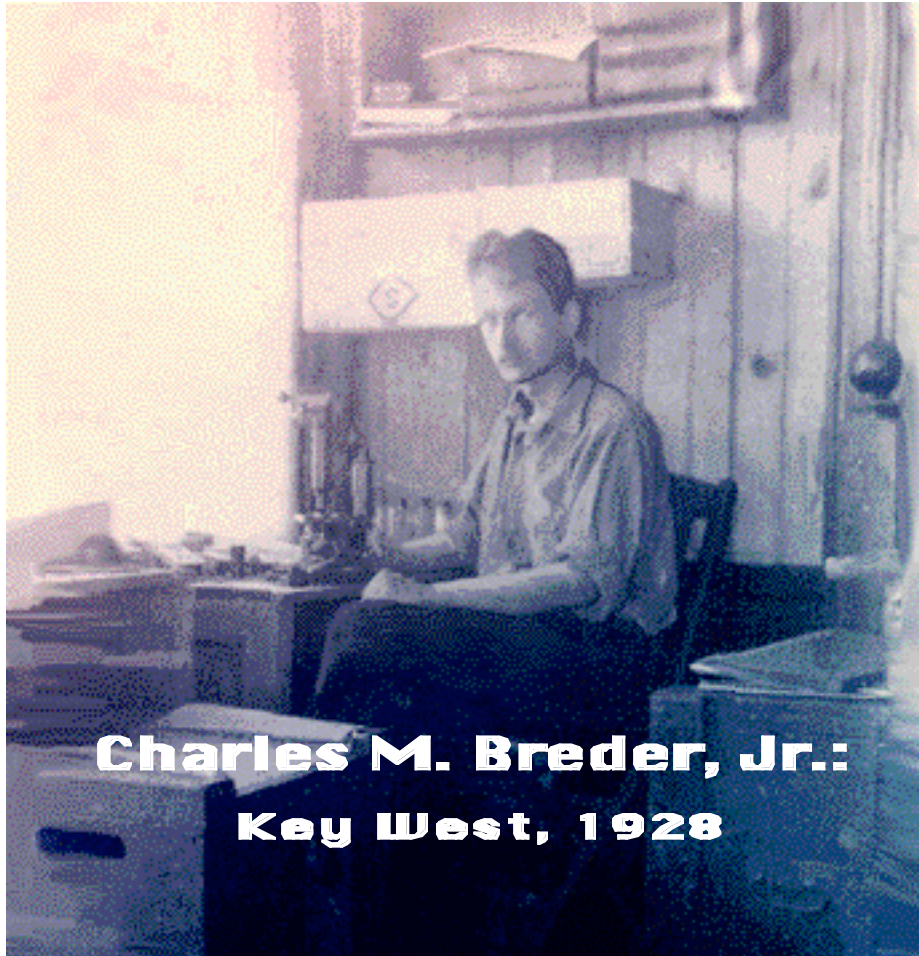

Coastal and Estuarine Data Archaeology and Rescue Program



March 2004



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



Mote Marine Laboratory
Sarasota, FL

Charles M. Breder, Jr.: **Key West, 1928**

A. Y. Cantillo

NOAA National Ocean Service

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(Editors)

Introduction by **C. A. Luer**

Mote Marine Laboratory



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Department of Commerce

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Charles M. Breder, Jr.: Key West, 1928

A. Y. Cantillo, E. Collins[△], S Stover[◇] and K. Hale[◇]
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ABSTRACT

Charles Breder, Jr. kept a detailed account of his excursion to Key West to collect tropical fish specimens for the New York Aquarium in 1928. Breder's observations includes data on flying fish, fish species around Key West (relative abundance, sizes and colors of individuals, sizes of schools, stomach contents, and an occasional opinion of how they tasted), weather, development and testing of equipment, contamination of the Key West Harbor, and daily life in the town. Also included in this diary, but not transcribed, are accounts of work in North Carolina, Interstate Park, and Lakehurst.

INTRODUCTION by Carl A. Luer, Ph.D.

After three decades of Spanish occupation, the United States Navy took possession of the island known as Key West in 1822. In 1828, Key West was incorporated as a town and a year later, Key West got its first post office. In 1831, the first American cigar factory was established in Key West and along with the mainstays of sponging, fishing and farming of pineapples, Key limes, tomatoes and melons, the deep water port began to develop its "metropolitan" flavor.

The diary that follows was penned by Charles Breder, Jr. in 1928, a century after Key West's incorporation, and provides a detailed account of his excursion to collect tropical fish specimens for the New York Aquarium. "Modern" access to Key West had been accomplished by Henry Flagler in 1912, when he extended the Florida East Coast Railway from Homestead, FL to Key West with his "Overseas Railroad." Even so, it is not surprising that Breder opted for ocean passage out of New York Harbor via the *S.S. Algonquin*, a ship he identifies in his initial entry dated August 25, complete with data on vessel length, beam, draft and average speed. Rather than spend the four-day journey relaxing on deck, Breder devoted his waking hours to statistical observations on members of Family Exocoetidae (flying fish). His notes not only provide behavioral observations regarding the preference shown by these fish for wind direction and the geometric orientation of their "flight path" in relation to the axis of the ship, but they also provide population densities based on surface areas that Breder calculated from the size and speed of the vessel!

The daily entries for his approximately two-week stay in Key West are filled with observations of dozens of fish species, including comments on relative abundance, sizes and colors of individuals, sizes of schools, stomach contents, and an occasional opinion of how they tasted. Especially intriguing to me are Breder's drawings and descriptions of his attempt to construct a waterproof light to hang overboard for nighttime collecting. The prototype consisted of an

[△] NOAA Central Library, Silver Spring, MD.

[◇] Mote Marine Laboratory, Sarasota, FL.

electric light placed inside a Mason jar, with the top "heavily taped and waxed." Breder's entry admitting that his creation worked for a few minutes before it leaked was written with a sense of disappointment. A modified version of his underwater nightlight replaced the wax with solder and lock nuts. I had to laugh when I read the September 4 entry declaring "...this time the socket blew up."

An interesting feature of Breder's diary entries is a passing comment on the weather. With rain as an occasional excuse for boats not leaving port, the September 3 entry attributes wind and a falling barometer to "...a hurricane reported off Cuba." A check of historical data available through any number of websites confirms an unnamed tropical storm south of Cuba during that time. Even though rain prevented some of his scheduled trips to the reefs, time off the water provided him the opportunity to organize thoughts and notes into publishable data. Six papers would result from the Key West trip.

The Key West Diary falls short of stating a goal in terms of live specimens for the New York Aquarium. Entries during the return trip on the *S.S. San Jacinto*, however, indicate 160 mortalities among the cargo of live fish during the first two days at sea. Whether the specimens ended up in display tanks or in the preserved fish collection is immaterial. It is the annotated accounts of Breder's experiences that represent the true tangible value of the expedition.

PHOTOGRAPHS OF KEY WEST

Plates shown are of Key West in general, or of places mentioned in the diary. The plates include Sombrero Lighthouse, La Concha Hotel, the cigar box factory, the aquarium (under construction), the Key West Harbor, and the turtle kraals. The Monroe County Library, Key West, FL did not have a photo of the old Milton Curry's aquarium, which was destroyed. The library only had a photograph of the 1930's aquarium. The Monroe County historian was not able to locate a photograph of Peter Robert's Fish Market (what Breder called Peter's Point).

NOTES ON LOCATIONS

The area around Key West has changed with time as the result of natural weather events and anthropogenic impact. Some features noted by Breder still exist, and others do not or have changed names. Man Key was an island full of birds, pelicans and gulls. Mangrove Key was composed of four islands just outside of Key West. Mule Key is west of the Key West Harbor. These keys are still identified in charts. No information was found on Sand Key and Barracuda Key.

DIARY AND TRANSCRIPTION

The handwritten diary of Dr. Charles Breder's activities in Key West in 1928 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 such as current names of species were noted in brackets and/or capital letters. Numbers outside the margin of the transcribed text are the page numbers of the original notebook.

Also included in this diary, but not transcribed, are accounts of work in: North Carolina, 1926; Interstate Park, 1926; and Lakehurst, NJ, 1926.

ACKNOWLEDGMENTS

The editors wish to thank the Breder Family; C. A. Luer of the Mote Marine Laboratory; M. J. Bello and L. Pikula of NOAA; and the Monroe County Library and Historian for their assistance. The transcription is part of the Coastal and Estuarine Data/Document Archeology and Rescue (CEDAR) project funded by NOAA/COP for the South Florida Ecosystem Restoration, Prediction and Modeling Program and the South Florida Living Measurements Resource Program.

PHOTOGRAPHS



Plate 1. Old docks, Key West Harbor (Photo F-109, #484, Monroe County Library, Key West, FL).



Plate 2. La Concha Hotel, Duval Street (Photo F-108, #1466, Monroe County Library, Key West, FL).



Plate 3. Cigar Box Factory, Key West (Photo F-500, #896, Monroe County Library, Key West, FL).



Plate 4. Overview of the harbor, Key West, (19--). [Photoprint, black and white (8 x 10 in). rc05480. Reference Collection, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>. This is part 4 of 4 numbered rc05746-8 and rc05480. The photograph shows the upper harbor where the terminal of the F.E.C. Railway was located.]



Plate 5. Construction of an open-air aquarium (1935) [Photonegative, black and white (3 x 5 in). PR06058. Print Collections, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>.]



Plate 6. View of the harbor from the La Concha Hotel (January 20, 1926). [Photoprint, black and white (8 x 10 in). rc18018. Reference Collection, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>.]

