylura notatus* and *Syngnathus* (with anterior broad chamber).

Brought the Poeciliids and pipefish aboard alive. Bishop collected Anurans and Annelids.

In the afternoon collected some *Lebistes* in the fountain in front of the Myrtle Bank hotel. One of the females had dark markings that suggested melanosis (saved alive).
Turned in midnight.

January 31 (excerpts from Forbes account)

Parr, Breder, Sears, Bishop and I started out in the sumptuous car of Beres, Duncanson, "competent and reliable driver", to cross the island, I planning to stop for the night at Castle Daly, D. Simmons's place. But though the car was sumptuous and the driver competent, we hadn't gone two miles before the gasoline fuel supply broke down, and after two hours of tinkering the rest of the crowd decided to postpone the trip till next day, while I hired a smaller car to take me to Castle Daly.

At Spanish Town a tire blew out and took a full hour to fix. I bought three bananas for 3 d and ate them while I waited. Then came a long and beautiful drive up over the mountains and through some lovely valleys by a large lake, which brought me at about 3 P.M. to Castle Daly, perched high on a hill commanding a splendid panorama. There I had a very pleasant afternoon and evening with the Simmonses and their guest, Mrs. Bell-Davies

Feb 1

Went to St. Anne's Harbor on the north shore collecting as we drove. Got some small *Gambusia* like fish only. It seems the mountain streams are rather barren. Reached an altitude 2600 feet. Met Dr. Forbes at the Osborn Hotel and returned before nightfall.

Visited the Jamaica Exposition in the evening and knocked about generally.

The young Exocoetids hatched from eggs #1 seem to be an *Exonautes*. Those kept in standing sea water are doing well but those in running have been killed by harbor conditions (?). The former attempt to fly in their bottle. One did break the surface and "flew" about a quarter inch. Their colors are very varied but tend to change from the dark of the earlier size through various yellows to a distinct reddish. When resting quietly in the water they not infrequently flutter their pectorals like a Poeciliid.

February 1 (excerpts from Forbes account)

After lunch we went on to Roaring River Falls, where Annette Kellerman was filmed in the Daughter of the Gods, and then on to St. Ann's,

where I met the party from the *Atlantis*. Parr had stayed behind, but Breder, Sears and Bishop were there in the same car, now behaving well with a new pump. We made a fast run back across the mountain, reaching Kingston about sunset.

Feb 2

Preserved a few young flying fish (from Eggs #1). Those remaining are distinctly bright reddish.

Made out of Kingston Harbor about 10⁰⁰ A. M.

Hydrographic stations were started within sight of the Harbor. A shark (sp?) and a *Physalia* seen at station 1.

The first one after dark (1936) yielded 2 *Cypselurus smithi* (?), 1 *Halocypselus evolans*, 1 *C. vitropinna* (?) large, 1 *C. sp.?* and 1 *C. monroei*, 1 *Parexocoetus*, *Strongylura ardeola*.

The second (1937) yielded 2 *C. furcatus*. Weed was abundant at the second and practically absent at the first. A large *Halocypselus* was taken in the tow between.

At the third station a *Carcharhinus milberti* was hooked. It had a small shark sucker attached. Preserved eye and parasites. Its stomach contained *Octopus* and *Barracuda*.

Notes on above catches.

C. monroei had 2 barbels reaching well past the end of the tail when caught. These could be "retracted" to $\frac{1}{3}$ that length and then stretched out again. This fish at such a size is practically colorless - just a pale yellow tint covered with the slight black pigment spots as in the figure of the type.

C. smithi (larger specimen) is a beautiful blue above with complicated black wing patterns. *Parexocoetus* has barbels present of prominent size.

C. vitropinna is a nearly ripe ♀

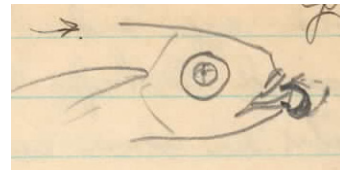
Halocypselus evolans has a definite wing pattern not like our figs.

February 2 (excerpts from Forbes account)

Under way about 10 A.M. with a boat load of friends of the crew out to see us off. Outside found a moderate east wind; went straight into it under power for 12 miles, where we hove to under jumbo and mizzen for our first station. I went out in a dory with the movie camera to film the ship from all sides. I also got some film from an decks showing the hauling in of some of the bottles with water samples from different depth. Finished the first station, set all sail and started under sail alone S X E for the next station about 3.10 P.M.

The sailing between stations was delightful, a light beam wind sending us along about 5 knots. Shortly after sunset we reached the second station, and this time, while the routine work of bottling water samples was going on, the ichthyologists dangled the light under water and got busy with their nets. Rich was the harvest. Early in the game a beautiful blue biplane flying fish was scooped in alive and in perfect condition, about 2-1/2 inches long, then another about one inch long, both were put in the aquarium with my old friend the glad-hand fish. A sheet of gauze was stretched over to keep them

from jumping out. Presently Breder took another look to see that all was well, and the smaller flying fish had vanished. He searched and searched till at last the awful truth damned on him - the glad-hand fish had eaten the missing flying fish. Now the victim was a rare and valuable specimen and must be recovered. Parr tried massaging the glad-hand fish's stomach, but the fish replied, "I'm never, never sick at sea". So the extreme penalty was exacted. The glad-hand fish was cut open and both culprit and victim were placed in formalin. One large flying fish dashed his head against the ship's side and was scooped up in a dying condition. Four others of four different species were caught alive and put in the aquarium. Other catches were some lively squid, which revealed a remarkable power of lightning changes of color, and a large sky-blue needle-fish - lots of treasures for the New York Aquarium. At 8.45 we finished the stations set sail and moved on in the moonlight.



16

Feb 3

By daylight only the large *C. furcatus* and *C. monroei* alive. The first seeks the bottom and the latter the top of the aquaria. *C. furcatus* constantly "balance" with its pectorals and ventrals working them about. *C. monroei* holds the pectoral fins stiffly upward and folded and the ventrals downward and spread and propels itself with the tail an act hardly noticeable in *C. furcatus*. The latter keeps its "whiskers" in its mouth sucking them in and out on the respiratory current. Those of *C. monroei* trail out behind.

Set 1 contained Exocoetids and other fishes.

Set 2 contained only *Dactylopterus*.

The above specimen of *C. furcatus* died in the P. M. with the barbels gone (sucked off?). *C. monroei* distinctly phototropic.

Just before dark 2 tow nets (deep) were put over. Brought up at 9³⁰ they contained expected deep water forms.

February 3 (excerpts from Forbes account)

The third station was done between 1 and 3 A.M. Some more flying fish were caught alive, including one brightly colored, called a butterfly fish.

As we were getting under way from that stations I was wakened with a splash, and found a pint or so of water had come in my port. The Captain had told me he thought I could safely leave it open, but he guessed wrong. I yanked the mattress off quickly to wash the salt from the outer cover at the basin, before it should soak in, thus rendering it soggy for all time. The Second Mate got John to get me dry linens, and after some time I went to sleep again. Needless to say, I closed the port.

Waking at 7.30 I found a hard rain squall going on so went an deck for a fresh water shower. I nearly

collapsed when I found the exit from the laboratory almost barred by a six foot shark lying on deck, his dorsal fin swaying in a sinister way, as the ship pitched. They had caught him with a hook in the small hours. Alas, all the squid and nearly all the flying fish have died in the night. They don't seem to like glass aquaria.

