1942
Florida - Palmetto Key

June 1 — Left the Pa. Station with Ethel $10^{\underline{00}}$ P. M. aboard "Palmland". Black out going through N. J. No club car. - service not as good as usual - N. Y. is a "dine-out". 1

June 2 — Club car attached - train late.

June 3 — Arrived Tampa an hour late. Got the 6:45 a. m. for Boca Grande. On time. Verlie, Bob Spearing and his two brothers met us. Had been raining but stopped before we got off. Had lunch in Boca Grande and made some purchases. Stopped off to see Chief DeWitt at the fish house. Reached Palmetto Key about $3^{\underline{00}}$ P. M. Spent the rest of the day getting things in order. Putting up in the guest room at the big house.

Turned in $10^{\underline{30}}$.

June 4 — Turned out $7^{\underline{30}}$. Clear and bright. Spent the morning finishing unpacking and getting the laboratory in order.

After lunch took some Kodachromes of Royal Poinciana in bloom and other flowers. Sent Bob off to make tow #1; tide just about at flood.

Made some tests of temp. of water in bowls under various conditions. See records on page 2. Spent most of afternoon sorting plankton of tow #1. See page 3 and 5 for details. Not a great quantity of eggs. Placed "tarpon" eggs, which were hatching, in glass dish in basin with wet rags designated as Bowl #1 - see page 9.

Analysis of bowl temperatures (June 4) 2

	1:15 p.m.	1:45 p.m.	2:15 p.m.	3:15 p.m.	5:00 p.m.	9:00 p.m.
Glass bowls						
1. On table	28.0	28.5	28.9	29.0	29.0	28.0
2. On #1	28.0	28.0	28.0	28.5	28.8	27.4
3. In pan with wet rag	28.0	27.8	27.5	27.5	27.6	26.5
4. On #3	28.0	28.0	28.0	28.0	27.6*	26.5
China bowls						
5. Dark room floor	28.0	27.2	27.0	27.0	26.9	27.0
6. Dark room sink	28.0	27.8	27.5	27.8	28.0	27.2
7. Freshwater in pan	25.2	27.8	28.0	28.0	28.0	27.0
8. Air	29.6	-	30.0	30.0	29.2	27.3

* Wet rag added to this second dish.

In cleaning out the lab, got a good sample of spiders and scorpions for Goerty.
Took a swim at 5:30.
Fixed and mounted a newly hatched larvae from egg 'G'.

June 5 — Turned out 7:00. Worked on larvae. They seem to be developing more slowly in the cooled bowls. See page 11 for records of temperatures.

Analysis of bowl temperatures (June 5)

Glass bowls	7:30 a. m.	2:00 p. m.		8:45 p. m.	10:30 p. m.
1. On table	24.8	27.8			
2. On #1	24.0	27.5	Discontinued		
3. In pan	24.0	26.8	experiment	27.5	27.0
4. In pan	24.0	26.8	7 bowls		
			placed in		
China bowls			evaporating		
			pan and		
5. D. r. floor	25.2	26.0	all hold the		
6. D. r. sink	25.2	26.5	same temp.		
7. Freshwater	24.0	26.8			
8. Air	25.0	30.4		29.2	27.5

Tow-net records

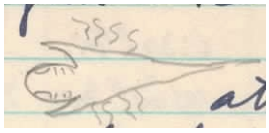
Made in channel to Captiva Pass unless otherwise noted (*)

Tow No.	Date	Hour	Tide	H_2O temp.	Remarks
1	June 4	1:15 p. m.	High	27.2°	
2	June 5	5:00 p. m.	Flood	29.0°	Much weed present
3	June 6	9:15 a. m.	Ebb	28.5	
4	June 8	10:00 a. m.	High	27.4	
5	June 10	9:00 p. m.	Early flood	29.0	Few eggs. Saved larval fish
6	June 11	9:30 a. m.	Ebb	28.7	
7	June 13	5:30 a. m.	Flood	-	Just about light
8	June 14	10:00 p. m.	Low	-	Net torn- no catch
9 *	June 15	6:00 p. m.	Ebb	-	In blue water 2 miles off shore half way between Captiva and Redfish Pass
10 *	"	6:15 p. m.	Ebb	-	In green water 1 mile off shore same place
11	June 16	3:15 p. m.	Ebb	32.0	Bottom tow
12 *	"	3:30-7:30 p. m.	Ebb	-	Net anchored off end of dock in strong tidal flow
13	June 17	9:00 a. m.	Ebb	-	
14 *	June 25	4:30-5:30 p. m.	Ebb	-	Net anchored off end of dock in strong tidal flow
15	"	6:30 p. m.	Low	-	
16	"	10:00 p. m.	Rising	-	
17	June 27	10:00 a. m.	"	-	In green water 2.5 miles off Captiva Pass over 22 to 26'
18	"	10:15 a. m.	"	-	In blue water 3 miles off Captiva Pass on 30'
19	June 30	8:15 p. m.	Falling	-	Just before sunset
20	"	9:45 p. m.	"	-	Raining - dark

[TOW NET CONTENTS DATA AT THE END OF THE DIARY] 5

Bob and Lamar seined the beach. Preserved from their catch; 2 batfish, 2 4
Strongylura, several *Lagodon*, 1 *Synodus*. Measured 5 *Dasyatis sahemis*[*] as follows.

No.	Sex	Width	Disc. length	Snout to ventral tip
1	♀	10	$9\frac{3}{4}$	$10\frac{5}{8}$
2	♂	7	7	$7\frac{1}{4}$
3	♂	$6\frac{1}{2}$	$6\frac{3}{8}$	$6\frac{5}{8}$
4	♀	$7\frac{7}{8}$	$7\frac{3}{4}$	$8\frac{1}{4}$
5	♀	$10\frac{3}{4}$	$10\frac{5}{8}$	$11\frac{5}{8}$



♀ #1 with 3 eggs - no embryo could be made out.
♀ #4 undeveloped "uterus"
♀ #5 with 3 embryos in an early stage - preserved. They could not be measured as they were not fully developed in terms of width and length. Pectorals without head attachments as yet. All 3 females had the left uterus developed.

Bob brought in some *Hydrobates* for experimental work. Checked on last years work with surface tension. Added a saturated solution of Santomerse "D" to a bowl until one *Hydrobates* sank. The slightest touch of a pipet in which this had been causes the insects to perforate the surface film with their feet and rest on their bodies. Additions of great quantities seem to make no particulate change. Always a few sink but most float on their bodies and have their movement greatly impeded. 6
Preserved those insects used as well as a sample of the sea water, and the Santomerse "D" + sea water for surface tension determination.

Bob made tow #2 while Ethel and I took a swim.

Spent some time fixing small aquaria.

After dinner worked on tow #2 and took some pictures of the sunset.

Fixed up a strainer for replenishing sea water in bowls. Too many small medusae come in an ordinary draw bucket of water at the dock end.