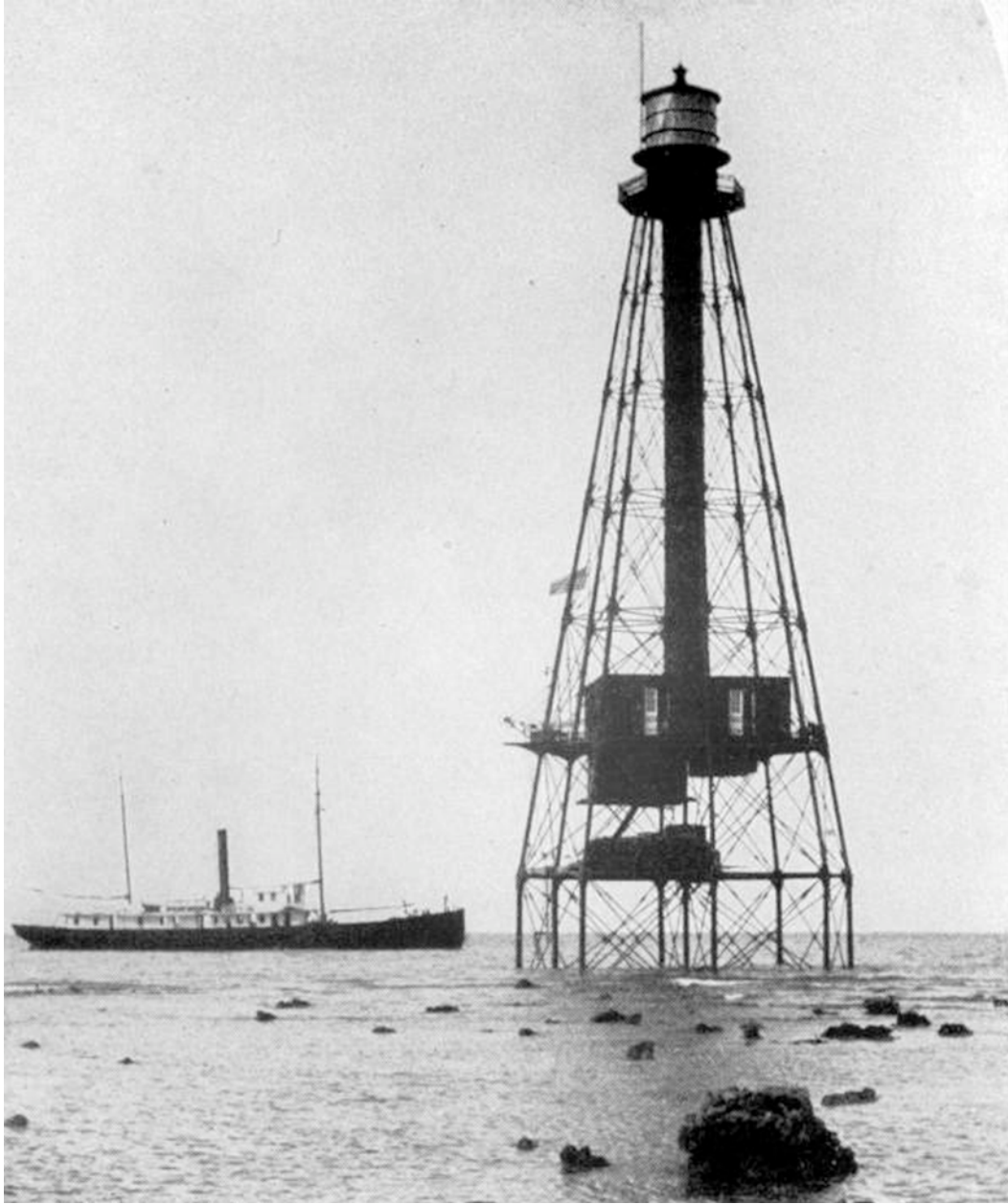


Plate 7. Sombrero Key lighthouse (19--). The lighthouse was built in 1858 and had iron skeleton tower 160' high. The light is 142' above water. [Photoprint, black and white (10 x 8 in). rc05651. Reference Collection, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>].



Plate 8. View of the courthouse from the La Concha Hotel, Key West (January 20, 1926). [Photoprint, black and white (8 x 10 in). rc05338. Reference Collection, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>.]



Plate 9. Looking north from the roof of the La Concha Hotel (19--). [Photoprint, black and white (4 x 3 in). N046597. General Collection, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>].

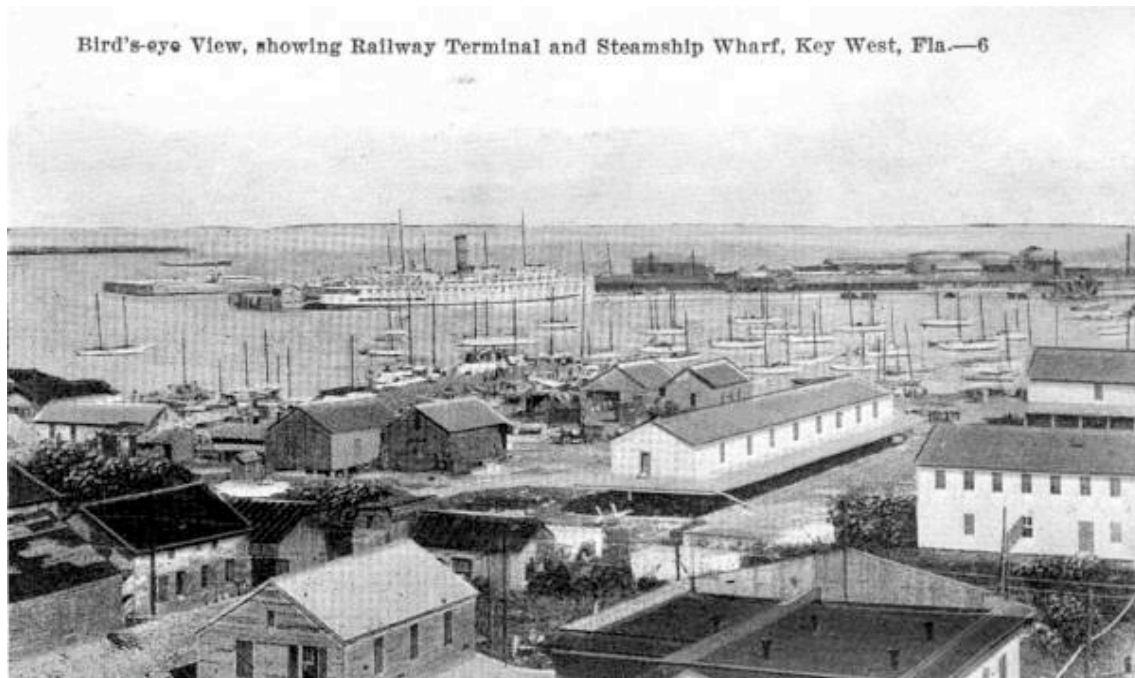


Plate 10. Bird's eye view showing railway terminal and steamship wharf (ca. 1923). [Photonegative of a postcard, black and white (4 x 5 in). N045069. General Collection, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>].



Plate 11. Barrels of privy waste on docks ready for dumping at sea, Key West (1929). [Photonegative, black and white (4 x 5 in). N033456. General Collection, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>].

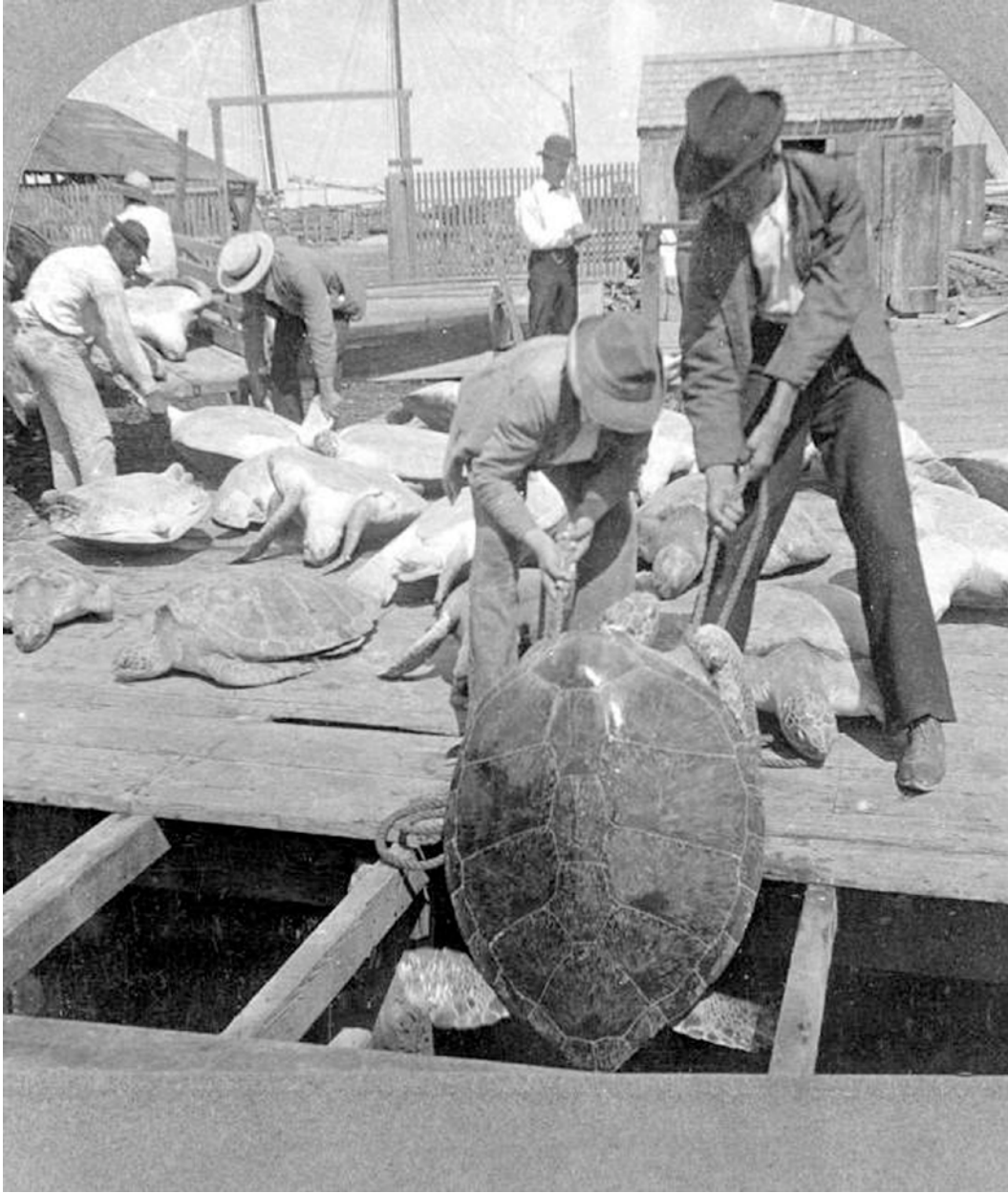


Plate 12. Loading green turtles for shipping (1898). [Photonegative, black and white (3 x 5 in). PR12653. Print Collections, Florida State Photo Archive. <<http://fpc.dos.state.fl.us/>>. Same as photograph F-500, #151, The Turtle Kraals, Monroe County Library, Key West, FL.]