About 9 A.M. we finished the fourth station and set sail for the south. A mountain peak on Jamaica is still visible among the clouds, about 50 miles away.

At intervals since last night, when drowsiness did not forbid, Breder and I have philosophized and philosophized about the high mortality of flying fish in aquarium, and their difference in that from such fish as cod and the glad-hand fish. He pointed out that flying fish are not accustomed to making contact with solids; they live near the surface of the

open sea. But cod and other fishes that maneuver among ledges and weeds near the bottom, and antennarius and other glad-hand fish that climb among the weeds, survive much handling. He illustrated it with a remora (shark sucker) which he had in a pail, which you could handle all you wanted without seriously upsetting. I raised the question of pathology. What does the flying fish actually die of? What would he show at autopsy? Does he become exhausted from hyper activity and develop some autointoxication? Does he die of fright through heart failures or what? Parr said that it has often been found that fishes manifest abnormally high oxygen consumption for several hours after having been put under experimental condition, which shows a persistent excitation and increased activity. There might be some interesting researches there. "Lethal neurasthenia in flying fish - how come?"

About 4 P.M. we reached station No. 5, and I finished my black and white movie film on the water bottle operations. Then I learned that they were going to lower the big net with the large winch for the first time so I took Kodacolor film of the preparations, although the sun having gone in, the light wasn't very good.

About 6 o'clock, when the water samples had all been taken in, the two big nets were secured to the weighted cable and lowered away, while the ship went ahead slowly under power. From then till 9 o'clock we went north at about two knots. Between 9 and 9.30 the big nets were hauled in. From each a half pail of assorted Plankton was collected. Those hauls included a handsome black fish whose wicked and determined looking square jaw, armed with long teeth as sharp as needles, revealed a soul which, according to Parr, is one of great ferocity. There were some bright scarlet shrimps which live at a depth so devoid of red light that they appear black in their native habitat. There was also a shrimp with an enormous head and still more enormous eyes. Parr said the "adaptationists" call attention to his big eyes as being adapted to vision in the very dim light in which he lives, overlooking the fact that since the whole animal, eyes and all, is perfectly transparent, so that the energy of the light goes through without stopping, he must be unable to use any of the energy for vision, or at most, so minute a fraction of it that with precious little light to start with, he must be virtually devoid of all vision.

Feb 4 Turned out 4⁰⁰ to work overboard light at station 1940. Two fish only appeared. *Cypselurus furcatus*? and a smaller C. sp? Could catch neither.
 Cypselurus monroei still living in aquaria. Photoed and movied. Spent A.M. fixing up aquaria with aeration.
 Set 1 contained practically no weed. A single *Spheroides* and a *Dactylopterus* and a *Halocypselus* (several in bad shape).
 The single young fish remaining of the Eggs #1 is distinctly bright red color except the tail which is still clear. No barbels evident. Pectoral reddish orange. In the sun light a metallic glint is beginning to appear - the deposition of guanin?
 17 The specimen of *Cypselurus monroei* alive at 4:00 was found dead at 4:15 with both barbels gone. Parts of each were recovered and preserved.
 About half an hour previously a piece of *Sargassum* was placed in the aquarium. The fish showed no reaction whatever but kept well away from it.
 Two sea birds "*S. kercis*?" were shot. Saved the eyes and cestodes from the second. Get species name.
 Turned in 9³⁰.

February 4. (excerpts from Forbes account)

Station No. 6 was done between 4 A.M. and 8 A.M. this morning. No fish caught. Parr had been operating the fathometer every hour since midnight and expressed the opinion that the soundings were not worth the fatigue entailed and the consequent loss of efficiency in the main work. Backus complained of the wear and tear of stopping the engine so often. I discussed it with the Captain who unofficially agreed with both points of view. It is fine sailing this morning and we are doing 7.5 knots with the east wind on the beam without the engine.

Later. The universal sentiment led to cessation of all soundings except at stations. At noon we reached station No. 7 and as usual, hove to on the starboard tack. Unhappily the fairly fresh trade wind and west-running surface current conspired to drive us sideways so fast that the wire attained an angle of more than 60° from the vertical. Consequently the

second set of bottles (the deep ones) had to be done over again. To get the angle steep enough we have been pushing straight into the wind under power with barely steerage way. At 5.15 the wire was out 3000 meters and the "messenger" sent down.

While we were hove to, during the unsuccessful attempt at the deep series, most of the crew went swimming off the lee side. I took a dip, which was gently refreshing, then took some Kodacolor film of the others romping in the sea.

The last of Breder's netted flying fish died this afternoon, about five minutes after I had been watching him swim around. Only one of those hatched from the eggs found in the Sargasso weed still lives. The Kingston harbor water killed nearly all of the crabs and shrimp in the aquarium. Live collecting seems difficult.

Feb 5 Turned out 7⁰⁰. At station 1942 Set 2 of yesterday contained some *Parexocoetus* and *Seriola*. Preserved the eyes of a Booby (*Sula leucogaster*) young bird.

The young Exocoetid remaining from the hatched eggs is active and still a deep red with orange pectorals. The active caudal portion is clear.

A small batch of eggs found in Set 2 of yesterday. They may be the young of *Halocypselus* designated eggs 2, nest 10. Some of the eggs were hatched but most in merely an advanced stage of development. Fine minute melanophores scattered over the body - tail clear. Yolk sac yellow-orange. Heart beating and some pectoral movement. These eggs are not as well banded with a cord as set 1, the merest trace of such a structure present and of a decidedly flimsy nature. The egg threads seem to be fewer and certainly do not hold as tight as the others.

Placed most in a mason jar for incubation. No *S. myriocystum* tied in. The eggs on *S. natans*.

Set 1 and 2 of today contained very little. 2 - a few large leptocephali and mashed Exocoetids.

At station 1943 (7 to 9⁰⁰ P. M.) had marked success in collecting Exocoetids. Preserved 18 most of the specimens. *Halocypselus evolans* exceedingly abundant. 1 *Cypselurus monroei*, 1 *Evolantia* sp ! ! 2 *Parexocoetus* with barbels, several small *Exonantes*?, 1 large *Cypselurus vitropinna*?, *Euleptorhamphus* 1.

Set 2 contained another nest of eggs (designated Nest 11 Eggs 3). This was very like Nest 10 in structure but the eggs were new - no embryo visible to the naked eye. Built of *Sargasso* [SARGASSUM] *natans* with no *S. myriocystum*. The weed collection is getting almost no material now.

Turned in 11³⁰.

February 5 (excerpts from Forbes account)

Lying on my bunk after lunch, reading Ruhl, I observed that my port was quite dry, and watching the sea I saw that the waves were not coming nearly to its level. So I opened it and enjoyed the sea breeze fanning my cheek as I read. All was well for nearly an hour. Then the ship gave an extra heavy roll to starboard. Fearing a rebound to port. I swung my port shut with my hand, but not tight enough, for the port went right under and the water was spattered in through the crack, soaked my shirt, pillowcase and both sheets but not the mattress or

pillow. If I hadn't swung the part shut when I did my bunk would have been well flooded, I think the port will stay shut till we reach Christobal.