The reduced temperature in the bowls as now fixed apparently makes all the plankton live.

Turned in $11^{\underline{00}}$.

June 6 Turned out $8^{\underline{00}}$. Bob made tow #3. Spent the morning working over the tow which was full of 'G' eggs. Prepared 4 bowls of them - see page 9.

A squall threatened in the P. M. but did not materialize. Spent the P. M. working over the eggs. The last in bowl #1 died - preserved.

Fixed shades in the lab on the side windows.

Bob got some small *Strongylura notata* for an aquarium. All six large ones are now filled and water tight.

Took a swim at 5:30.

Took 50' of movies of schools of young needlefish and mullet at the dock.

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[*] Now probably *sabina*.

Turned in $12^{\underline{00}}$. after spending the evening sitting up with the 'G' eggs and collecting insects and spiders for Goerty.

7 [TEMPERATURE DATA AT THE END OF THE DIARY]

8 June 7 Turned in $9^{\underline{00}}$. Got shades placed on all the wide windows of the laboratory. - a good improvement.

Worked on another old aquarium, corking the parts of two broken ones after lunch. Hot and oppressive. A squall broke at 2:45 p. m.

Plan in use for raising eggs

1. Filtered sea water to keep plankton if organisms to a small size and few in number.
2. Bowls in water bath to keep temp. within limits and prevent too rapid changes.
3. Few eggs to a bowl. Water changed at least every 24 hours. Contents removed to another bowl while scum which accumulates on bottom is wiped off. Egg shells, etc. removed by pipette. (In a word, careful sanitation).
4. After larvae are feeding use straight sea water for food organisms removing all larger organisms (Medusae, etc.) by pipette.

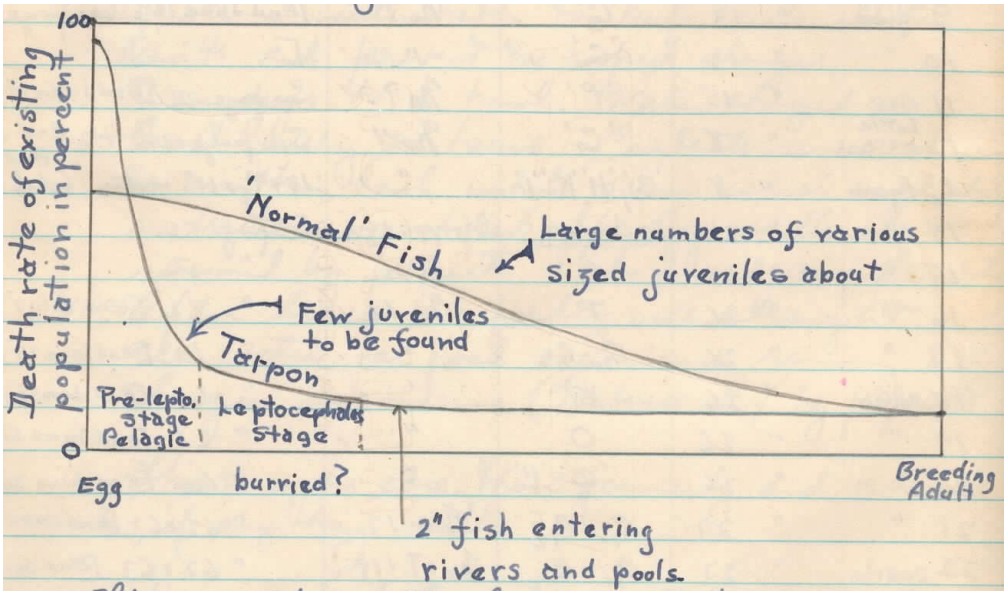
This is more care than formerly and should work, if anything will.

By 5:30 bowls No. 3 and 4 all dead - as before. The above factors would not seem to be important. Bowls 5 and 8 not examined. To be left till tomorrow.

9 [RECORDS OF EGGS IN BOWLS AT THE END OF THE DIARY]

If these fish have a normally great mortality at this stage it may be that these continued losses are merely normal and not incident to bad handling. Then the following tentative hypothesis would be tenable. Very heavy mortality at first

10 dropping off rapidly with nearly all the rest growing up. Then there would be little chance of getting survival in a dish. There would be scant chance of getting a leptocephalus in a tow net - especially if they burrow in the bottom - one (?) in the history of man. If a "normal" mortality curve could be represented as follows then the tarpon curve would be as the second graph.



This graph could also be made to read, instead of death rate; 'Nos. present'. In this case the steep drop would come in the first few days after hatching.

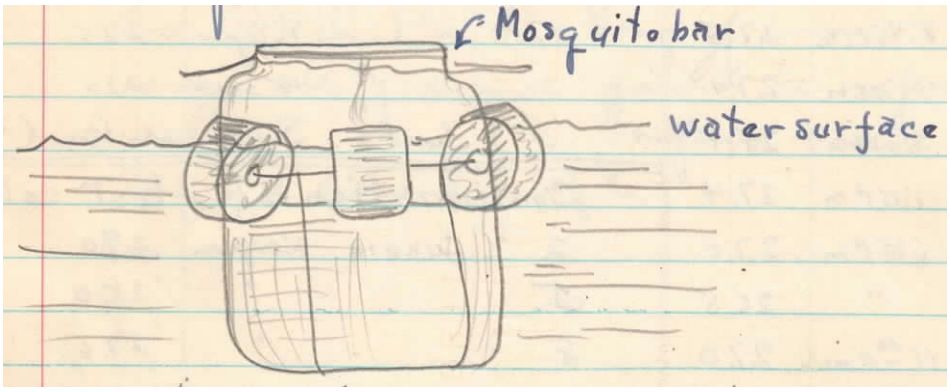
Rain continued later and into the night. The force broke the light line to the laboratory stopping evening work.

Turned in $11^{\underline{00}}$.

[TEMPERATURES IN BOWLS DATA AT THE END OF THE DIARY] 11

June 8 Still raining intermittently. Bob made tow #4. Larvae 'G' living in bowls 5 and 8 (Tow #3). 12

Fixed up "bowls" #12 and #13. The former a large wide mouthed bottle with filtered water tethered under the dock to give movement, as indicated below:



No. 13 is an aquarium carefully cleaned and with filtered water mostly in an attempt to raise egg 'H'.

Intermittent rain all day.

Bob collected some *Sardinella* for Hildebrand at the fish house off Punta Blanca.

Spent the whole day "nursing" the 'G' eggs along, writing letters, etc. Mounted some slides of 'G' and 'H' in balsam.

In the evening made same test development. O. K. - used D-76 and Hypo left from last summer - perfectly satisfactory.

Continued rain all night.

June 9 Still raining hard. Turned out $9^{\underline{00}}$. The weather is such that little can be done. More or less 'caught up' with indoor work and cannot work out doors as the rain is intermittently torrential.

Larvae 'G' in bowl #5 still going - about 1 day. 13

Rain stopped at $10^{\underline{30}}$ - evident by clearing.