Plates 13 and 14. Shark fishing, Pearl Banks (Photos #98 and #5879, Monroe County Library, Key West, FL).

Diary Transcription

Key West
1928

Aug 25 Aboard S. S. Algonquin with J. J. Shea. Cast off 2:10 P.M. Eastern Standard 69
Time. Sky overcast, little breeze. Sea calm. Passed Scotland Light Ship 3:45 P. M.
Dead calm. Data on S. S. Algonquin.

Length of vessel 402 ft.

Beam of vessel 54 ft.

Draft of vessel 20 ft.

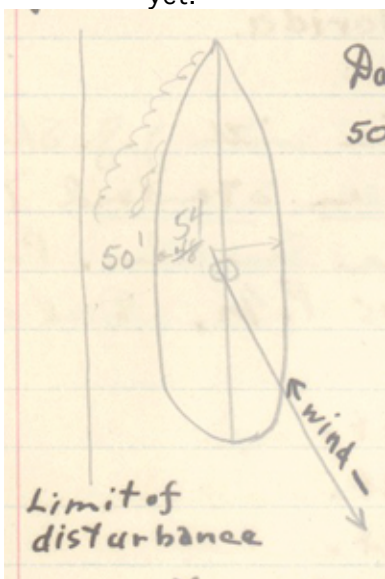
Average speed 16 knots per hour.

Log read. 48.5 knots 7:00 P.M. E.S.T.

Log read. 91.4 knots 9:45 P.M. E.S.T.

Clear with light south breeze. No ground swell, surface gently rippled but no motion to ship. Moon over starboard bow brilliant. No phosphorescence in the water. Turned 10:30 E.S.T. A few gulls were seen just outside of N. Y. Harbor (Herring gulls) and 1 Petrel. Saw but 1 lobster buoy. Numerous Menhaden purse seiners were about, one with his net set. Passed fairly near the Gullie, N. J. pound nets.

Aug 26 Turned out 4:30 A.M. E.S.T. The first streak of dawn just showing. Sun up about 5:10. Light south breeze. No clouds, haze at horizon. One small piece Gulf weed at 5:25. Made first statistical observation for Exocoetidae. None about as yet. 70



Data for population calculations. $50 + 48/2 = 74'$ x knots. $6080 = \text{sq. ft. scanned.}$

Log readings

Time	Reading in knots
4:55 A.M.	202.6
5:30 A.M.	212.0
7:30 A.M.	244.2
9:00 A.M.	266.6
9:30 A.M.	275.5

Tursiops truncatus playing about ship at 6:45 and 7:15. Very active and handsome. 7:30 Water flying fish. A few petrels seen.

(1) Calculations for area of first statistical observation.

$74' \times 8.1 \text{ knots} = \text{area disturbed}$

$8.1 \text{ knots} = 49248 \text{ ft.}$

Reading log $212.0 - 202.6 = 9.4 \text{ knots in } 35 \text{ min. or } 8.1 \text{ in } 30 \text{ min.}$

$74' \times 49248' = 3,644,342 \text{ sq. ft. - area scanned. Half beam from each bow.}$

Porpoises of 2 kinds in several schools - probably 30 or 40 individuals between 9:00 and 9:30 all from west side. Also a few petrels. No Exocoetidae as yet.

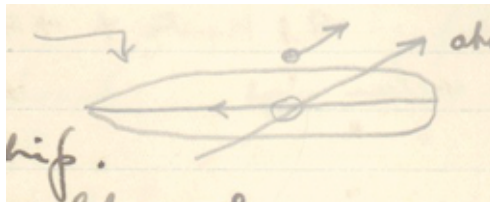
(2) Calculations for area of second statistical observation.

$74' \times 8.9. 8.9 = 541120$

$74' \times 541120 = 4,004,288 \text{ sq. ft.}$

71

First flying fish 11:10 A. M. C. *heterurus?* about 8" long. Flew with wind. Broke water well to after port of ship.



Porpoises have disappeared.

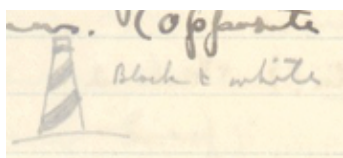
(3) Calculations for area of second statistical observation. (opposite (West of) Cape Hatteras Light)

New simple method.

44992 x knots (striking out decimal point) = sq. ft. scored.

44992 = 74 (width of strip) x 6080 (feet to a knot) (striking off last place, always a '0' to compensate for disregard of decimal in knots for the period of observation).

44992 x 7.9 = 3,554,368 sq. ft. scored.



Log reading

11:45 A.M. 310.5 knots
12:15 P.M. 318.4 knots

Entered blue G. S. water 12:35 P.M. Passed Diamond Shoal Light ship on outside.

First flying fish in Gulf Stream 1:50 (clear winged - 4). Common thereafter.

72

Log reading

2:15 P.M. 349.3 knots
2:45 P.M. 357.4 knots

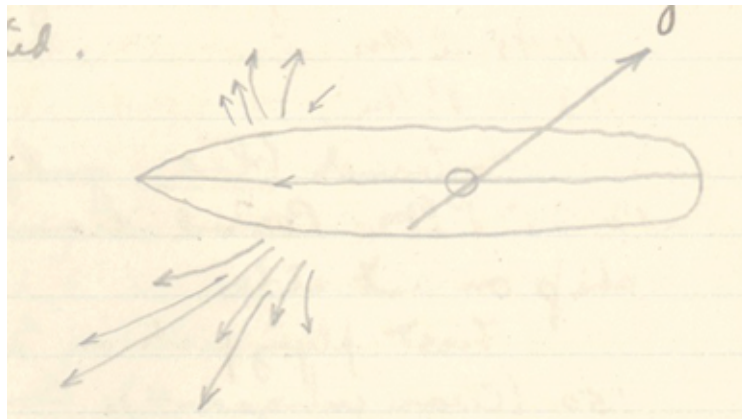
(4) Calculations for area of fourth statistical observation.

8.1 knots x 44992 = 3,544,352 sq. ft.

Population	4-clear wings	starboard	8	2:15 - 2:30
	4-clear wings	port	12	2:15 - 2:30
	4-clear wings	starboard	9	2:30 - 2:45
	4-clear wings	port	38	2:30 - 2:45
	Total of 2 observations		67	2:15 - 2:45
	4-black wings (Rondeleti?)	starboard	1	2:15 - 2:30
	4-black wings (Rondeleti?)	port	1	2:30 - 2:45
	Total of 2 observations		2	2:30 - 2:45

Entire area scanned. 7,088,704 with a population of 67 & 2 or 69 Exocoetidae or 1 fish per every 102,734.8 sq. ft. of surface,

Of the fishes seen at this observation it is evident that most were on the windward side. A sketch of the principal courses of flight is given below with their relative lengths suggested.



Log reading

73

5:00 P.M. 390.2 knots
 5:30 P.M. 399.4 knots

(5) Calculations for area of fifth statistical observation.
 $9.2 \text{ knots} \times 44992 = 4,138,264 \text{ sq. ft.}$

Population	4-clear wings	starboard	2	5:00 - 5:15
	4-clear wings	port	41	5:00 - 5:15
	4-clear wings	starboard	4	5:15 - 5:30
	4-clear wings	port	7	5:15 - 5:30
	Total of 2 observations		54	5:00 - 5:30

Entire area scanned 8.276.528 with a population of 54 Exocoetids or 1 fish for every 153,261.7.

Later when taking flight times it seemed that there were still less fish in the air. Some noted were very small, not over 2". Most of the flights were short and most to the windward and "shaded" side of the ship. After dark the path of the moon was searched for flyers for about $\frac{1}{2}$ hour but none were seen. Still further absence? They should have been evident in the moonlight as it streaked across the bow exactly where most "brake" during the day. Turned in 11:00.

Aug 27 Turned out 6:30. Weather continues clear and calm. Many pieces of Sargassum weed harbor small fishes of about 1 to 2". They are about the color of the weed.

Log reading

74

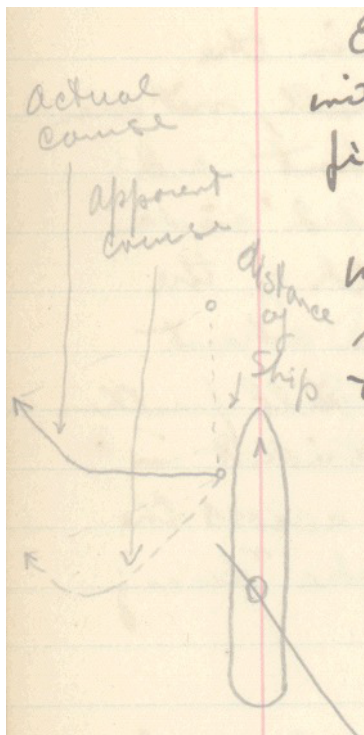
7:15 A. M. 614.7 knots
 7:45 A. M. 623.9 knots

(6) Calculations for area of sixth statistical observation.
 $9.2 \text{ knots} \times 44992 = 4,139,264 \text{ sq. ft.}$

	4-clear wings	starboard	17	7:15 - 7:30
	4-clear wings	port	6	7:15 - 7:30
	4-clear wings	starboard	34	7:30 - 7:45
	4-clear wings	port	7	7:30 - 7:45
	Total of 2 observations		64	7:30 - 7:45
	dusk pectoral	starboard	1	7:30 - 7:45
	clear ventral			
	Total Exocoetidae		65	

Entire area scanned 8,278,528 sq. ft. with a population of 65 Exocoetids or 1 fish to 127,362.0 sq. ft.