Today Burkenroad got out of the dragnet some violet colored pelagic snails and some small Portuguese men-of-war. The snail has the remarkable faculty of making himself a float, which we watched him do in a glass bowl. On the bottom he was helpless, but when boosted to the surface, he set right to work; he reached out a wide tongue-

like projection of his foot, imprisoned a bubble of air, pressed it against himself, secreted a layer of mucus around it which held it as a bubble, then reached out for another, which was built against the first etc., till he had a multiple float. Burkenroad put a Portuguese man-of-war, nearly the size of the snail, in the bowl with him, The snail proceeded to eat off all the P. m-o-w's tentacles, although these are the structures which sting hell out of almost everything else in the animal kingdom. The snail's appetite recalls the donkey's love of thistles.

The light has brought in a harvest of mullets the first time we have seen them. Some move individually darting at random about the light. Some move in dense schools, so much en masse that Parr thought they must be a different kind of fish, till some were scooped up in the net and proved to be the same. Perhaps those in the school are the conservative bloc - the Main Street fish, while the others are

individualists, free lancers and radicals. Several flying fish were scooped up, one a primitive type hitherto only known in the Pacific Ocean and supposed to have been walled off there when the isthmus was formed. Two were just alike and one of these when put in the aquarium did an incessant series of outside loops. His body was curved as if he had a cramp in his abdominal muscles which kept him somersaulting. Breder decided the whole lot were too valuable as specimens to be allowed to damage themselves and stood no chance of surviving anyway; so he pickled the whole lot. Later, however, a new epidemic of flying fish got scooped in, including five duplicates of the outside looper, all about 1-3/4 inches long, and one full-grown fish of a different species. These Breder was willing to try in the aquarium, so I am hoping for a colored movie of them tomorrow. At 9.30 P.M. we finished the stations, hoisted sail and moved on toward Panama. But the wind being dead astern and sailing slow, the engine was soon started.

- Feb 6 Turned out 7³⁰. The sea is alive with sea birds and dolphins working on flying fish.
 Last night 5 *Halocypselus* and the *Cypselurus vitropinna* were placed alive in aquaria (all dead this A. M.).
 C. vitropinna ♂ - the point pattern described by Parr is nearly as strong on this fish as on *C. heterurus*. and the ventrals are tipped with rosey. Both of these may be secondary sex characters - ? The ventrals are far aft even for *vitropinna*.
 The single larvae of Eggs #1 still alive, Eggs #2 not hatching yet.
 Set No. 3 of yesterday contained many *Mugil* and a few *Exocoetidae*. The *Mugil* were very numerous about the light last night.
 19 Practically all the scant weed of this area has flying fish eggs. (Eggs 4 Nest 12 preserved entire). Covered with the nudibranch specimens turned over to Burkenroad.
 All seem to be *Halocypselus* with very fine threads quite unlike those of *Exonantes*?
 Eggs #2 hatching at 9:30 A. M. Their larval stage do not dive so much as did those of #1.
 Teased eggs out of nest 13 and 14 and held for development. None preserved at the time of separation from weed.
 Set 2 contained a quantity of "hashed" *Exocoetids*.
 Station 1946 contained another *Evolantia* - this one young with a beak clothed in a dark membrane. The rest of the Synentognaths consisted of small *Halocypselus* and *Exonantes*. There is another species of *Halocypselus* collected last night but not tonight that has a very high forehead !
 Turned in 3⁰⁰.

February 6 (excerpts from Forbes account)

About 7 A.M. we stopped at station No. 10. All the flying fish put in the aquarium last night were dead, and joined the formalin fraternity. While at station, Bishop in the bow scooped up a number of the violet snails and more of their detached egg clusters supported by soap bubble floats. One had the float attached when put in the pails but promptly became detached and sank to the bottom leaving egg cluster and bubble float on the surface. Burkenroad said the snail after this stage seemed inactive and he thought she became exhausted and probably died after shedding the egg cluster. They also got some

very fine *Physalia* (Portuguese men-of-war) and I took nearly 100 feet of Kodacolor film of them in white pails in the sunlight showing the motions of both the float and the tentacles.

Harry Sears shot a bird, and they launched the dory to retrieve it. Kelly and Sears went out but couldn't find it. However, a booby found them and swooped down three times as if to attack, but swerving up when two or three feet away. The third time Sears killed him with the oar. That made two boobies and two jagers which he has collected and Bishop has skun. They also brought back in the dory some fine *Physalia*. About 10 o'clock we finished the station

and started under power with only the jumbo set, for the wind is light and dead astern.

Most of the day has been spent reading Ruhl on Central America in preparation to flying over the same. Just before 4 P.M. we reached station N. 11 and hove to. Parr considerably abandoned the towing of the big net to enable me to reach

Christobal tomorrow. We finished the station just at 7 P.M. and started on. After supper four or five large dolphins (about 4 ft. long) cruised around the stern for some time. The boys tried to lure them with fish oil, and stood by with the harpoon, but they scorned our blandishments. They were very beautiful with bright blue bodies and yellow tails, and Breder saw one change to olive green as he swam.

Feb 7 Turned out 7³⁰. Point Manzanillo and Cape San Blas visible - after 10 years.
Eggs 5 and 6 dead - discontinued. 1 fish of Eggs 2 retained and all of eggs 3. Set 1 contained Exocoetid "hash".
Spent the A. M. making ready for shore.
Spent the P. M. and evening looking over the Colon situation - M. W. Markham and Capt of the Port.
Turned in 3³⁰ A. M.

February 7 (excerpts from Forbes account)

We made fast time, and at midnight reached station No. 12. At 2.40 A.M. the fact that we were getting under way penetrated my slumbers. At 6.25 I waked to find, to my surprise, that we were already stopping at station No. 13, our last before Christobal. I went on deck to see a fine array of mountains north of us extending many miles to east and west, and Isla Grande flashing brightly about 10 miles away. The depth being just under 1000 fathoms necessitated only one series of bottles, but the thermometer at 400 meters depth broke, and another one had to be sent down. But at 8.25 they finished the station and got off on the last lap for Christobal. The wind is still so light that we are only using mizzen and jumbo and not getting much out of them.

Breder, as we watched together for flying fish, told me Nomeus, the beautiful blue fish I filmed yesterday in color, is an excellent example of his generalization about fishes which live in proximity to solid objects withstanding contact. Those Nomeus, after a day and a half in the aquarium, are still thriving, whereas practically all the flying fish have died in a few hours. Nomeus habitually lives under the shadow of *Physalia* (Portuguese men-of-war), being apparently immune to its sting and enjoying its protection.

We are skirting the shore of Panama whose steep slopes are seen with the binoculars to be clothed with lovely, rich verdure. Passed the Christobal breakwater at 1.15. Anchored before 2 P. M. and went ashore with all the officials.

Feb 8 Spent the day collecting with Bishop. Visited innumerable small creeks between Colon and Gatun. Got *Gambusia*, *Mollienisia sphenops*, *Panamichthys*, *Dormitator*, *Eleotris* and *Astyanax ruberrimus*. These latter have non-red fins (clear) like aquarium specimens. Was the creek they were in as bad as aquaria or are the Darien ones different?
Also iguana, *Bufo marinus* and *B. m* tadpoles.
Spent the evening about town.
Turned in 11⁰⁰

Feb 9 Came over to Panama City in the A. M. and met Parr, Sears, Burkenroad with Bishop. Spent the day looking over old haunts in Panama City. Saw *Hemiramphus saltator* in the market.
Spent the evening discussing matters and walking about.
Turned in (Hotel Central) 12³⁰.