In a wash tub with slightly flared sides it measured $7^1/_2$".

Took some pictures of *Anolis* copulating.

Worked on repairing nets, etc.

After lunch worked the shrimp trawl on the west side of Palmetto Key. Got the usual assortment with nothing of special note. Established some of the things, *Monacanthus*, *Prionodes*, *Syngnathus*, *Gobiosoma*, *Paraclinus* [?], etc. in the laboratory aquaria. also some invertebrates.

Larvae 'G' in bowl #5 and in bowl #12 still going.

A *Hyla* came to the screen door to catch insects?

After dark tried a flash-light on the smallest *Monacanthus*. As always it failed to react as did the Tortugas material.

Rained intermittently all night.

June 10 Larvae 'G' in bowl #5 still going.
Preserved and sorted the collection of arachnids for Goerty.
Released the *Hyla* and took colored movies of him in an areca palm.
Got the final aquarium tight and in operation.
Preserved some misc. fishes which Bob collected by seine at nearby points.
Fixed up the aquaria with fresh water after lunch.

14 Took some movies of *Anolis* and *Cnemidophorus* in the p. m.
Took a swim at $5^{\underline{30}}$.
Larval 'G' in bowl #5 still going $8^{\underline{00}}$ p. m.
Bob made tow #5 well after dark - see page 3. Picked and preserved larval fish from it - an all night job. Very few eggs.
Turned in $11^{\underline{30}}$.

June 11 Turned out $8^{\underline{00}}$. Bob made tow #6.
The last of 'G' in bowl #5 dead - preserved.
Nothing to be found in bowl #8.
Small fish evident in bowl #13.
Small fish evident in bowl #12 (especially a young *Lactophrys*?)
Tested a 'G' egg as to floatation and temperature in a tall tube. Between 29.0 and 32.5 they slowly float up - just barely so but the slightest turbulence will send them off in any direction.
Spent the morning working over the eggs. Prepared bowl #6 for 'G' eggs and bowl #7 for mixed mostly 'O' eggs.
Mounted a number of larval fish in balsam for future reference.

16 Worked the shrimp trawl in back of Palmetto Key. Got enough blue crabs (a bucket full) in from time for supper. The usual things were obtained including a very large *Hippocampus hudsonius punctulatus*, an adult *H. zosterae*, a small *Chaetodon capistratus*, 2 very small *Chilomycterus* one *Prionodes*, 1 *Mycteroperca bonaci* (3"), one large *Diplectrum formosa*, 2 large *Lactophrys tricornis*, two *Paralichthys* sp.
Later Bob gathered some white anemones on the beach and picked up 2 very small *Chaetodipterus faber*. Nearly all black with very large black ventral fins. This had a striking resemblance to certain of the East Indian demoiselles going under the name of Jesuits.
Preserved a series of the larger fishes and held alive most of the smaller.
Took some pictures (black and white) of the spadefish and the *Chaetodon*.
Turned in $12^{\underline{00}}$.

1 Negative evidence for disorientation by light rays in plectognathi fishes. Page 13, 22, 41, 44, 45, 46, 54, 55

2 Flounder development. Slides and preserved material.

3 Feeding of anchovies. 40, 41, 42, 43, 45, 47, 51, 52, 53, 55, 57, 59, 60, 88, 89. 90, 91, 92

4 Effect on world picture of variation in physical constants - the possibility of their real occurrence?

5 Evolution that did not take place.

1. The boat (a world of water with no land and animals floating all their life on the surface. All boat like animals have recourse to land or water for reproduction).

2. The wheel

   a. Wheels like skates could be evolved.
   b. The whole animal like a wheel - a starfish is a start

Why are these and other items absent when the incredible eye, flight and other items present?

Could be chance or some actual limits on organic design. If these could be defined it would be worth while !

6 The behavior of young *Chaetodipterus faber.* Page 16, 18, 19, 20, 22, 23, 24, 28, 33, 38, 44, 48, 50, 78, 84, 85

7 Behavior of *Gobiosoma* with air in a shell. Page 19

8 Fate of fish larvae and eggs in the sea where plankton is abundant. See page 23, 24, 26, 28, 31, 32, 59, 62, 70, 75, 76, 87 27

9 Differential behavior between *Strongylura* and *Tylosurus* young. See page 30, 31, 32

10 Data for Field Book of Technique. See page 34, 35, 36, 37, 67, 76, 77, 81

11 Development of egg 'P' - *Lactophrys tricornis*. See page 29, 33, 35, 38, 39, 40, 42, 50, 53, 56, 58, 70, 71

12 Transportation of larval *Synodus foetens*. See page 41, 43, 53, 59, 76, 85, 86, 90, 91, 92

13 Protective habits of *Opsanus beta*. See page 42, 44

14 Further data on *Achirus* and lights. See page 40, 43

15 Further data on the "gravidity" of *Hippocampus*. See page 42, 43, 44

16 Behavior of young *Oligoplites*. 22, 54, 55

17 The sting of *Scorpaena*. 54, 55, 59, 66, 78

18 Bands on young *Archosargus probatocephalus*. See page 65, 66, 74, 75

19 Nesting of *Gobius* sp. (*Bathygobius soporator*). 78, 60, 82, 83, 84, 85, 87, 89, 91, 92

16 June 12 Turned out $9^{\underline{00}}$. A very hot night.

Worked over the eggs and took some movies of *Chaetodon*, *Chilomycter* and *Chaetodipterus* in the a. m.

After lunch visited the tarpon pool. One tarpon still there. Numerous young *Gambusia* seen. Collected a few spiders.

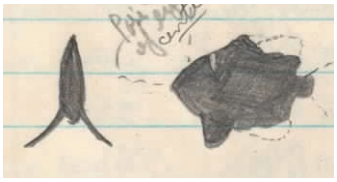
Took movies and stills of the laboratory building.

Took a swim at $4^{\underline{30}}$.

Bob painted Mary Roberts Rhinehart's skiff.

At low water last night a great blue heron was much disturbed by a pelican. As the heron stalked the flats the pelican flying low would light with a splash and catch
18 the heron's intended prey and scare everything else away. At this the heron would make for the pelican with repeated "quaks" and the pelican would fly off while the heron would return to fishing emitting low throaty grunts "to itself". In the meantime the pelican would circle around and repeat the performance. This happened four times before the heron left. Very evidently these two types of fishing do not agree - and the pelican to some extent was taking advantage of the heron who was "pointing" prey for the former.

Bad day for *Amphioxus* near the big dock at low water, 6:30. None were to be found. Did get however 4 more young *Chaetodipterus* in their black phase. These could be caught by hand right at the water's edge in scarcely enough water to float them. Naturally it was a dead calm.