In measuring flight times the following was noted. The fish uniformly flew at right angles to the axis of the ship and then headed into the wind. Due to the speed of the vessel the apparent course of the fish is considerably different and gave the impression it fell off with the wind, which these did not do. This applies to those first 5 times on this date.

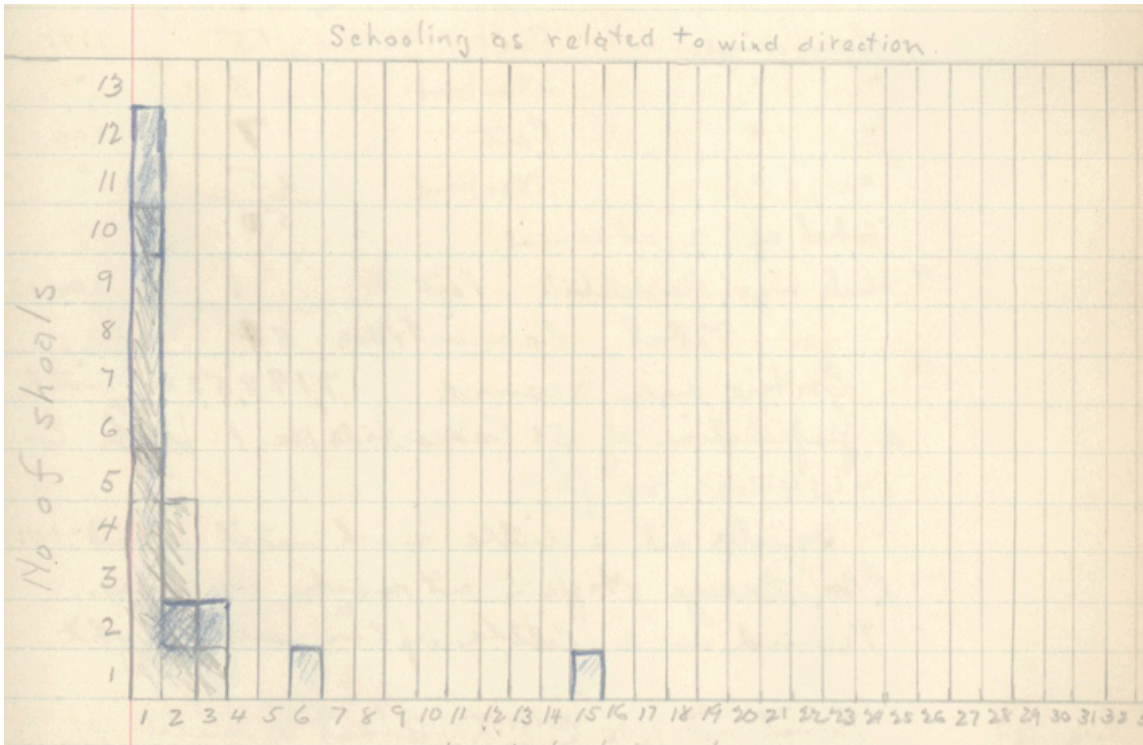


[ABOVE DRAWING WAS ON THE MARGIN OF PAGE 74.]

Density of Exocoetid Population

75

		No of fish per sq. nautical mile			
Aug 25					
5-5:30 AM	1	<1	<1.0	to	3,644,342 sq ft
9-9:30 AM	2	<1	<1.0	to	4,004,288
		First flyer 11:10 AM			
11:45-12:45	3	<1	<1.0	to	3,554,368
		First flyer in Gulf Stream, 1:50 PM			
2:15-2:45	4	1	360.4+	to	102,734.8+
5:00-5:30	5	1	241.2-	to	153,261.7-
Aug 26					
7:15-7:45	6	1	241.9-	to	127,362.0-
2:45-3:15	7	1	261.9-	to	141,147.5-
Aug 27					
8:00-8:20	8	1	72.7+	to	508,212.9+
11:30-11:00	9	1	60.0+	to	609,888.0
3:30-3:50	10	1	5.5+	to	6,708,768.0



76

At noon a little breeze sprang up and numerous small rain squalls could be seen, sometimes as many as 3 at once. Rainbows were evident when the sun struck them. We passed through two - all small.

Captain Byron W. Leek told of timing flying fish with a stop watch when on the San Jacinto with a moderate sea and a light breeze. The highest time aloft seen by him was 42 seconds. The tail was touched at times.

Log reading

2:45 A. M. 730.6 knots
 3:15 A. M. 738.6 knots

(7) Calculations for area of seventh statistical observation.

8.0 knots x 44992 = 3,599,260 sq. ft.

4-clear wings	starboard	15	2:45 - 3:00
4-clear wings	port	3	2:45 - 3:00
4-clear wings	starboard	7	3:00 - 3:15
4-clear wings	port	25	3:00 - 3:15
Total of 2 observations		50	
4-black wings (Rondeleti?)	port	1	3:00 - 3:15
Total Exocoetidae		51	

Entire area scanned 7,198,520 with a population of 51 Exocoetidae 1 fish to 141,147.5 sq. ft.

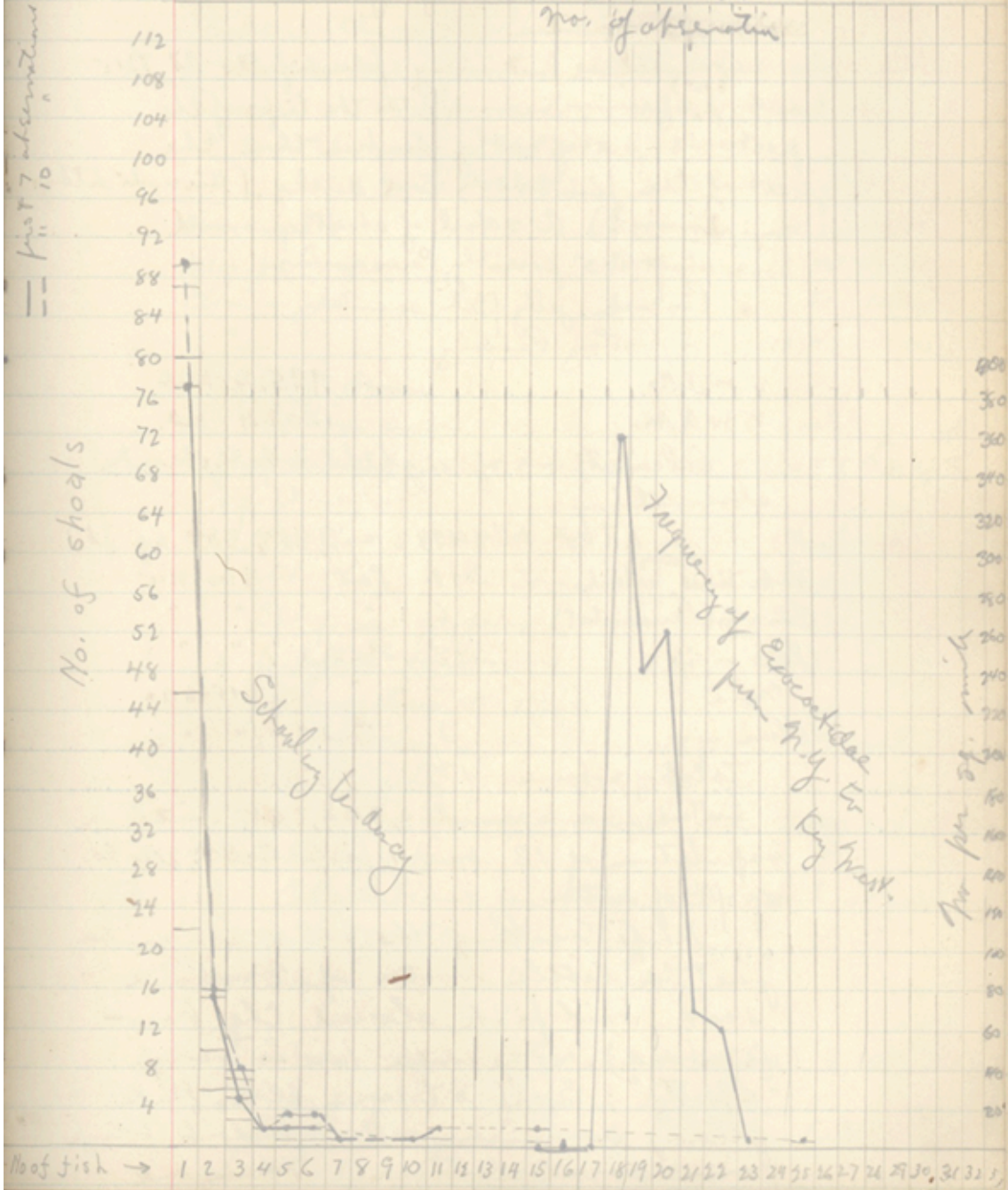
Squalls and a little swell until about 10:00 P.M. Breeze stiffening but much warmer. Turned in a little after midnight.

Schooling tendency in flight of

Eurocoetidae

1 2 3 4 5 6 7 8 9 10

no. of observation



78 Aug 28 Turned out 7:00 E.S.T. About 3 miles off the Florida coast, the buildings of Miami over the starboard quarter.

Exocoetidae not very plentiful. At 7:15 a large (12") specimen seen with the tips of the pectorals perceptibly darker than the rest of the fin which was dusky, (*Hirundichthys rufipinnis?*^Δ) A school of about 10 small ones about 2"-3" possible *Parexocoetus*.

Pinkish jellyfish common.

Log reading

8:00 A. M. 995.2 knots
8:30 A. M. 1002.9 knots

(8) Calculations for area of eighth statistical observation.

7.7 knots x 44992 = 3,354,384 sq. ft.