Feb 10 Turned out 7³⁰ A. M.
Met Mr. Yetek in the A. M. and made arrangements to go to Barra Colorada. Saw two species of large *Tylosurus* in the market (bought by Parr).
In the P. M. met Dr. Clark and visited his lab. at Georgas Memorial Lab. Saw many vampire bats under study.
The Pedro Miguel Locks will be drained in 4 years - see the mixture. This man knows Darien !

- In the evening a fiesta was held in Panama City. Took in and turned in 11⁰⁰.
- Feb 11 Turned out 5³⁰ and got 7⁰⁰ train for Barra Colorada. Arrived there before 9⁰⁰ A. M. Spent the morning looking for unrecorded fishes. Tramped over Snyder Molino Trail to Raymond Shannon Trail. In the first creek along the latter from the junction *Rivulus splendens* were taken in numbers. This stream is a series of drying fovals [?] only. A surface swimming tadpole also. In the second creek *Rivulus*, *Brachyrhaphis episcopi*, and *Piabucina panamensis* were taken. Our guide, Sylvestre, said those were all the up creek fishes on the island. In the P. M. rowed about the "harbor" investigating all inlets. None have flowing streams in them at all during the season. The following species were seen but not collected. *Cichlasoma maculicauda* abundant ! ! *Aequidens coeruleopunctatus* rare, *Gobiomorus dormitor*, few *Gambusia affinis* and *Astyanax*. At the laboratory dock were seen the above and also *Brycon chagrensis*.
- 22 Sylvester collected in similar shore points and collected *Gobiomorus dormitor*, *Rhamdia wagneri*, *Brachyrhaphis episcopi* and *Hoplias microlepis*. These came from the first inlet to the west of the laboratory dock. Small ticks are very numerous on this island as well as other more interesting forms: saw a deer (tame), toucan, howler monkey, white faced monkey, capuchin monkey, honey bears, basilisks, but no other lizards. Various small Bufonids, *Eleutherodactylus*, etc. common. In the evening went at it with flash lights. Got *Thyrina*, *Gobiomorus Cichlasoma*, *Astyanax*, *Oostethus* at the lab dock. Got *Astyanax* and *Piabucina* in Lutz Creek. Did a little wandering about in the jungle till 11⁰⁰ and turned in.
- Feb 12 Got the early morning train for Colon (Mr. Yetek aboard) and got stuff fixed up. Went out to the Tarpon Club and met Mr. Markham and looked about. Caught a few fishes below the spillway. Tarpon not abundant, snook plentiful and *Caranx hippos* caught. Spent the evening in Colon. Turned in 2⁰⁰.
- Feb 13 Turned out 9⁰⁰. Wrote letters and prepared to sail. Due to some money difficulty sailing was postponed. Spent the day fast to the oil dock. Fixed up the living fishes, etc. Went to town in the evening and looked on at the annual pre-lenten carnival. The women dressed in old native costume. Turned in 11⁰⁰.
- Feb 14 Cast off about 11⁰⁰ A. M. Rain squalls all afternoon. Set 1 contained no fishes. Mostly dark winged flying fishes seen on the wing - *Exonantes*?
- 23 Got 2 large *Halocypselus* and 3 barbeled *Parexocoetus* at station 1950 laying in a wind row of Sargasso. Also a nest. Designated Nest 15 with new eggs. These *Halocypselus* have quite black wings (in flight). The eggs of Nest 15 designated #7. Turned in 3³⁰.
- Feb 15 Turned out 7³⁰. Worked on above material. Set 1 contained 3 Exocoetids and 2 *Syngnathus*, 1 *Pseudomonacanthus*. Preserved some of the eggs #7 and held the rest for development. Nest No. 16 at station 1951 in the dip net. Eggs all hatched (entire nest preserved). Heavy cords similar to the first nest in structure. At station 1952 a good series *Evolantia* (large) and various small Exocoetids. No *Parexocoetus*. Many small squid and many little *Coryphaena*. No sargasso weed. Turned in 12³⁰.

Feb 16 Rain. A shark was seen at station 1953 with prominent large white tip to its dorsal and pectorals. At 4⁰⁰ P. M. Little and Big Coin [?] Islands in sight. Have been taking soundings since yesterday with the Fessenden Fathometer. (Hourly 12 - 8 p. m. watch). This area of sea seems to be very sparsely inhabited. Practically no weed, birds or fishes.

Porpoises at station 1954. A little later a 5' *Acanthocybium* and a 2' *Scomberomorus cavalla* were caught trawling. This was all on the hook - the change being due to the shoal water?

Turned in 8²⁰.

Feb 17 Turned out 8⁰⁰. Two *Cypselurus lutkeni* flew on board during the night. The tail is quite black - the body blue and white (typical) and the fin pattern black.

At station 1956 was a loggerhead.

The Sargasso nets are catching practically nothing. Set 2 contained 2 *Spheroides* and 1 *Dactylopterus*.

Saw Old Providence late in the afternoon.

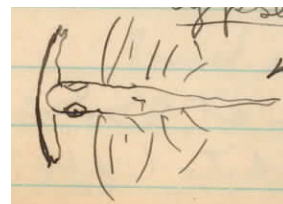
At station 1959 there was very little life. Two kinds of Exocoetids, black and white *Cypselurus* (young?), and *Halocypselus*.

At station 1960 more was about. *Halocypselus* (net caught) *Cypselurus lutkeni* large 1, and a strong small *Cypselurus* with a transverse barbel. The young of what. The fish itself was very pale, for most part milk white with very light yellowish cross bars on the body and faint shades on the wings.

A very small sprig of Sargassum #1 harbored a young *Cypselurus furcatus*. This weed last seen Feb 15th and *C. furcatus* never far from shore or with a lack of weed. The weed is very sparse. This piece also held Exocoetid eggs. That saved - preserved by Burkenroad.

Material 1959 and 1960 preserved together. *Nomeus* (3) were taken about the light with no *Physalia*. Do they lose their *Physalia* by night? A large dolphin was seen actually catching flying fish in the night.

Turned in 4⁰⁰.



25

Feb 18 Turned out 8⁰⁰. Eggs not dead. Part preserved. Flying fish few, *Physalia* numerous. In set 2 was a hatched nest of flying fish eggs. Saw Roncador Rocks just before sundown.

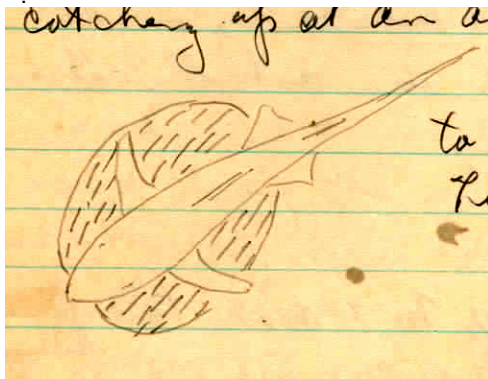
At station 1955 2 *Cypselurus lutkeni* were taken and a single *Halocypselus* seen. Numerous *Myctophids*. At station 1956 1 *Cypselurus heterurus*, 1 *C. smithi*? several *Halocypselus*. Sharks *Carcharhinus* were numerous. 2 caught. Saved parasites. Exocoetids numerous but disturbed by presence of sharks. Turned in 6⁰⁰.