These fish hold their ventrals out rigidly at nearly all times and prefer the surface layers in aquaria that are <u>not</u> suffocating. The typical form and color is shown. This is a jet velvety black and even the eye cannot be seen by ordinary methods. The dotted portions of the fins cannot be seen either. Because of this they seem to glide rather than swim since the entire locomotor portion is transparent. Changes in the steering fins give on the impression of a fluid change in the outline of a pure black body, which is nicked by a small white mark at the nape.
19 Sometimes these fish as quite active and at others remarkably quiescent. When found they are usually solitary or in twos hugging close to some bit of floating drift usually not more than 2 or 3 times larger than themselves. Sometimes they lighten ever so slightly on the body or head. This immediately makes the large eyes apparent.

Preserved one specimen that a file fish had bitten.

Turned in $10^{\underline{00}}$.

June 13 Turned out $7^{\underline{30}}$. Bob made tow #7. Spent the a. m. working over this tow.

A *Gobiosoma robustum* in one of the aquaria set himself up in an empty "conch-type" shell. There was some air included in the whorls of the shell, somewhat restricting the movement of the fish. He would take one mouth full of air and came to the opening of the shell and let the bubble go.

Nothing can be found in bowl #13 - discontinued.

Bowl #12 contains what appears to be a single young *Lactophrys*?

Bob got 5 more young *Chaetodipterus*.

Took stills in black and white and color and movies of them in aquaria and dorsally in a bowl.

Examined the beach where they were found. It is sand (white) or shell and anything coal black is notably conspicuous. However all along this beach are black snails which give it a peppered appearance. Much more pertinent however are floating (half water-logged) fragile bits of wood that are just about the size and 20
general get-up of these fish. As these pieces move just at the water's edge it is distinctly difficult to tell which is wood and which is fish. Apparently these bits of woods are broken off from dead mangrove branches which have blackened in the decomposing trash about the mangrove stands. At least large very fragile bits of branches may be found nearby which break into angular fragments. Those which roll in the wavelets are water worn and as jet colored as the fish.

Thus it would appear that superficially conspicuous actually the fish are "lost" among the more numerous bits of wood. The mechanics of why these pieces are so uniform in size and why the *Chaetodipterus* takes on its adult coloration at only a slightly larger size.

Another, or the same pair of *Anolis* were mating on another stake by the laboratory door - got a good sequence of movies of it.

The *Chaetodipterus* young (10) came from the beach of the island (about 200') - or one for every 20 feet. They were all cleared out yesterday and today. About $6^{\underline{00}}$ p. m. 2 more were seen that recently came in. These were left for further study. They were together and chasing each other in circles not unlike a couple of larger *Angelichthys*. (This paces to 326.6' or one fish for about every 32.6 feet.)

[TEMPERATURES IN BOWLS DATA AT THE END OF THE DIARY] 21

A fairly strong north-west wind was blowing most of the day, breaking the 22
heat wave. This caused some surf on the beach which forced the little *Chaetodipterus* to move off into slightly deeper water - about 1 inch deep.

Bob and Verlis went to Bookelia for a visit with the Spearings leaving the dogs with us on the island.

Six wood ibises feeding on the flats at $7^{\underline{30}}$. Last night a porpoise was feeding off the end of the dock - the first seen this year, except one on the trip over from Boca Grande, which had a piece taken out of its 'dorsal'.

Took movies of the wood ibises feeding, just before sundown.

Worked the overhead light at the end of the dock from 9 to $10^{\underline{00}}$. Got an unusual variety and number of specimens. Dead low water on a very low tide.

Preserved: 3 *Strongylura* sp., 1 Scombrid, 1 Engraulid, 1 Clupanodon

Also took 1 *Syngnathus*, 1 *Hippocampus zosterae,* 1 Eel sp.? many *Atherina*, 1 *Achirus*

As soon as the Scombrid got into the influence of the light it curled at an off angle - like a leaf and seemed in trouble. Later in a bucket a flash light beam did the same thing. (This is a young leather-jack according to Bob and behaves this way even in day light. He is probably right. The general color is a brassy silver.)

The *Achirus* (9 mm) s. l. performed just as described by Beebe and Tee-Van for the Haiti material. This specimen was even smaller than theirs, about $^{1}/_{2}$ the size of their smallest.

23 Turned in $11^{\underline{30}}$.

June 14 Turned out $9^{\underline{00}}$. Wind still blowing. A line of "suds" on the beach. A little 'surf' is running and no young *Chaetodipterus* can be found. Apparently they move off into deeper water except on the calmest of days. Strangely the various small black objects that look so much like them are also nearly missing. Cast up on the beach by the waves? In their places is a considerable amount of *Zostera*-like leaves and other trash. This is quite uninhabited.

The object that looks most like these fish is a plant part (seed or flower part?) which is quite black. Preserved a number of the objects that were first mistaken for the young Spade fish. Also a few of the black snails.

Took some movies and stills of some large sea-pigeons (inkfish) = nudibranchs.

Spent most of the P. M. cleaning aquaria and bowls.

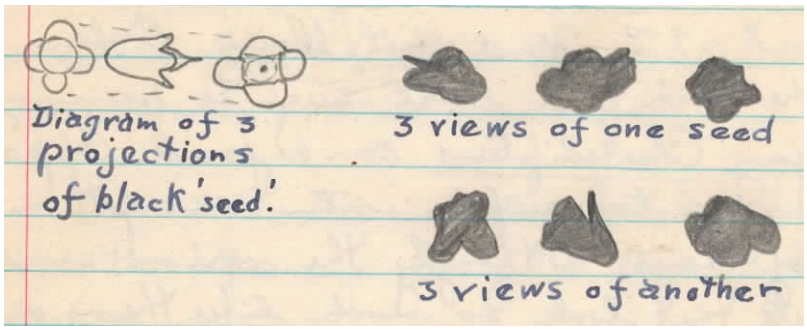
In bowls #9 and #10 some plankton was left. Today neither eggs, larvae or egg shells remain. There must be a terrific mortality from such causes in the sea hereabouts - discontinued.

A little *Lactophrys*? is in bowl #5.

Yesterday the second flounder died - preserved.

The little black vegetable objects which look so much like a young *Chaetodipterus* even give the effect of the enlarged black ventral fins. The details of their form as well as their appearance at odd angles is represented below.

24



Actual appearance of a seed and several outlines of two showing what is actually seen as the roll in a gentle lapping at the waters edge. Compare these with what can be seen of *Chaetodipterus* under similar conditions.

[For publication give several projections of each indicating in the legend <u>only</u> what they are.] This reduces "mimicry" to an absurdity (or does it?), or at least to monochrome.

The fate of the eggs and larvae in bowls #9 and #10 may account for the rapid disappearance of the larvae on hatching - are most of them lost in this water as compared with the outside? Get a bottle of each and count organisms. Do all species successfully spawning in the Sound (or in "green" water) have appropriate modifications. Those that definitely do spawn and have their entire being in the sound so far as known clearly do. They include at least the following classification.