Black tip dusky pectoral	1	port	8:00 - 8:15
Clear wings (<i>Parexocoetus?</i>)	6	port	8:00 - 8:15
Clear wings	3	starboard	8:00 - 8:15
none	-	starboard	8:15 - 8:30
Clear wing	3	port	8:15 - 8:30
Total of 2 observations	13		

Entire area scanned 6,708,768 with a population of 13 or 1 fish to 508,212,91 sq. ft. of water.

While making the above observations just a little north of Miami a 3 to 4 sail fish cleared the bow (starboard). The water here is very "spotty"; Gulf Stream blue, pale green; brownish and the dark blues over coral bottom. They are all distinct and definite and cut sharp lines with each other.

79 (9) Calculations of ninth statistical observation. 10:30 to 11:00 A.M. - log removed (speed assumed to be the same as the 8th).

7.7 knots x 44992 = 3,354,388 sq. ft.

Clear winged 4	4	starboard	10:30 - 10:45
<i>Halocypselus</i> sp.	1	port	10:45 - 11:00
Clear winged 4	5	port	10:30 - 10:45
Clear winged 4	1	starboard	10:45 - 11:00
Total of 2 observations	11		

Entire area scanned 6,708,768 with a population of 11 or 1 fish to 609888.0 sq. ft. water.

While making the above on the starboard side (opposite Largo Key) saw also

- 1 *Sphyrna tiburo* about 9'
- 1 *Balistis carolinensis* about 1'
- 1 *Chilomycterus schoepfi* about 8"

All swimming near the surface. Several pinkish jelly fish were also seen. Shea saw a *Ogcocephalus*. Capt Leek saw a 10' hammerhead.

(10) Calculations for area of tenth statistical observation. 3:20 to 3:50 P.M. E.S.T.

7.7 knots x 44992 = 3,354,384 sq. ft.

Clear winged 4	1	port
Total	1	

Entire area scanned same as last 6,708,768 with a population of 1.

^Δ Valid name is *Exonates rufipinnis*.

This observation made just a little ahead of Sombrero Light.

Incidentally saw 3 more clear-winged flying fish between there and American Shoal Light. The population hereabouts seems sparse. 80

Arrived Key West dock 7:30 P.M.

Made straight for Hotel La Concha. Have room 308. Looked Duval Street over a little. This place is not as tropical in aspect as Panama and not as exotic. Very American in get up.

Turned in 10:30.

Aug 29

Turned out 6:00.

pH of hydrant water 7.6. Kennedy field set.

Position of Exocoetidae population records.

1	Lat. 36° 15.5'	Long 75° 7.5'
2	Lat. 35° 37.5'	Long 75° 12'
3	Lat. 35° 10'	Long 75° 11'
4	Lat. 34° 45'	Long 75° 20'
5	Lat. 34° 18'	Long 75° 22.5'
6	Lat. 31° 13'	Long 76° 55'
7	Lat. 29° 17'	Long 78° 9'
8	Lat. 25° 34'	Long 79° 58.5'
9	Lat. 25° 4'	Long 80° 13'
10	Lat. 24° 35'	Long 80° 57'
First specimen	Lat. 35° 16'	Long 75° 10'
First in Gulf S.	Lat. 34° 53'	Long 75° 18.5'

Visited fish dock and spent the morning getting "cars" etc. in shape. Fishes were brought in some numbers by boys and others. Took a number of photographs of man-of-war birds, pelicans, *Tylosurus*, boats, jewfish, live-cars, etc. Cannot say I saw anything of special interest but made arrangements to go out on fishing boats etc. tomorrow. A cigar-box factory casts cedar sawdust all over the harbor and makes the water polluted. There is no place where fish may be kept that is free of it. 81

Spent the afternoon in similar activities. Already a good collection is in the live cars. In the water about the dock were noted

Sparisoma abilgaardi in schools of about 12

Hardhead (*Hepsetia stipes?*) in schools of about 100 - 300

Sardinella (macrophthalmus) in schools of about 100 - 300

Strongylura (acus?)^Δ solitary and in groups up to 12. 3" to 12" long. Seen feeding on hardheads. [*notatus* WRITTEN IN PENCIL ON MARGIN]

Very tame allowing a close approach. Man-of-war birds, pelicans and gulls about dock. Not more than 5. 2 and 4 respectively.

In the evening visited a negro "tabernacle" meeting. Very curious - hysteria - negro spirituals, etc.

Turned in 12:00.

^Δ No such species name. *Tylosurus acus*, *Strongylura exilis*, *S. marina*, *S. notata* and *S. timucu* are needlefish.

82	Hour	Locality	Tide	Temp air	Temp H ₂ O	pH	Salinity
Aug	29	10:45 AM	K. W. dock	ebb	-	148	8.4 10.2
	30	4:45 PM	1 mile off "	flood	148	151	8.4 10.3
	31	11:30 AM	K. W. dock	flood	145	150	8.5 10.2
Sept	1	5:45 PM	K. W. dock	dead low	-	148	8.4 10.4
	2	9:30 AM	K. W. dock	flood	154	152	8.6 10.4
	3	3:30 PM	K. W. dock	ebb	151	141	8.6 10.3
	4	1:30 PM	K. W. dock	ebb	156	150	8.5 10.2
	5	3:20 PM	K. W. dock	ebb	154	152	8.5 10.3
	7	8:45 AM	K. W. dock	flood	154	152	8.5 10.2
		8:00 PM	Peters Point	ebb	-	160	8.4 10.2
	8	2:30 PM	K. W. dock	ebb	-	150	8.5 10.2

Aboard S. S. San Jacinto

Sept	11	9:15 AM	Fresh sea water		86°	8.6	10.2	
		"	Jewfish overflow		-	8.4	-	
		6:00 PM	Fresh sea water		86°	8.6	10.2	
	12	7:00 AM	"		86°	8.6	10.2	
		"	Jewfish overflow		-	8.2	-	
		1:30 [?] PM	Fresh sea water		86°	8.2	10.2	
		6:10 PM	"		86°	-	-	
		6:35 PM	"		82°	-	-	
	13	4:00 AM	"		84° to 76° in 1/2 hour			
		[NOTE ON MARGIN: [xxx] at 83°						
		6:15 AM	"		76°	8.5	10.1	
		12:45 AM	"		-	8.5	10.1	
		"	Jewfish overflow		-	8.4	-	

83 Fishes as food

Yellowtail (broiled)	Very good
Red snapper (broiled)	Good
Stone crab cocktail and salad	<u>Excellent</u>
Turtle steak (green turtle)	Good
Jewfish (fried)	Good
Crayfish stew	Good
Conchs (raw)	Good
Conch (salad)	Fair
Grits and grunts	Fair

84 Aug 30 Turned out 7:00. Went out to visit Mangrove Key with "Tommy" and "Georgie". This is a small Key of four islands just outside the Key West Harbor, a little to the east. It is completely covered with mangrove trees. The fauna about these nearby Keys is poor. Saw the following.

Carcharhinus sp? About 8, each about 30" long and each with an *Echeneis* about 3" attached. The tips of the sharks tails were tipped with black, otherwise slatey gray. They cruised about up to 2 feet of the shore line at high tide.

Neomaenis griseus[◇]. A few about wrecks making 50 in all about 8" long. While trying to catch some 2 bigger ones came in (2' and over) and were caught. [NOTE ON MARGIN: One stomach was full of mangrove land crabs about 1" across. ♂ spent.]

L. apodus. A few about 8" long with the above.

Abudefduf saxatilis. 2 about 4" long. Tomtates about a dozen 4".

Hepsetia stipes. Abundant in large schools up to 3" long.

Sardinella (macrophthalmus?). A few schools about 4".

Dwarf herring. A few schools about 1¹/₂".

Tylosurus (acus?). Common in schools up to 30 and from 3" to 15".

Barracuda sp. 3, 7" to 15". The latter taken on a hook.

Cyprinodon sp. Rarely in runs.

Mollinesia latipinna. A few with the above.

Then went to Mule Key a little to the west of the Harbor. This is similar but 85 more interesting. On the way saw two *Hemirhamphids* rise out of our way. They act very much like flying-fish. It seems that they perform the way one could imagine a flying fish act if its wings had been trimmed.

Mule Key is a single island which we circumnavigated as we did Mangrove Key (went into the channels between in the case of the latter. [There is a bulk of a Spanish war vessel there which I was on.]) Saw the following at Mule Key.

Dasyatis sp? 2 about 18 to 24" across.

Neomaenis griseus. More numerous than at Mangrove Key.

L. apodus. The same; also one larger school of fish about 6" long. (200 or more)

Anisotremus virginicus. 4 or 5 about 7".

Abudefduf saxatilis. A few about 4".

Hepsetia stipes. "Millions". More than ever seen by my men.

Sardinella (macrophthalmus?). Several large schools about 4".

Dwarf herring. Several schools about 1¹/₂".

Tylosurus (acus?). [NOTE ON MARGIN: "*notatus*"] Common in schools up to 75 from 5" to 15".

[NOTE ON MARGIN: "*Eucinostomus californensis* common to both places."]

Pomacentrus (leucostictus?). 1 tiny one over its rock hole. (about 1¹/₂") 86
Brilliant yellow below and behind blue above. This is the normal habit of these according to the men.

Barracuda sp. A few small 6 to 10".

Tomtates. A few.

Got a number of Holothurians up to 18" - at least 2 species; a number of yellow sponges; 3 conchs; 1 hermit crab in a conch shell and several kinds of small snails; also a number of the large black long spined sea urchins. [NOTE ON MARGIN: "Saw a single *Limulus*."]]

3 adult and 2 young (white) Great Blue Herons on Mule Key.

Grassy bottoms surround most of these Keys and the marl gets stirred up frequently leaving a sediment of white mud all over everything - unpleasant. In other places there is simply a hard mud bottom with broken coral. The place is full of wrecked hulls - mostly iron. These are not specially favored by fish but the wooden ones are more so.