Feb 19 Turned out 8⁰⁰. At station 1966 a white tipped shark (sp.?) was caught.

Set 1 contained a few Exocoetids and misc fish preserved.

Station 1967 lasted from sundown to midnight. Bright $\frac{1}{4}$ moon seemed to spoil the influence of the light. A single Exocoetid seen (taken) - *Halocypselus* (pug headed form). Sharks numerous and large one with 14 young taken *Carcharhinus* sp. One not caught was followed by a cloud of some small, exceedingly well integrated school of herring-like fish. They turned and wheeled following the shark as it weaved from side to side catching up at an amazing rate of speed. They paid no attention at all to the overboard light.

Turned in 12⁰⁰.



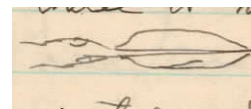
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- Feb 20 Turned out at 3⁰⁰ for station 1968. Conditions essential similar to the preceding but with the moon gone. Exocoetids numerous as well as sharks, including one with a cloud of small fish as above described. Took barbeled *Parexocoetus* (2) *Cypselurus furcatus* (2) when weed drifted by, *Halocypselus* (several) *C. comatus* = *C. antarei* (1) and a large *C. heterurus*.
 Another shark was caught.
 This region is part of reefs that have not been charted for 100 years making navigation somewhat dangerous. A brown booby came aboard and was photographed extensively by all.
 Set 1 contained several *Psenes*-like fish.
 Station 1970 - one *Cypselurus lutkeni* 225 mm s.l., 287 mm t. l. Head preserved in Zenkens [?]. One shark taken.
 Station 1971 - After the moon sank Exocoetids became very numerous. The following were collected between midnight and dawn.
 Evolantia - 6
 Exonantes (black wings) - 5
 Cypselurus (with transverse beard) - 2
 Parexocoetus (barbeled) - 11 (in Jenkins and 1 in Bouin)
 Halocypselus - 8 (in Jenkins and 1 in Bouin)
 Cypselurus lutkeni - 1
 Coryphaena with *Argulus* - 1
 Decapterus - 2
 Myctophids - many
 Stayed up most of the night collecting this material. A few sharks seen.
- 27 Feb 21 Flying fishes began to appear in numbers as soon as we started crossing Pedro Bank. Spent most of the day negotiating it. As soon as we crossed it the flyers disappeared. See the statistical counts.
 Just at night fall the hills of Jamaica could be made out. Nothing could be collected at stations 1974 & 1975 - bright moon, start stations and fairly heavy sea. Turned in at 8⁰⁰ and had the first good sleep since Panama.
- 28 Feb 22 Turned out 7³⁰. Sea calm. Just off Jamaica. Spent a considerable time taking a bottom sample in Bartlet Deep - gritty tan colored mud. A few white-spot finned sharks about. The night light was unsuccessful - only 1 Myctophid and a squid.
 Got a good rest.
- Feb 23 Off Cayman Brac 8⁰⁰ on station. An islander came aboard and took some mail. Set (last of yesterday) contained many Myctophids and other general stuff. *Canthidermis* 1, *Pterophryne* (1) *Leptocephalus* (1) etc. At station 1979 2 *Pseudomonocanthus* and 1 *Mugil* were taken at the night light. 2 *Strongylura* sp. (*ardeola*?) were seen and a large eel (?).
 Flying fish were very few throughout the day.
 At station 1980 - all night very little was taken. 1 *Halocypselus*, 1 *Parexocoetus*, a few young dolphin and 1 Myctophid. Bright moon and a fine sea running. Lay off to negotiate the shoals off South Cuba by daylight.
 Turned in 1³⁰ A. M.
- Feb 24 Turned out 7³⁰. The Keys of South Cuba in sight. At station 1981 got a small red (deep maroon) halfbeak under drift. Spent most of the day coasting along the southern coast of Cuba. Flying fish very few. None actually seen during counting periods.
 Turned in 10²⁰.
- 29 Feb 25 A heavy sea produced unpleasant roll that got most of us to fix glassware securely, etc. Turned out 7³⁰. Sea still running with a good sailing breeze. Flying fish few.
 Spent most of the day resting - little could be done - sea too high.
- Feb 26 Two stations made at night 1984 and 1985 were fruitless - bright moon and high seas. There is little weed and few flying fish flying in this area anyway. This sea seems to be quite barren. Saw Grand Cayman before sunset.
- Feb 27 Two stations made at night 1988 and 1989 were fruitless - bright moon. The dredge however brought up a variety of Synentognaths. Sunrise revealed a large number of *Cypselurus*? flying. Last night we apparently passed out of the area of barrenness. A small hawksbill turtle was taken in the dredge.

Flying fish very abundant all morning. Fell off in numbers about noon time. Saw a number of "balled" weed masses out of reach, that may have been Exocoetid nests.

Tried the night light at station 1992. Bright moon - not a fish appeared - nor a squid.

- Feb 28 Flying fish, mostly *Halocypselus* abundant but sea too high - try photography - breaking over the bow. In the P. M. tried some movie making of flying fish in flight - rather unsuccessfully. At station 1995 tried the night light a new way. Used a photo flood bulb in the face of a bright full moon. Set 1 *Parexocoetus* and 1 *Hemirhamphus*. Saw but could not catch *Cypselurus furcatus* 6±, *Parexocoetus* 4, *Hemirhamphus* 2, *Strongylura* 1, no *Myctophids* or squid were about. 1 *Coryphaena* of about 6". Apparently the *Myctophids* and their predators do not come up on moon-light nights. The *Hemirhamphus* had terrific mandibular flaps (85 mm long ±). In the water it resembled a piece of broken *Zostera*. The lamp broke and terminated activity for the night. Turned in 1⁰⁰.



- March 1 Off Cape San Antonio, Cuba. Flying fish abundant. tried to take movies of flying fish. Several 2' *Tylosurus raphidoma* (?) seen under weed clumps. Tried the repaired night light at station 1999 but the current was so great that it was immediately abandoned. Mechanically the light worked well enough. Reached sight of Yucatan in the night but the conditions were such as to prohibit night light work.
- March 2 On way to Havana. Cloudy - smart breeze. Heavy sea. Nothing could be done. Made up to 10 knots at times.
- March 3 Last night one *Cypselurus heterurus* came aboard. Flying fish fewer this morning. Seas still high - high winds - now making for Key West, Fla. Relatively large numbers of young 3-4" flying fishes were about. *Physalia* numerous. These pale blue as compared with the deep colors of the Panama specimens. Gulf weed scarce. At the first night station no. --- just off Havana Cuba tried the night light again. Got 2 *Mugil* and 1 *Priacanthus altus* (about 3"). Bright silver all over or mottled polka dot fashion black and white. The second station, near dawn, was not tried with the night light. A single photo-flood bulb seems to be able to outshine the moon. Try two !
- March 4 Spent the day making the string of stations from Havana to Marquesas Keys. *Physalia* numerous. Got one *Nomeus* under one. Flying fish fewer than yesterday. Started packing up for we are due in Miami tomorrow. Coasted along the Florida Keys after dark following the very numerous lights. Phosphorescent bodies present in wake of ship - about size of peas. Turned in 12⁰⁰.
- March 5 Turned out 6⁰⁰. Miami in sight. No flying fishes seen - water green. Got in and through formalities by 11³⁰. Met Ralph De Sala and wife. Took 10⁵⁰ train to N. Y. *Atlantis* due there with material about March 15.