25 [TOW NET CONTENTS DATA AT THE END OF THE DIARY]

Carry eggs and young 26

Hippocampus	*Galeichthys*
Syngnathus	*Felichthys*
Gambusia	
Mollienisia	

Hatch in an advanced stage, eggs guarded or not

Atherina	*Fundulus*
Opsanus	*Cyprinodon*
Paraclinus	*Lucania*

Others may all have successful outside spawning, with failures in the Sound.

The tows fail to show even fragments of even young fish. The smallest - see slides - are all out of this classification and may have moved in from outside "blue" water.

Bob made tow #8 and tore the tow-net badly - no catch. He got however a sample of sea water preserved - for counting plankton organisms.

A high wind sprang up and blew most of the night.

Turned in $11^{\underline{30}}$.

June 15 Turned out $8^{\underline{30}}$. Clear and dead calm.

Ethel spent the a. m. trying to mend the tow net.

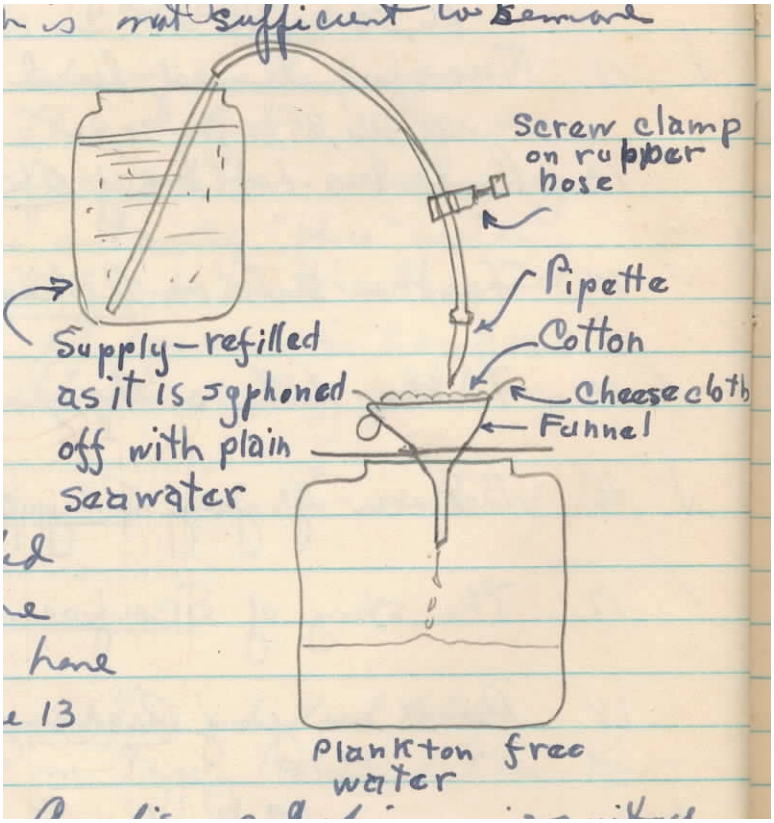
Took photos of a very young *Strongylura* (*raphidoma*)? in a bowl. This fish measures approximately 15 mm. The inner rim of the bowl measures 142 mm and the ring imprint in the bottom 85 mm. Fish left in bowl for growth and further study.

A scorpion and a centipede were found drowned in one of the aquaria. This is the first time in 5 years that such a thing has been noted here. 28

After lunch wrote some letters. Ethel continued working on the silk net - a large job.

Bob went off with the repaired tow net to make an outside tow. Made tow #9 and #10.

Prepared a water <u>filtering</u> device for sea water as, quite evidently, straining water through bolting cloth is not sufficient to remove all large organisms, destructive to newly hatched larvae. The arrangement is shown herewith.



At 5:30 took a swim - water 92° !

The beach was patrolled regularly but no more young *Chaetodipterus* have appeared since June 13.

Took movies of an *Anolis* catching mosquitoes on one of the laboratory screens.

The small fish in bowl #2 dead - preserved.

Spiders, scorpions, etc are notably more abundant. A considerable number were collected today.

29 Tows #9 and #10 were made about half way between Redfish and Captiva Pass, the first in blue water about 2 miles off shore and the second in green water about 1 mile off shore. A sample of the water was taken with tow #9 and preserved. It was quite evident in the buckets of these tows that there is a large difference in the total plankton content, both in the amount of dead sediment and the concentration of the living material.

Worked over these in the evening. See notes on page 25. Made sketches of egg 'P'.

It is notable that newly hatched larvae of two species were present in tow #10 and in a good viable condition. In tow #10 one such larvae was found while none were ever seen in the inside tows, confirming the view that they do not last in inside waters - or for that matter not very well in outside 'green" waters.

Made up bowl #11 of eggs 'P' in filtered water. These 'P' eggs are in an early stage of development. They are probably too small for Tarpon eggs, as based on ovarian examination of five years ago.

Worked the night light from 10:30 to $11^{\underline{00}}$ on a still ebbing tide. In contrast to the night before last there was practically nothing worth wetting a net for. Got one small *Anchovia* and some plankton for the fish in the aquaria.

A stiff breeze has sprung up. Turned in $11^{\underline{00}}$.

June 16 Turned out $9^{\underline{00}}$. Clear and calm.

Worked over eggs 'P'. They are now demersal with the embryo well advanced. 30
This is possibly an isospondyle egg - perhaps the true tarpon egg? It lacks the large perivitelline space of egg 'G' which may actually be an ill egg - ? However it is somewhat small - 1.4± mm diameter.

Took some pictures of Belonids off dock - *Strongylura notatus* or *Tylosurus* (*raphidoma*?). There was one of the latter and many of the former. The latter, straw colored would stay substantially in one position resting by a bit of drifting stem or weed that looked very like it in general get up. This is the 'stick fish behavior' of the Dry Tortugas. In the present case the tide was ebbing fast and the drift was being swept past the dock. Pieces of drift were not more than 2' apart and generally less. As the piece near which *Tylosurus* hovered tended to pass under the dock it would dart rapidly forward and settle near another piece. Thus it has a back and forth movement of an average of about 18". The fish was about 6" long.

Just what points of reference it used to hold its position was not clear although it may have sighted the dock although it was about 3' 'upstream' from it. Also why it selected this position was not clear, although this may be a method of feeding; possible from bit to bit of drift to take smaller fish also hovering under such shelter, but drifting with it.

In a sharp contrast was the behavior of the *Strongylura* which in more or less 31
of an aggregation kept moving hither and yon in an area of about 20 feet in diameter. It is notable that these are green from above, not greatly unlike the color of the water !

The *Tylosurus* of just about the same size (some of the *Strongylura*) were larger and smaller) occasionally made movements as though to join them but never left off its "schooling" with inert bits of trash.

Is this protective coloration? How can we account for this selective difference in the schooling behavior of two such fish? Between these two there is evidently a deep behavior differential as great as or greater than the physical nature of them. One social and the other substituting the social behavior by attraction not to its kind but to sticks that look more or less like it.