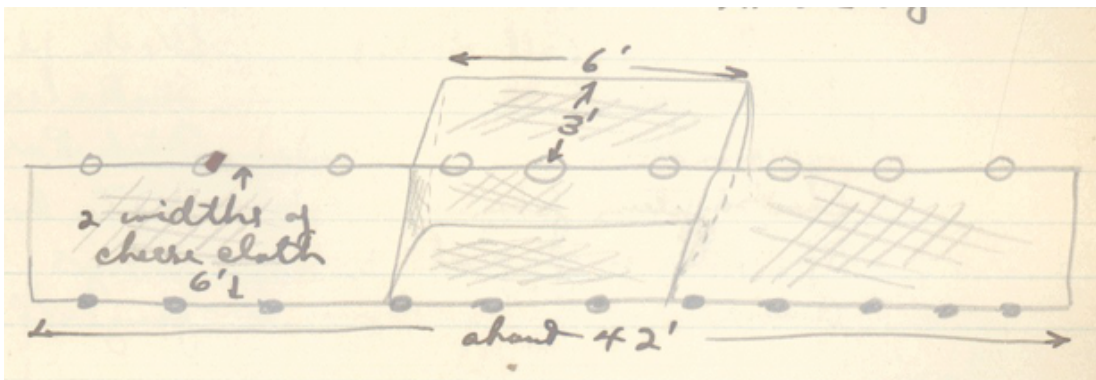
The drenching squalls got us thoroughly wet in the A.M. Saw a single *Anolis* sp? on Mangrove Key. Mosquitoes are small and bite sharply.

Got back to the dock at 5:30. Shea has gotten a good collection of the usual fishermen species.

[◇] Valid name is *Lutjanus griseus*.

<i>Balistes vetula</i>	Nassau turbot
Ocean Trigger (<i>Canthidermis</i>)	Ocean tally
<i>Lactophrys</i>	Shellfish
<i>Abudefduf</i>	Cock-eye pilot
<i>Sphoeroides</i>	Swelling fish
<i>Carcharhinus</i>	Fish shark
<i>Pomacentrus</i> (yellow below)	Yellow-bellie
" (all dark)	Black fish
<i>Mollinesia</i>	Suckalea
<i>Cyprinodon</i>	Mud purser
<i>Chaetodipterus faber</i>	White angel
<i>Sparidae</i> in general	Pugs
<i>Amia</i>	"Young red snapper"

87 Aug 31 Early this A.M. a heavy squall, rain, wind and lightning. The thick weather prevented us from going collecting. Stayed in the fish house and worked on apparatus. Had a cheese cloth seine made as below.

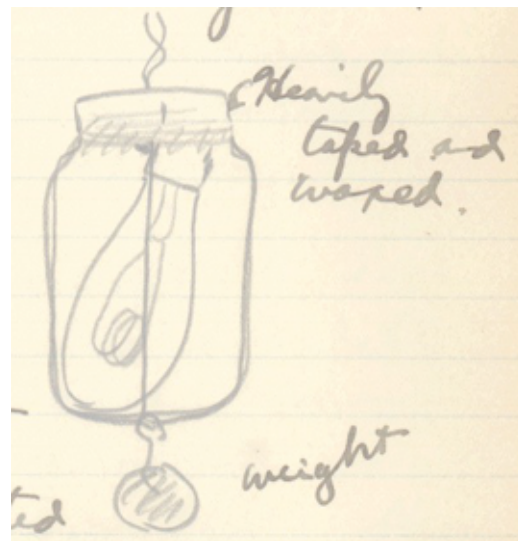


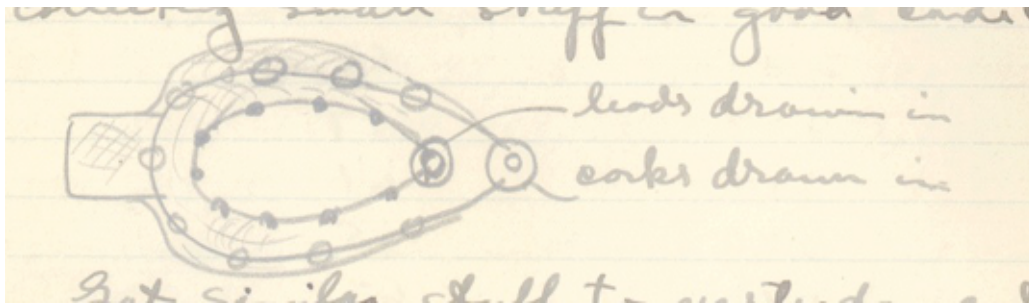
This is made of very strong cheese cloth and hung as above.

Made a light to hang overboard at night by placing an electric light in a mason jar as below for night work.

Had a small live car made for holding very little fishes.

Shortly after lunch it stopped raining and cleared a little. Visited Mangrove Key and tried out the new seine. It works well and is not drawn up on the beach but pursed together in shallow water and the fish left in a square "live-car" of water. Excellent for collecting small stuff in good condition.





Got similar stuff to yesterday and also the following.

Spherooides spengleri. 3 - 1 to 2".

Chilomyxterus schoepfi. 1 3/4". The spines are unossified and the entire animal inflates with rapidity as a soft smooth ball with flaccid appendages. When uninflated the entire fish is a flaccid lump. These young at various stages may well be *Lyosphaera globosa* and *L. digitalis* although the fin count of the latter is confusing.

Caranx (crysos?). 2 - 2".

Syngnathus (short-nosed sp?) 3 4-5"

Strongylura (acus?). [NOTE ON MARGIN: "notatus"] This is probably not this species. No caudal keel - flat depressed body quadrate in outline. The dorsal is tipped with brick red as is the tip of the upper caudal lobe. The central rays are bluish green, the lower lobe clear. The pectorals are yellow. These colors are all as "water color" washed with no distinct outlines. Measured a few. 90

s. l. mm.	upper beak mm.	lower beak mm.
238	67	71
204	57	59
214	61	63
220	65	67
217	62	65

A number of others measured as follows>

mm is s.l.: 232, 241, 197, 210, 215, 223, 205, 254. 226, 210, 198, 216, 240, 192, 221, 200, 224, 201, 262, 214, 214, 224, 213, 245, 197, 198, 205, 234, 212, 162, 186, 175, 179, 210. 236, 180, 197, 219, 218, 202, 195, 182, 155, 178, 226, 207, 220, 234, 203, 205, 200, 210, 158, 198, 206, 197, 193, 186, 188, 205, 127, 191, 212, 180, 205, 209, 211, 210, 251, 232, 222, 210, 254, 173, 242, 182, 201, 164, 142, 156, 170, 137, 105, 155.

Pomacentrus (leucostictus?) 2 brilliant blue and yellow. The boys catch both this type and the black (*adustus*) about the Mallory dock. They are not geographically distinct.

Next visited artificial "Pearl Harbor", a manufactured Key on which the Ocean Leather company has a "factory".

Here got similar fishes and the following also.

Balistes carolinensis 1 - 1" 91

Tylosurus (acus?) Tremendously abundant and some larger. These latter were all ripe and a good sample was preserved. Measurements follow.

s.l. mm: 390, 411, 368, 390, 429, 381, 392, 350, 373, 424, 365, 379, 354, 383, 331, 382, 175, 341, 339, 348, 337. [NOTE ON MARGIN: "The stomachs all partly filled with an unidentifiable bluish paste".]

Tylosurus sp. - 2 small examples; preserved. Sides with dark spot on posterior rays. The fish vaguely suggest *Ablennes* in pattern. Beak short. [NOTE IN PENCIL: "*S. raphidoma*".]

Tomtates. Common small.

L. apodus. Common small.

Pomacentrus (leucostictus?) Brilliant - common.

Anchovia sp. In schools with the dwarf herring. About 1".

Sphyrna (barracuda?) Common but not as much so as about Mangrove Key.

Sphyrna tiburo (bonnethead). Seen about 2' long near Mangrove Key. Did not have a shark sucker. Also saw a fishshark (*Carcharhinus*) there with its sucker.

Cyprinodon (variegatus?). Large specimens in a small disconnected pool at Pearl Harbor and a few in a cove.

92 *Hepsetia stipes*, *Eucinostomus californiensis*, *Jenkinsia stolifera* in large schools and common.

The beach near the shark factory was covered with the centra of shark vertebrae. Collected a number. Short spined, long spined sea urchins, Holothurians, Conchs, Horse conchs, etc. common.

A jewfish slaughtered at the dock contained the pharyngeal teeth of a parrotfish.

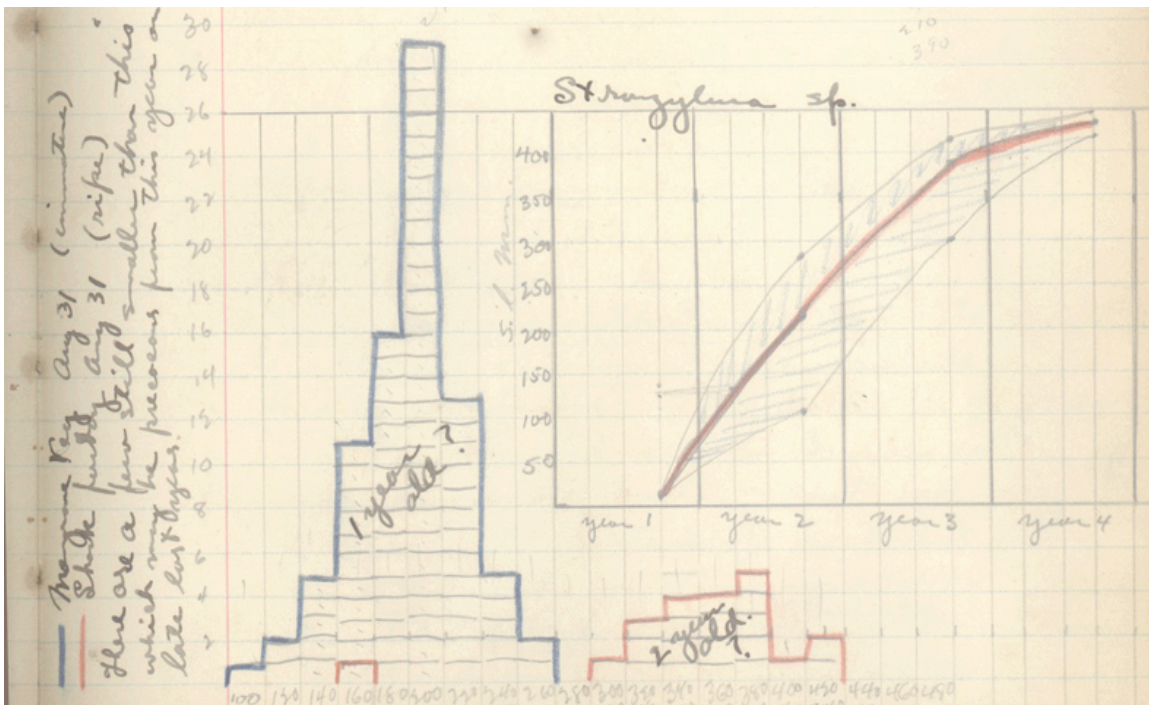
The fishermen say Tarpon are ripe from now to November. The smallest taken were measured 3" long and was kept in the local aquarium for a time. Also that porkfish and grunts spawn now but also throughout the year irregularly.