The Scientific Party on the Cruise follows.

A. E. Parr	Bingham
M. Burkenroad	Bingham
Greenwood	W. H. O. I.
M. Bishop	Peabody Museum
H. Sears	W. H. O. I.
Forbes (to Panama)	Harvard

- March 6 Frog chorus heard just outside Fayetteville, N. C. 6³⁰ P. M. Seemed to be spring peepers and cricket frogs in the distance (about 1/2 mile north of Fayetteville at an unscheduled stop).

Jan 25 ---
 Jan 26 ---
 Jan 27 (saw a *Cypselurus furcatus*?)
 Jan 28 (saw a *Cypselurus furcatus*?)
 Feb 2 a *Cypselurus smithi*? 2; *Halocypselus evolans* 1, *C. vitropinna*? 1, *C. sp.* 1, *C. monroei* 1,
Parexocoetus (barbeled) 1, *Strongylura ardeola*? 1
 b *C. furcatus* 2
 c ---
 Feb 4 (saw 2 *Cypselurus*?)
 Feb 5 *Halocypselus* (many), *C. monroei* 1, *Parexocoetus* (barbeled) 1, *Exonantes*? (many), *C.*
vitropinna 1, *Evolanti* !! 1, *Euleptorhamphus* 1
 Feb 6 *Exonantes*, *Evolantia* 1, *Halocypselus*
 Feb 14 *Halocypselus* 2, *Parexocoetus* 3
 Feb 15 *Evolantia*, 1 *Halocypselus* (small), *C. furcatus* 1, *Cypselurus smithi*?
 Feb 17 *C. sp.*? 1, *Halocypselus* (small), *C. furcatus* 1, *C. lutkeni* 1
 Feb 18 *Cypselurus smithi*? 1, *C. heterurus* (2)
 Feb 19 *Halocypselus* 1 (preserved with Feb 20)
 Feb 20 *Parexocoetus* (2), *C. furcatus* (2), *Halocypselus* and *C. comatus*? (1), *C. heterurus* (1)
 Feb 23 *Halocypselus* 1, *Parexocoetus* 1
 Feb 28 *Parexocoetus* 1, *Hemirhamphus* 1

Specimens Preserved

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[Synentognaths marked in red (NOTED WITH AN ASTERISK IN THIS TRANSCRIPTION)]

Jan 22	Dip net	<i>Scomberesox</i> * Set 1 and Set 2 <i>Scomberesox</i> * and <i>Mugil</i>
Jan 23	Set 1	<i>Cypselurus furcatus</i> * and <i>Exonastes rondeletti</i> *
Jan 24	Set 1	<i>Kyphosus</i>
	Set 3	<i>Pterophryne</i>
	Set 4	<i>Pterophryne</i> (1) Myctophid (1) <i>Leptocephalus</i> 6± (European eel?)
Jan 25	Set 1	<i>Parexocoetus mesogaster</i> * (1) Myctophid (1) <i>Leptocephalus</i> 6± 2 <i>Isospondyli</i>
	Set 2	<i>Kyphosus</i> (1)
	Set 3	<i>Parexocoetus</i> (1)
	Set 4	<i>Pterophryne</i> (1)
Jan 26	Set 1	<i>Parexocoetus</i> * (1) <i>Coryphaena</i> (1)
	Set 1	<i>Kyphosus</i> (1) <i>Syngnathus</i> (1) <i>Canthidermis</i> (?) (1)
	Set 2	<i>Parexocoetus</i> * (3) <i>Coryphaena</i> (1)
	Set 2	<i>Syngnathus</i> (3) <i>Pterophryne</i> (1) <i>Isospondyli</i> (1)
	Set 3	<i>Cypselurus</i> * (1) <i>Halocypselus</i> (1)
	Set 4	<i>Coryphaena</i> * (1)
Jan 27	Set 1	<i>Halocypselus</i> * (2)
	Set 1	Myctophid (3)
	Set 2	<i>Halocypselus</i> * (2)
	Set 2	<i>Canthidermis</i> (1)
	Set 3	<i>Pterophryne</i> (2) and Carangid (1)
	Set 4	<i>Pterophryne</i> (2) and Carangid (1)
	Set 4	<i>Coryphaena</i> * (3)
	Set 5	Misc. fishes (see page 7 & 8)
	Set 5	Synentognaths (see page 8)
	Set 6	Misc. fishes (see page 8)
	Set 6	Synentognaths (see page 8)
Jan 28	Set 1	<i>Pterophryne</i> (3) <-- last of first bottle of mixed fishes
	Set 2	<i>Pterophryne</i> (1) Carangid (1) <-- Beginning 2nd bottle of mixed fishes
	Set 3	<i>Pterophryne</i> (7) <i>Kyphosus</i> (1) <i>Pseudomonocanthus</i> (1) <i>Canthidermis</i> (1)
		<i>Spheroides</i> (1)
Jan 28	Set 3	<i>Hemirhamphus</i> (1), <i>C. furcatus</i> (1) <i>Parexocoetus</i> (3)
	Set 4	<i>Hemirhamphus</i> (1), <i>Parexocoetus</i> (2)
	Set 4	<i>Syngnathus</i> 1, Carangids 3, <i>Spheroides</i> 1, <i>Pterophryne</i> 1
	Set 5	<i>Parexocoetus</i> (1)
	Set 5	<i>Canthidermis</i> (1) Myctophid (large) (1), <i>Pterophryne</i> (1)
Jan 29	Set 1	See page 10 (misc. fish)
	Set 1	See page 10-11 (Synentognaths)
	Set 2	See page 11 (misc. fish)
	Set 2	See page 11 <i>Istiophorus</i> and <i>Coryphaena</i>
	Set 3	See page 12 (Synentognaths)
	Set 3	See page 12 (misc. fish)
	Set 4	See page 12 (Synentognaths)
	Set 4	See page 12 (misc. fish)
Jan 30	Set 1	See page 13 (misc. fish)
Feb 2	Set 1	<i>Halocypselus</i> (large)
	Set 1	(misc. fish)
Feb 3	Set 1	(misc. fish)
	Set 1	(Synentognaths)
	Set 2	<i>Dactylopterus</i>
Feb 4	Set 1	(Synentognaths)
	Set 1	(misc. fish)
	Set 1	<i>Seriola</i>
	Set 2	<i>Halocypselus</i> , <i>Parexocoetus</i>
Feb 5	Set 1	Misc. fish
	Set 2	<i>Leptocephali</i> 2
	Set 2	Exocoetid
	Set 3	<i>Lactophrys</i> , <i>Diodon</i>
	Set 3	<i>Halocypselus</i>
Feb 15	Set 1	Synentognaths 3
	Set 1	<i>Pseudomonocanthus</i> 1, <i>Syngnathus</i> 3

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Feb 17	Set 2	<i>Dactylopterus</i> 1, <i>Spheroides</i> 2
Feb 19	Set 1	Exocoetids, <i>Dactylopterus</i>
	Set 1	Carangids, <i>Spheroides</i> etc. (with last night's Myctophids)
Feb 20	Set 1	<i>Psenes</i> -like fish