Made tow #11 in the usual place to see if the young larvae sink instead of being eaten. None were taken although this was made as close to the bottom as possible. Two 'H' eggs were caught - probably accidentally while the net was being lowered. No post larval fish were taken either - presumably they hug the bottom very closely. Young larvae could not do this: their natatorial ability would easily prevent it.

Made tow #12 at 3:30. This consisted of setting the net just as the ebb flow began well at the dock and anchoring it off.

With the *Strongylura* are schooling 2 *Hyporhamphus* of the same size. Except 32
for their corporal differences they are very much of the school and behave in a similar fashion. They all were feeding on plankton organisms. Their short darts at floating mats followed by swallowing motions were quite evident.

Bowl #6 contains one well advanced *Lactophrys*?

Spent most of the p. m. working over tow #11.

Took a swim at 5:30.

Mounted some more larval fish from tows in balsam.

Spent the evening going over tow #12. This lasted until $7^{\underline{30}}$ - 4 hours overboard. The tidal flow was weak however, as it usually is here. There were no eggs or larvae, which was to have been expected at this time of day on a basis of previous experience. There were many echinoderm larvae present. Aside from the this it resembled the earlier tows in the channel.

A squall threatened about sunset but passed around.

Tried the overboard night light. Nothing showed up worth catching. A calm night and the mosquitoes were terrific !

New moon tonight.

Turned in $11^{\underline{00}}$.

June 17

Turned out $8^{\underline{00}}$. Bob had made tow #13. Spent most of the a. m. working it over. A good variety of eggs were present and a larval 'H'. This is apparently the case early in the morning when they are hatching in great quantities before

33 wholesale destruction has set in.

Made sketches of several of the types for future reference. Quite clearly the letters used to designate eggs are covering several types. Only reference to the preserved material can straighten the matter out - at least, however they do give a point of departure.

The objects which resemble the small *Chaetodipterus* are the dorsal parts of the bloom of the Red mangrove. Either they have been broken off by the wind or are unfertilized flowers that have dropped off. Those on the tree at this time of year are much larger and growing the curious green stem-like process from them. Several of these were preserved, which had fallen off much later and were still living. The White and Black mangrove have a different flower which does not do this.

Preserved the *Lactophrys*? in bowl #6 - discontinued.

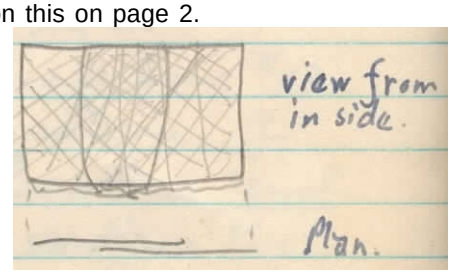
Took a swim at 5:30. A rung of the swimming ladder gave way. This was preserved for Nigrelli. The bottom rung was gone when we got here and top one is still good. It is hardly ever wetted. The date this was put in is given in an earlier notebook.

One of the 'P' eggs in bowl #11 hatched by 6:40. It now looks like some kind of a flounder larvae. This one may be premature hatching however as the rest are in their shells - see sketch made in egg notes.

34 For the last week have wanted to get some movies of the striking sunsets to be seen here. All this time the sunsets have been plain and uninteresting. A most striking difference to those generally to be seen.

Took a compass bearing on the lay of the building and dock. The line of the dock points almost a compass north - about 2.5° west of north. This gives the 3 back windows of the lab a true north light. The clearing in back of it provides space for skylight. 4 side windows face almost due west as the front of the building is at right angles to the dock. These screen the aquaria and are well protected by oak and palmetto growth. Also there are shades on these windows.

The lowest temperature is in the dark room which has its own flat roof at about 8' (where stringers ride) and a "chimney of 4" gutter pipe. The floor, specifically is the coolest place in the building - see notes on this on page 2.



The large 8' wide x 6' high garage door way is protected by cloth mosquito bar. These are two pieces each 8' long hanging to overlap. They are 6' wide each. See sketch. They are weighted with sinkers and crumple on the floor for about two feet. This is a most effective mosquito bar as most of those on our clothes brush off in passing between the folds. A screen door of ordinary type lets many more mosquitoes come in. The

35 windows, and doors to the bedrooms, have ordinary wire screens fastened to the outside.

Worked around the laboratory on general chores in the evening. Turned in $11^{\underline{00}}$.

June 18 Turned out $8^{\underline{00}}$.

The 'P' eggs in bowl #11 all hatched. Larvae look vigorous. They appear about as in yesterday's rough sketch. They lay on their side with a large yolk sack on the bottom, swimming in short darts occasionally.

Measured up the laboratory for future reference. Since this building is so completely adequate for the purpose it was thought best to preserve the dimensions. The data is given on page 36 and 37.

Spent most of the morning working over the eggs and drawing the following plans. These, with photographs, should make reconstruction relatively easy.

Caught 2 very small spiders which build flat webs about the small picture hooks on the east wall of the lab. near the sink. Took a photo of the nest.

The larvae of egg 'P' is now more active and up from the bottom to some extent. They beginning to look like some plectognath type of fry - large pectorals, very chunky and rounded (encased in a membrane it appears) and with few vertebrae. They could be counted already if I wanted to sacrifice them.

Bob returned from Ft. Myers with supplies. 38

Took a swim at 5:30.

Took movies of the sunset to finish off the color movies of this place.

By $8^{\underline{00}}$ p. m. the larvae of egg 'P' had mouth and vent open ready to feed and swim upright. They are 'fat' little things, certainly some plectognath. Changed their water from plankton free filtered water to raw sea water examined for the presence of medusae or other larger organisms.

Scorpions seem to be becoming increasingly numerous. Eight or more were taken in the lab this evening. Two of these, presumably males, were fighting when caught, many seem to be females turgid with young.

Turned in $10^{\underline{30}}$.

June 19 Turned out $8^{\underline{30}}$.

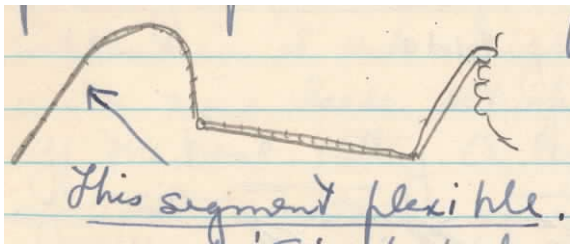
The 'P' larvae are up and going and show individual vigor in pursuing small objects of food. They are now developing pigment and seem to be an olive-green as viewed by a hand lens. They are certainly some form of plectognath, and look like a larval *Spheroides*? Taken more or less frequently in the tows.

Preserved 3 of the little black *Chaetodipterus* which an equally small *Chilomycterus* was feeding on. Now there is nothing in the aquarium but them and one *Chaetodon* and 2 *Gobiosoma*.