Could not use the light at night because of failure of party to supply electricity. Turned in 10:30 P.M.

93

Papers from this Key West Trip

- 1 Bulletin: Collecting tropical fishes for the aquarium.
- 2 Zoologica: Fish notes from Key West, Florida.
- 3 Zoologica: A method of enumerating Exocoetidae.
- 4 Zoologica: Synentognath data from Key West.
- 5 Book: Add data on life history, etc.
- 6 Copeia: Jew fish notes.



- 1 pH, salinity and temperature records
- 2 Stomach contents
- 3 Useful fishing apparatus
- 4 Knowledge of larval conditions
- 5 Collection of rare fish not to be obtained at market
- 6 Finding of diseased pork fish
- 7 Useful habit and scientific data
- 8 A good collecting seine

Sept 1 Visited Man Key early in the A. M. This Key is even more barren than the others so far visited. Circumnavigated it and saw the following.

Dasyatis (caudal with fins above and no keel below) 2' to 4' broad - 5

Eucinostomus. a few 2" about 12 - 7".

Neomaenis griseus. fairly common. 8 - 14"

Seriola sp. 1 small. 3" preserved. This fish hung in the mangroves at the surface in a half diagonal position and skipped out of the lunge of the dipnet several times. Largely yellowish, with dark paired vertical bands.

Strongylura (acus?). Large and small common in places. Took eggs from a ♀ but could not get no ripe ♂s. These fish the same size as those preserved yesterday. Some were spent ♀.

Carcharhinus. 3 - 3' seen.

Adudefduf saxatilis. - 2 - 3" seen.

Cyprinodon (variegatus?) - small schools seen.

Mollinesia latipinna - a few with the above.

Sphyraena barracuda - a few seen - up to 2'.

Hepsetia stipes - a few schools.

Sardinella macrophthalmus - a single school.

Jenkinsia stolifera - a few schools.

Neomaenis apodus - a few with *L. griseus*.

Lactophrys sp. 1 - 8"

Lagodon rhomboides - 3 small - 3"

Then sculled over to Barracuda Key over a grassy bottom that had very little invertebrate life on it and saw an identical selection of fishes.

Photographed a roost of man-of-war birds on it - the first one seen.

Photographed my men operating the seine.

Then moved off to the banks between Man and Sand Key. Got a few *Panulirus* for dinner and saw a selection of the more reef-like fishes.

Balistes carolinensis; *Halichoeres bivittatus*; *Anisotremus virginicus*; *Teuthis bahianus*^Δ; *Centhis coeruleus*[◇]; *Neomaenis griseus*; *Adudefduf saxatilis*; *Sardinella (macrophthalmus?)*; *Caranx (ruber?)*

Had an interesting swim here in 20' of water.

On the way there and back dipped up a great many bunches of Sargasso. About every 12th bunch had a young *Balistes carolinensis* (2-3") or a young *Monacanthus hispidus* (1 - 1 1/2') under it. One bunch had a pipefish in it. Nearly all harbored shrimp and crabs. The latter three matches the weed well. The *M. hispidus* were green in a few cases, although the weed was bright orange yellow.

On return to the dock saw 2 large barracuda 4 and 5' about.

95

96

^Δ No such species name. Could be *Acanthurus bahianus*.

[◇] No such species name. Could be *Acanthurus coeruleus*

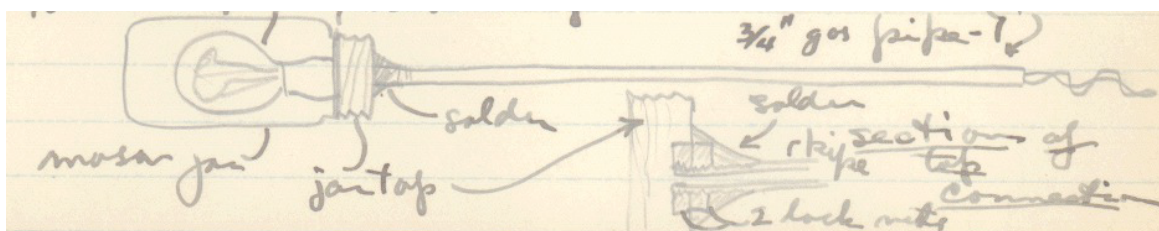
At night tried the night light. It worked extremely well for a few minutes but leaked in water so it had to be discontinued. In the few minutes it was overboard 97 *Hepsetia*, *Jenkensia*, *Sardinella* and *Eucinostomus* were about in numbers as well as some species not recognized.

Turned in 10:30.

Sept 2 Turned out 8:30. Sunday Expect to 'do' the town today. Went to the dock to see that the fish were fed. A cobia (*Rachycentron*) died. Photoed 'Capper' [?] feeding the fish. 2 *Albula vulpes* were brought in one of the fishermen says he sees them nightly while getting crayfish just out of the harbor on a 'bank'.

Spent the P.M. looking the town over - there is little to recommend it. Read and rested in the evening. Turned in 11:30 P.M.

Sept 3 Turned out 8:30. A fair southeast breeze with the barometer falling. No fishermen went out today partly because of a hurricane reported off Cuba and partly because today is Labor Day. In the A. M. fixed up the night light in a manner that should work, as below.



Full corrected calculations for Exocoetidae

98 S. S. Algonquin.
Depth
Beginning [xxx]

Length. Beam.
Width disturbed.

Date	Lat.	Long.	Speed	Course	Wind. vel.
(1) Aug. 26	36° 15.5'	75° 7.5'	15.5	186	2
(2) Aug. 26	35° 37.5'	75° 12'	15.5	186	2
(3) Aug. 26	35° 10'	75° 11'	15.5	186	2
(4) Aug. 26	34° 45'	75° 20'	15.5	186	2
(5) Aug. 26	34° 18'	75° 22.5'	15.5	186	2
(6) Aug. 27	31° 13'	76° 55'	15.5	186	
(7) Aug. 27	29° 17'	78° 9'	15.5		
(8) Aug. 28	25° 34'	79° 58.5'	15.0		
(9) Aug. 28	25° 4'	80° 13'	15.0		
(10) Aug. 28	24° 35'	80° 57'	14.0		
(11) Aug. 26	35° 16'	75° 10'	Single fish		
(12) Aug. 26	34° 53'	75° 18.5'	Single fish		

Work over.

See yellow [xxx] and original records.

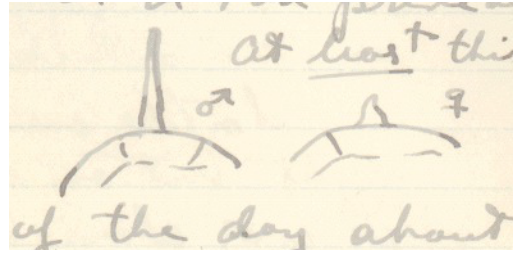
[TABLE CONTINUES ON FOLLOWING PAGE.]

Wind direct	Air temp.	Water temp.	Bac.	No. fish	Hours	99
S	82	85	-	<1	5-5:30 a	
S	82	85	-	<1	9-9:30 a	
S	87	85	30:42	<1	11:45-12:45	
					2:15-4:50	
					5-5:30	
					7:15-7:45	
					2:45-3:05	
					8:00-8:30	
					11:30-12:00	
					3:20-3:50	
					11:40 A.M.	

	Photographs	(2 plates ruined)	100
	Films	Plates	
Aug. 29	Cigarbox factory	Man-of-war birds	
	Boats	"	
	"	Pelicans	
	"	"	
	Harbor	<i>Tylosurus</i>	
	" ruins [?]	"	
	" ruins [?]	"	
	"	Jewfish	
		"	
		"	
		Boats	
		"	
		Live cars	
		"Our" boat	
Aug 30		Cast net. [xxx] Sigh [?]	
Sept 1		Man-of-war bird roost	
		Pelicans in flight	
		Cray fish and water glass	
Sept 2	Feeding fish in live cars		
	View from hotel		
	"		
	"		
Sept 3	Copper mending dip net	Green turtles in pen	
	Turtle pens	"	
	"	"	
	"	Man-of-war birds at dock	
	"	"	
	Market from turtle pens	"	

101

Visited the turtle crawls. They contained a large number of ♂ and ♀ *Chelonia mydas*. The tail of the ♂ is much larger than that of the female. No mistake could be made if the character is thoroughly reliable. Those that I had previously seen were all ♀. At least this much different.



Spend the rest of the day about the dock photographing man-of-war birds, etc., and gathering what data I could on fishes.

Promicrops: Two were butchered. One a ripe ♂ of about 5'. Its stomach contained no food but a hard lump of amorphous red stuff that looked like clotted blood. Preserved it. Peter Robert says most of them have this in their spawning season. The other one was about 3 1/2' and was apparently *immature*. Weighed about 60 lbs. The stomachs of most of these fish are empty because of being retained in cars and wells.

Ocyurus chrysurus. Examined about 20. Mostly spent fish but a few ♂ were ripe. It is near the end of their long and irregular spawning season the fishermen say.