Data on Sargasso Net Sets

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Jan 22	1	9:30 - 10:25 A. M.	19.2°C	5.9 knots	
	2	10:25-3:25 P. M.	19.2-19.4°C	36.8 knots	
Jan 23	1	12:10-2:25 P. M.	20°C	10.5 knots	
	2	2:35-5:00 P. M.		14.0 knots	(no fish)
Jan 24	1	8:20-9:15 A. M.		72.2	(chub)
	2	9:20-12:05 P. M.		19.7	(no fish)
	3	12:10-2:10 P. M.		14.8	(1 <i>Pterophryne</i>)
	5	5:05-8:40 P. M.		15.2	(<i>Leptocephalus</i> , <i>Ptero.</i> , Myctophid)
Jan 25	1	5:05-8:10 P. M.		19.4	(1 <i>Parexocoetus</i> + others)
	2	8:15-9:30 A. M.		5.8	(<i>Kyphosus</i>)
	3	9:40-11:05 A. M.		5.7	(1 <i>Parexocoetus</i>)
	4	11:15-1:20 P. M.		7.5	(1 <i>Pterophryne</i>)
Jan 26	1	5:10-8:20 A. M.		18.0	(<i>Parex.</i> , <i>Coryphaena</i> , <i>Kyphosus</i> , <i>Syngnathus</i> , <i>Canthidermis</i>)
	2	8:40-12:20 P. M.		19.7	(<i>Parex.</i> , <i>Syng.</i> , <i>Ptero.</i> , Carangid)
	3	12:35-3:35 P. M.		20.0	(<i>Halocypselus</i> , <i>Cypselurus</i>)
	4	3:50-6:20 P. M.		13.0	(<i>Coryphaena</i>)
Jan 27	1	5:00-8:45 A. M.		30.5	(<i>Halocypselus</i> and Myctophids)
	2	8:55-11:10 A. M.		19.0	(<i>Halocypselus</i> and <i>Canthidermis</i>)
	3	11:20-2:10 P. M.		24.3	(<i>Pterophryne</i> and Carangids)
	4	2:18-4:40 P. M.	25.3°	18.4	(<i>Pterophryne</i> and <i>Coryphaena</i>)
	5	4:50-8:00 P. M.		23.5	(see page 7 & 8)
	6	9:00-3:40 P. M.		46.0	(see page 8)
Jan 28	1	6:40-7:20 A. M.		7.0	(see page 9)
	2	8:05-10:05 A. M.		12.6	(see page 9)
	3	10:12-12:35 A. M.		18.4	(see page 9)
	4	12:50-5:10 P. M.		32.4	(see page 9)
	5	5:20-7:50 P. M.		19.1	(see page 9)
Jan 29	1	3:00-9:00 A. M.		43.3	(see page 10-11)
	2	9:20 A. M. - 6:15 P. M.	69.2		
	3	6:20 P. M. - 8:20 P. M.		18.4	
	4	9:15 P. M. - 7:05 A. M.	76.0		
Jan 30	1	7:20 A. M. - 1:12 P. M.	46.3		
Feb 2	1	3:15 P. M. - 6:45 P. M.	17.4		
	2	9:00 P. M. - 12:20 A. M.	15.0		
Feb 3	1	2:43 A. M. - 6:25 A. M.	16.7		
	2	9:25 A. M. - 3:40 P. M.	43.6		
	3	9:45 P. M. - 4:20 A. M.	40.3		
Feb 4	1	7:30 A. M. - 12:15 P. M.	35.7		
	2	7:35 P. M. - 5:45 A. M.	67.1		
Feb 5	1	9:50 A. M. - 4:20 P. M.	40.3		
	2	4:35 P. M. - 6:45 P. M.		16.8	
	3	10:00 P. M. - 6:45 A. M.	66.0		
Feb 6	1	10:30 A. M. - 3:50 P. M.	41.5		
	2	7:00 P. M. - 12:00 Midnight	37.1		
Feb 7	1	2:45 A. M. - 6:30 A. M.	27.8		
Feb 14	1	12:37 P. M. - 2:37 P. M.	9.6		
	2	4:30 P. M. - 6:00 P. M.		12.5	
	3	7:35 P. M. - 11:40 P. M.	34.0		
Feb 15	1	3:00 A. M. - 10:55 A. M.	56.1		
	2	3:00 P. M. - 9:40 P. M.		45.1	
Feb 16	1	9:35 A. M. - 12:50 P. M.	18.2		
	2	2:30 P. M. - 4:10 P. M.		11.0	
Feb 17	1	1:28 P. M. - 2:20 P. M.		7.0	

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	2	2:55 P. M. - 5:05 P. M.		16.4
	3	6:40 P. M. - 10:20 P. M.	42.7	
Feb 18	1	5:00 A. M. - 8:00 A. M.	24.5	
	2,3	2:35 P. M. - 10:25 P. M.	31.1	
Feb 19	1	5:50 A. M. - 11:30 A. M.	37.8	
	2	1:45 P. M. - 5:18 P. M.		25.0
113 Feb 20	1	8:20 A. M. - 1:55 P. M.	36.5	
	2	3:09 P. M. - 5:45 P. M.		17.8
	3	8:00 P. M. - 10:35 P. M.	20.0	
Feb 21	1	10:20 A. M. - 3:40 P. M.	35.8	
	2	10:20 P. M. - 8:20 A. M.	60.5	
Feb 22	1	8:33 A. M. - 2:00 P. M.	38.8	
	2	7:55 P. M. - 7:20 A. M.	74.8	
Feb 23	1	9:25 A. M. - 11:55 A. M.	16.5	
	2	2:15 P. M. - 5:10 P. M.		19.5
	3	7:55 P. M. - 10:40 P. M.	19.4	
Feb 24	1	12:40 P. M. - 3:45 A. M.	111.8	
Feb 26	1	7:30 P. M. - 10:10 P. M.	19.0	
Feb 27	1	11:45 P. M. - 5:00 A. M.	39.0	

Motion Pictures

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Roll #1	Departure (bad) Sargasso net. Jan 20 - Jan 25.
Roll #2	Sargasso net (bad) Sargasso sorting (enough) Jan 25
Roll #3	Sargasso net coming aboard (enough) Jan 28
Roll #4	<i>Cypselurus monroei</i> Feb 4
Roll #5	Brown Booby Feb 20
Roll #6	<i>Atlantis</i> sailing Feb 28 (enough) Flying fish in flight Feb 28 - Mar 1

Still Pictures

Pack 1

1	Sargasso net Jan 25	7	Hair cutting aboard Jan 25
2	Dip net Sears Jan 25	8	Exocoetid eggs set up Jan 26 (NG)
3	Sorting sargasso weed Jan 25	9	Exocoetid eggs set up Jan 26
4	Battery of aquaria Jan 25	10	Exocoetid nest No. 4 Jan 27
5	Parr sorting weed Jan 25	11	Exocoetid nest No. 4 Jan 27
6	Burkenroad with dip net Jan 25	12	Exocoetid nest No. 4 Jan 27

Pack 2

1	Portinus on cupola Jan 27	7	Jamaica scene Feb 1
2	East end Jamaica Jan 30	8	Jamaica scene Feb 1
3	East end Jamaica Jan 30	9	<i>Cypselurus monroei</i> in aquarium Feb 3
4	Jamaica scene Feb 1	10	<i>Cypselurus monroei</i> in aquarium Feb 3
5	Jamaica scene Feb 1	11	<i>Cypselurus monroei</i> in aquarium Feb 3
6	Jamaica scene Feb 1	12	<i>Cypselurus monroei</i> in aquarium Feb 3