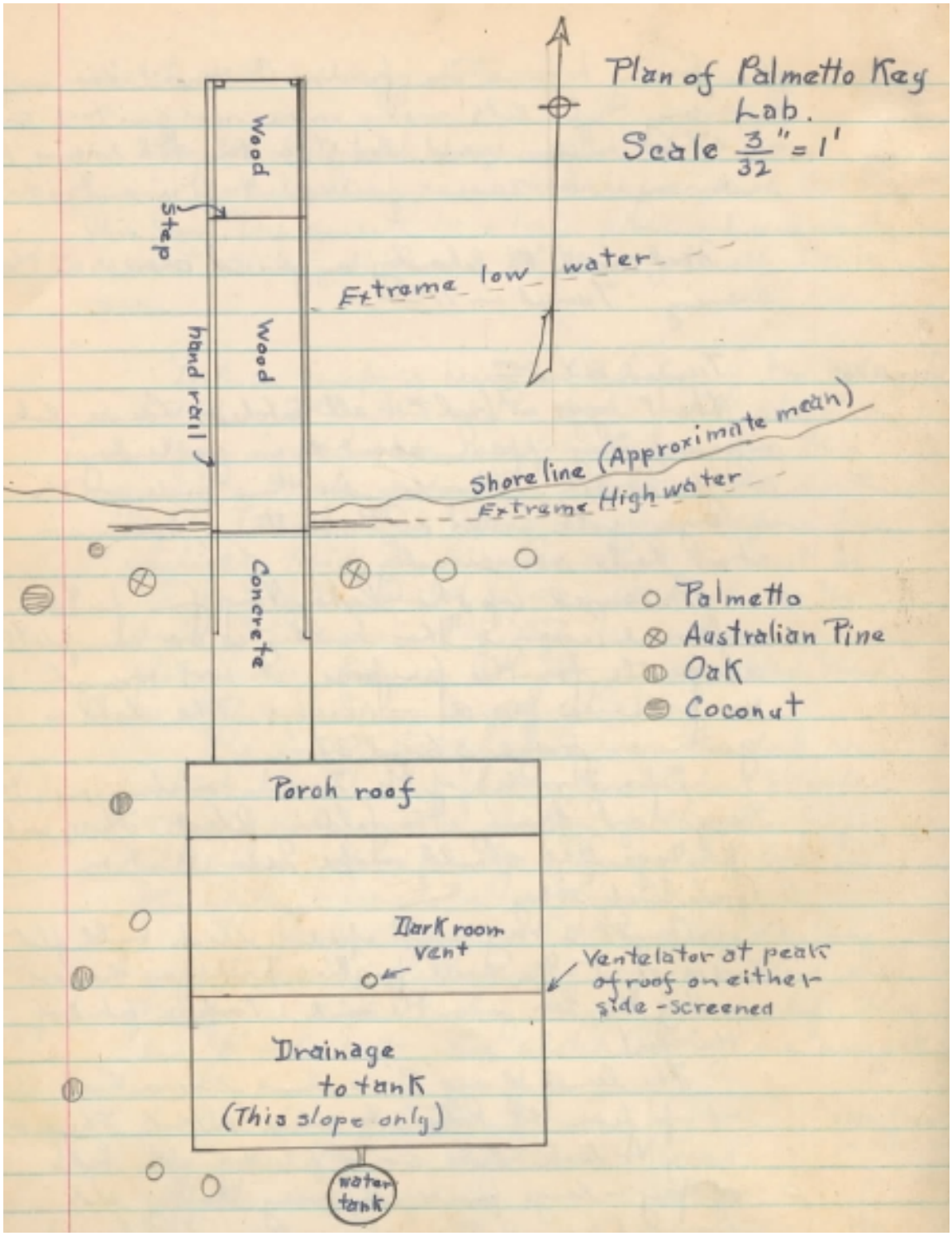
The 'P' larvae seem to be mildly phototropic.

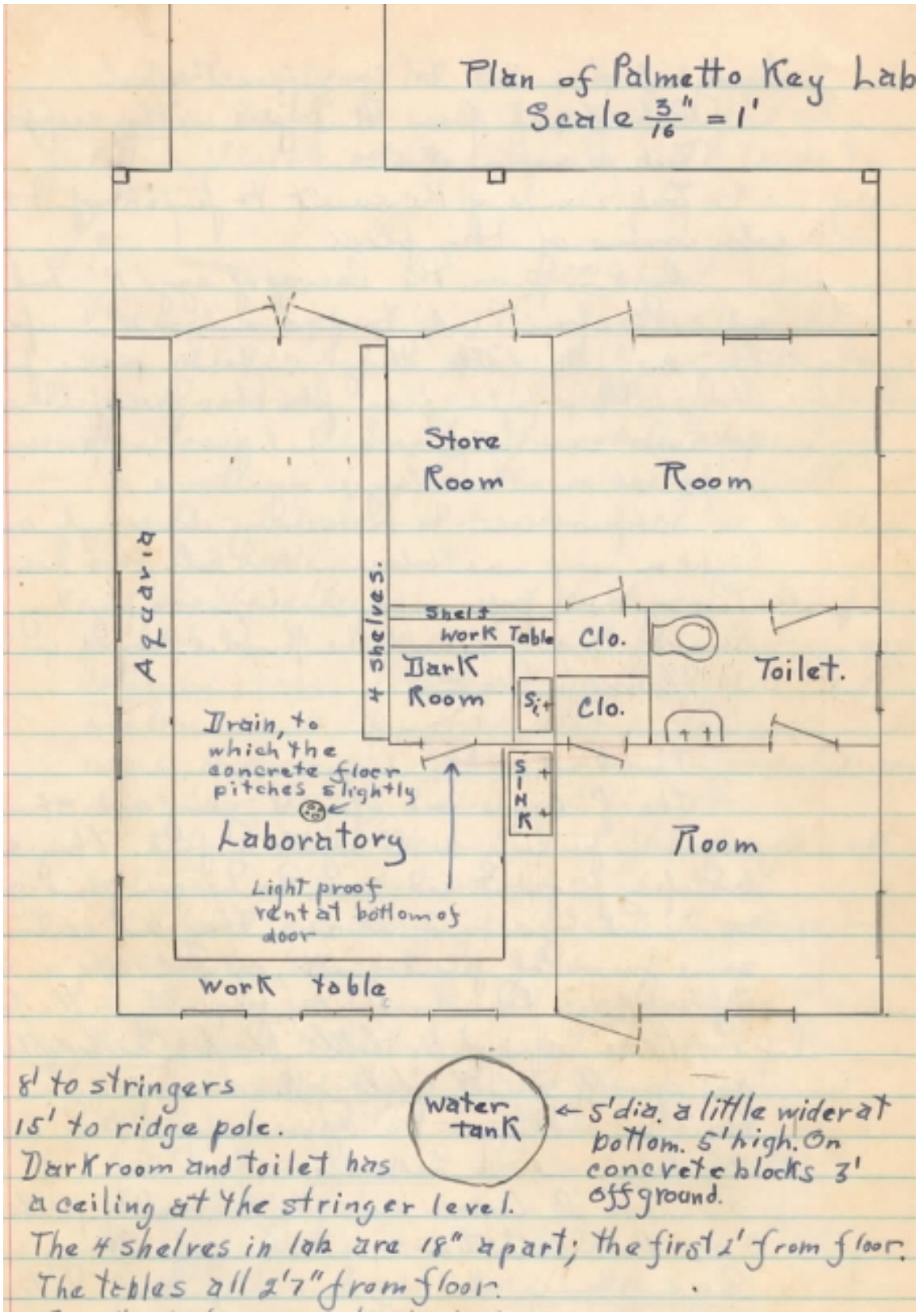
Bob collected a number of *Strongylura*, *Eucinostomus*, etc. by the big dock - preserved all.