Margate fish. One large 1+' fish was a ripe ♂.

102

Amia (bivittatus?) A large example was caught by boys about the dock.

Epinephelus morio. All spent (10 fish).

There is very little going on as all the fishermen are watching the weather. Clouds are gathering and it rained about 5 o'clock with rising wind.

In the evening tried the night light but on account of the rain it was charged [?] all over.

Still raining at 10:30. Turned in 12:00.

Sept 4

Wind still up but barometer falling. One boat went out to the reefs but was forced back. Nothing doing at all about the docks. Wondered about town trying to find something to do most of the day.

Tried the night light and this time the socket blew up !

Rained heavily off and on all night.

Sept 5

Turned out 8:30. Wind still too stiff to go to reefs. Little to do. Fixed night light again. Saw them unloading red snappers from off Rebecca Light. These brought in on a 2-masted [SHIP] on ice, re-iced and shipped (all) to Havana. Angel Rios, a Cuban outfit. Some fishermen were out - brought a *Urolophus jamaicensis*. Said electric rays are sometimes found here.

104

Omitted lunch today with good effect.

Took in 'movie' show in the evening.

[TABLE INSERTED IN NARRATIVE BETWEEN PAGES 102 AND 104.]

		Photographs (continued))	103
	Films	Plates	
Sept 4	Loafers in market (aquarium [?]) Conch boat at market		
Sept 5	Storm clouds approaching Unloading red snappers " " "		
Sept 7	Peters Point locality Cast net at Peters Point		
Sept 9		Saddle Buck fishermen R. R. at Saddle Buck	
Sept 10	Fish being shifted for loading " " " "		
Sept 11	Tanks aboard San Jacinto "		
Sept 12	Detail of piping Shea at work on air apparatus " "	Flying fish in flight " " " Porpoises at bow " " " "	
Sept 13	Shea cleaning fish tanks		

[CONTINUATION OF PAGE 104]

- Sept 6 Turned out 8:30. Visited dock and made arrangements to go out for *Cyprinodon* and *Mollinesia* tomorrow. The live collection is coming nicely now.
 In the evening tried out the night light. It works well. Got a good sample of the stuff about the fish dock. Saw a tarpon (about 3¹/₂') cut through the light and a small squid. Took a couple of *Albula leptocephalus* and a very tiny *Hippocampus*, among other things.
 Turned in 12:00.
- Sept 7 Turned out 8:00. Went to Peter's Point and collected *Mollinesia*, etc. It is an unpleasant stinking mud hole, full of hot water and offal. The fishes we got appear to enjoy it however.
 M. latipinna abundant
 Cyprinodon variegatus common
 Fundulus sp.? not common

- Opsanus beta* 1 small
Eucinostomus californiensis a few small
Anolis californiensis is fairly common about town on the land etc. Saw a gecko - 105
 very pretty.
 Sat up till midnight talking with a young man from N. Y.
- Sept 8 Turned out 7:00. Expected to go out to the reefs today again but weather still too thick there. A jewfish opened by Peter Robert contained some eel incised in the "stomach lining", perfectly black and preserved, similar to the lump of blood found before. All ♂ opened so far ripe. A single ♀ opened sometime before any arrived, Spent the day in not very productive activity.
 Sat talking in the evening. About midnight a gun fight in which 2 shots were fired (corner of Duval and Fleming St.) enlivened the otherwise quiet day. A Chinaman got shot in the hand wresting a gun from a negro.
- Sept 9 Turned out 8:00. Went to Saddle Bunch Key by car with Sikes the hotel clerk 106 and some of his friends. They went fishing here on a high way bridge. Not a fish was caught. The following were seen.
Neomaenis griseus (abundant - large)
Caranx sp. - (1 large)
Strongylura sp. - (1 - 2')
 Shark in distance.
 Clupeidae sp. 1 school.
 This is supposed to be a famed locality. Mullet was used as bait and it was positively uncanny how the gray snappers could distinguish between chum and the piece with a hook in it. It did seem almost like a display of unbelievable intelligence. The chum would be snapped up at once and the bait smelled and passed up. The pieces were similar in all respects, handled one as much as the other, etc. A long wire leader was used. Possibly all those that would take a piece of flesh not weighed to fall in a certain manner had been already selected out - a matter of individual variation acting in the Darwinian sense.
 One of the men told me that sometimes great numbers of Exocoetidae were blown ashore on Tortugas, mostly small. □ Write Longly.
 Spent most of the P. M. resting and getting things together. 107
 Rained in the evening. Turned in 10:30.
- Sept 10 Turned out 8:00. Rain - the most we have seen yet. Spent most of the day getting this ready for departure. Photographed the fish being "condensed" [?] for purposes of going aboard.
 Let jars of formalin with the following for preserving flying fish.
 Peter Roberts
 Willard Baker "Copper"
 Begley Filer
 The San Jacinto due at 2:00 A. M. tomorrow.
 Rested in the evening.
- Sept 11 San Jacinto docked 2:10 A. M. Fish loaded by 3:30. The method of loading is rather crude and somewhat rough. However I see no way of improving it at present. The boat equipment is good. Turned in 4:30 A. M. Turned out 7:00.
 Flying fish about in fair numbers. 84 specimens dead in the tanks. A few preserved.
 Made some flying fish enumerations. The log is not out so the following data is given.

Wind over starboard bow.

108

Time	Numbers	Bow	
8:40 - 8:55	---	Port	\
8:55 - 9:10	1 - 1 - 3	Starboard	/
10:45 - 11:00	---	Port	\
11:00 - 11:15	2 - 1 - 1 - 2 - 1	Starboard	/
1:45 - 2:00	1	Port	\
2:00 - 2:15	3 - 1 - 1 - 2	Starboard	/

It would appear that we are entering an area of higher concentration. This agrees with the outbound data and shows the Straight of Florida to be relatively poor in Exocoetidae.

The great disparity between numbers in a side is closely connected with wind direction. See above and other figures. How do the fish know there is an adverse wind on one side and vice versa?

Next enumeration as follows.

5:20 - 5:35	2	Starboard	\
5:35 - 5:50	---	Port	/

The difference between the sides remains the same but there has been a drop in numbers - the water is about the same (see table). May it be because the light is less intense? That seems to be the only different factor.

Took a much needed rest in the P. M.

Passed Fowey Rocks 12:00 noon.

Passed Hillsboro Light 12:30 P. M.

Turned in early 9:00 P. M.

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- Sept 12 Turned out 5:30 A. M.
 Made Exocoetid observations, etc. Porpoises about in fair numbers.
 76 fish dead tanks today.
 160 total
 Shea says this is an unusual route. Passed through a small squall at noon.
 Got 4 photos of Exocoetids. Shea fed the fish and prepared the air line for use when the temperature falls.
 Got 5 photos of porpoises under the bow.
 Ran out of Exocoetids or nearly so about 2:00 P. M. Too far toward outside edge of Gulf Stream?
 Turned in 11:00.
- Sept 13 Passed out of Gulf Stream about 3:00 A. M. See table of temperatures, etc. Heated water turned on fish. Water green - no Gulf weed. Data S. S. San Jacinto. Beam 53' Length 403' Drought 17 to 23;
 Exocoetid observation shown them to be entirely absent 6:30 - 7:00 A. M.
 A few porpoises seen; 2 large loggerhead turtles and numerous petrels.
 Total fish dead 203.

S. S. Algonquin

Sta. No.	Lat.	Long.	Port	Starboard	Course	Wind dir.
1	36° 15'	75° 7'	---	---		
2	35° 37'	75° 12'	---	---		
3	35° 10'	75° 16'	---	---		
4	34° 45'	75° 20'	51	18	L	
5	34° 18'	75° 23'	48	6	L	
6	31° 13'	76° 55'	51	12	L	
7	29° 18'	78° 9'	23	28	L	
8	25° 34'	79° 59'	10	3	L	
9	25° 4'	80° 13'	14	5	L	
10	24° 35'	80° 57'	1	---	L	
11						
12						
First fish	35° 21'	75° 15'				
First in Stream	34° 52'	75° 18'				

Speed for calculations. 15.5 (1 - 7); 15.0 (8 - 9); 14.0 (10)

Beam 54'

Width disturbed on each side 50'

Length of each observation in knots (77')

		Area observed		Area observed
S	1	7.75 3,628,369.35	D	9 7.50 7,172,631.00
S	2	7.75 3,628,369.35	D	10 7.50 6,554,455.60
S	3	7.75 3,628,369.35		
D	4	7.75 7,256,738.70		
D	5	7.75 7,256,738.70		
D	6	7.75 7,256,738.70		
D	7	7.75 7,256,738.70		
D	8	7.50 7,172,631.00		

Width of disturbance 154'

Use $\frac{1}{2}$ for single observations. 77'

Sta. No.	Lat.	Long.	Port	Starboard	Course	Wind dir.
1	25° 29'	79° 54'	---	L 5		
2	25° 58'	79° 49'	---	L 7		
3	26° 41'	79° 47'	1	L 7		
4	27° 8'	79° 42'	---	L 2		
5	30° 56'	79° 20'	1	L 7		
6	31° 22'	79° 3'	2	4 L		
7	31° 57'	78° 23'	4	L 1		
8	32° 31'	77° 43'	---	L 1		
9	32° 52'	77° 20'	3	L ---		
10	35° 44'	75° 6'	---	---		
11	37° 14'	74° 40'	---	---		

Speed for calculations. 15.13 (1 - 4); 17.3 (5 - 11)

Beam 53'

Width disturbed on each side 50'

Length of each observation in knots

(all single)	Area observed	Area observed
1 7.565	351,874.86445	9 8.65 4,022,320.345
2 7.565	351,874.86445	10 8.65 4,022,320.345
3 7.565	351,874.86445	11 8.65 4,022,320.345
4 7.565	351,874.86445	
5 8.65	4,022,320.345	
6 8.65	4,022,320.345	Width of disturbance 153'
7 8.65	4,022,320.345	Use $\frac{1}{2}$ for single observations. 76.5'
8 8.65	4,022,320.345	