Pack 3

1	Jamaica scene Feb 1	7	Jamaica scene Feb 2
2	Jamaica scene Feb 1	8	Jamaica scene Feb 2
3	Jamaica scene Feb 2	9	Jamaica scene Feb 3
4	Jamaica scene Feb 2	10	Jamaica scene Feb 3
5	Jamaica scene Feb 2	11	Jamaica scene Feb 3
6	Jamaica scene Feb 2	12	Jamaica scene Feb 3

Pack 4

1	<i>Cypselurus monroei</i> Feb 4	7	Panama views Feb 7
2	<i>Cypselurus monroei</i> Feb 4	8	Panama views Feb 7
3	<i>Cypselurus monroei</i> Feb 4	9	Panama views Feb 7
4	Nest #4 Feb 6	10	Panama views Feb 7
5	Nest #4 Feb 6	11	Barra Colorada Feb 11
6	Panama views Feb 7	12	Barra Colorada Feb 11

Pack 5

1	Barra Colorada Feb 11	7	Gatun spillway Feb 12
2	Barra Colorada Feb 11	8	Men swimming off Roncador Rocks Feb 14
3	Barra Colorada Feb 11	9	Men swimming off Roncador Rocks Feb 14
4	Barra Colorada Feb 11	10	Men swimming off Roncador Rocks Feb 14
5	Barra Colorada Feb 11	11	Men swimming off Roncador Rocks Feb 14
6	Gatun spillway Feb 12	12	Men swimming off Roncador Rocks Feb 14

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Pack 6

1 Brown booby Feb 20
2 Brown booby Feb 20
3 Brown booby Feb 20
4 Brown booby Feb 20
5 Brown booby Feb 20
6 Brown booby Feb 20

7 Brown booby Feb 20
8 Brown booby Feb 20
9 Brown booby Feb 20
10 Water bottles Feb 27
11 Water bottles Feb 27
12 Water bottles Feb 27

Pack 7

1 Water bottles Feb 27
2 Water bottles Feb 27
3 Water bottles Feb 27
4 *Atlantis* under sail Feb 28
5 *Atlantis* under sail Feb 28

6 *Atlantis* under sail Feb 28
7 *Atlantis* under sail Feb 28
8 *Atlantis* under sail Feb 28
9 *Atlantis* under sail Feb 28
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Egg Collections

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Jan 26	No 1	12:50 (teased out) 12:50 (in toto)
Jan 27	No 1	12:30 (teased out)
Jan 28	No 1	1:30 (teased out)
Jan 29	No 1	8:30 A. M. (hatching)
Feb 2	No 1	9:00 A. M. (larvae)
Feb 3	No 1	12:00 noon (larvae)
Feb 4	No 1	9:00 A. M. (larvae)
Feb 4	No 2	10:00 A. M. (eggs) (Feb 5)
Feb 5	No 3	10:30 P. M. (eggs)
Feb 6	No 4	9:30 A. M. (entire nest No 12)
Feb 6	No 5	
Feb 6	No 6	
Feb 14	No 7	9:00 A. M. (teased out eggs)
Feb 15	No 7	8:30 A. M. (incubating eggs)

Locality of Nests

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Jan 26	Set 1	(Nest of hatched eggs No "0")	1
	Set 2	(Eggs No 1)	2
	Set 3	(Fragment of central cord) not saved	3
	Dip net	(Nest of hatched eggs - shells still all (?) on threads	4
Jan 27	Set 2	(Fragment of central cord) not saved	5
	Set 3	(Fragments (3) of an old nest) not saved	6
	Set 3	(A whole small nest woven through with hatched shells	7
	Set 3	(A whole small nest woven through with hatched shells	8
Jan 29	Set 4	(Fragment of an old nest (Jan 30) page 12) not saved	9
Feb 4	Set 2	(Eggs No 2) see page 17 under Feb 5	10
Feb 5	Set 2	(Eggs No 3) see page 18	11
Feb 6	Dip net	(Full nest. <i>Halocypselus</i> ?) (Preserved entire) <i>Sargassum</i> #4	12
	Set 3	(of Feb 5) Fragment on <i>Sargassum</i> #1	13
	Dip net	Fragment on <i>Sargassum</i> #6	14
Feb 14	Dip net	(complete) <i>Sargassum</i> (and some #4?) + trash	15
Feb 15	Dip net	(complete) #4 + ? + ? Shore forms	16
Feb 17	Dip net	(small piece of #1) Burkenroad collection	17
Feb 18	Set 2	(Eggs hatched #1 and #3 bound together) not saved	18

Statistical Counts

Page	Total no.	Page	Total no.	Page	Total no.
1 a	0	b	53	21 a	5
b	0	c	5	22 a	8
c	2	d	155	23 a	18
d	0	10 a	7	24 a	2
2 a	0	b	3	25 a	2
b	0	c	55	26 a	3
c	0	d	0	27 a	37
d	0	11 a	0	b	0
3 a	0	b	91	28 a	2
b	0	12 a	0	b	1
c	0	b	0	29 a	0
d	0	c	12	b	0
4 a	0	d	12	30 a	0
b	0	13 a	14	31 a	0
5 a	0	b	1	b	1
b	0	c	0	32 a	0
c	0	d	0	b	0
d	0	14 a	0	33 a	19
6 d	0	15 a	10	b	7
7 a	3	16 a	4	c	2
b	6	17 a	26	34 a	96
c	47	b	6	b	22
d	2	18 a	9	c	85
8 a	9	b	4	35 a	130
b	17	19 a	50±	b	20
c	5	b	33	36	24
9 a	66	20 a	7	37	5

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<u>Parexocetus</u> - 1, 3, 4, 6, 9, 10, 11,		<u>Sphaeroides</u> - 1, 9, 10,
<u>Halocyprinus</u> - 2, 4, 6, 7, 8, 12,		<u>Xyphocheilus</u> - 2, 3, 4, 9,
<u>Exocoetidae</u> - 1, 8,		<u>Pteropoda</u> - 2, 3, 4, 6, 7, 8, 9, 10, 11,
<u>Cyprinus</u> - 3, 4, 5, 8, 9, 10, 11,		<u>Leptocephalus</u> - 2, 3, 10,
<u>Eleutherochordus</u> - 8,		<u>Myxolophus</u> - 2, 3, 7, 8, 9, 10
<u>Nemichordus</u> - 9,		<u>Aspidopterus</u> - 3, 4,
		<u>Coryphaena</u> - 3, 4, 7, 8, 11,
		<u>Syngnathus</u> - 4, 8, 9,
		<u>Conthideus</u> - 4, 7, 8, 9,
		<u>Loxopterus</u> - 4
		<u>Seriola</u> - 6, 11,
		<u>Carangids</u> - 7, 8, 9,
		<u>Pseudomacrus</u> - 7, 9, 10
		<u>Lagocephalus</u> - 8
		<u>Antennarius</u> - 8
		<u>Dactylopterus</u> - 8, 10
		<u>Sardinella</u> - 9
		<u>Istiophorus</u> - 10
		<u>Pisces</u> - 12,