Got a couple of the round bodied type of "grampus". The first walking leg 39 modified as a feeler is flexible at its extremity. It tends to bend sharply at one place, even more so than shown in the sketch, but may be thrust out straight and curved 'S' shaped or used for exploratory purposes almost as flexible as an Octopus tentacle. Actually the whole appendage is made up of a great number if small joints - like some insect antennae, excepting only the dorsal segment.



36


Plan of Palmetto Key Lab.
Scale 3/32" = 1'
Wood
step
hand rail
Wood
Extreme low water
Shoreline (Approximate mean)
Extreme High water
Concrete
Palmetto
Australian Pine
Oak
Coconut
Porch roof
Dark room vent
Ventelator at peak of roof on either side - screened
Drainage to tank
(This slope only)
water tank


Plan of Palmetto Key Lab
Scale 3/16" = 1'
Store Room
Room
Aquaria
4 shelves.
Shelf
Work Table
Clo.
Dark Room
Sink
Clo.
Toilet.
Drain, to which the concrete floor pitches slightly
Laboratory
Light proof vent at bottom of door
Room
Work table
8' to stringers
15' to ridge pole.
Dark room and toilet has a ceiling at the stringer level.
water tank
← 5' dia. a little wider at bottom. 5' high. On concrete blocks 3' off ground.
The 4 shelves in lab are 18" apart; the first 1' from floor.
The tables all 2'7" from floor.

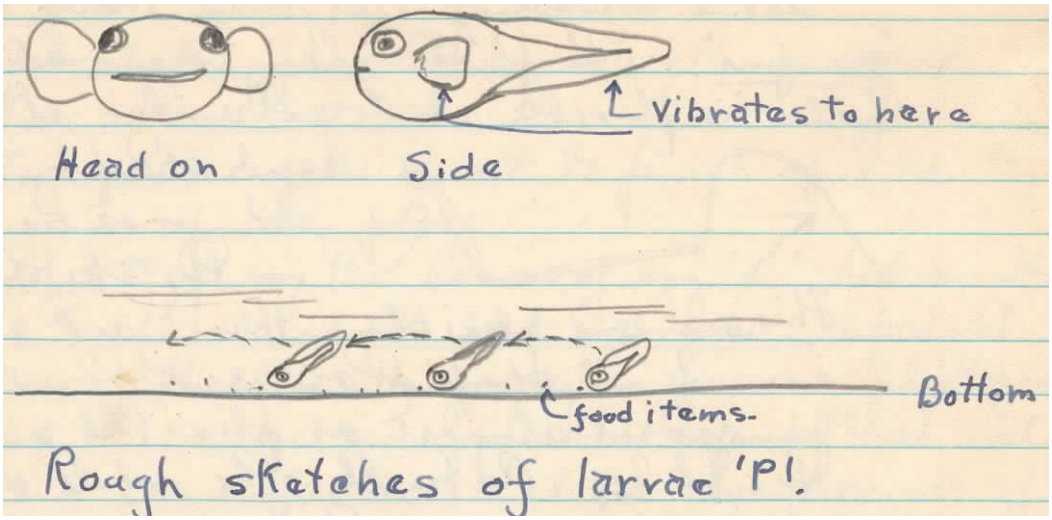
In the afternoon used the dredge (shrimp trawl) in back of the island. Got a large collection of *Gobiosoma bosci.* Preserved a good sample. Got another small *Epinephelus*, also a dozen or more *Hippocampus zosterae*. Also the usual mixture of pigfish, canfish, pinfish, etc.

There were intermittent light drizzles all afternoon. Very hot afterwards.

Placed one very "gravid" male *H. zosterae* in a separate aquarium for study.

The larvae from the 'P' eggs are feeding vigorously. They propel themselves by rapid vibrations of the pectorals and tail tip, and tend to sink when not actively swimming. The mouth is large and "frog-like" not small as in most plectognath. Frequently feeding is done by a series of "bumping" motions on the bottom while they pick at or engulf very small organisms lying dead or nearly so on the bottom of the glass laboratory dish in which they are kept.

40



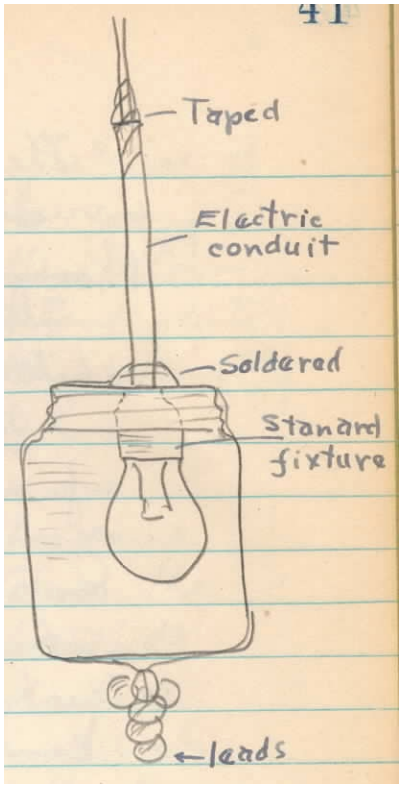
After dark worked the night light from Bob's boat. It worked very well. We drifted from the Channel to the island to a point about 1/2 mile toward Captiva Pass. Got the following:

Atherinidae - 2 day ±
Hyporhamphus - several
Hemiramphus - 2 young
Engraulidae - several small
Synodus? - 1 just transforming from a leptocephalid
Chirus - 2 about 20 to 35 mm s. l. - floating at the surface ala Beebe and Tee-Van.
Chilomycterus - 1 young
Strongylura - 2 sp.? (see specimens)
Clupeidon - several small
Mugil - 2 young
Apodes - 1 small

It was a dark clouded night and while we were working a squall broke - continued through part of it. Mosquitoes very bad as soon as wind died down.

Preserved most of the catch except the Engraulids, *Synodus*? and *Clupeidon*. Saved these for study of feeding behavior.

41



The light used consists of a mason jar with a fixture soldered in it and weighted with seine leads. It operates off the boat battery. A light of 5 watts, 6 volts.

Although attracted to light the little *Chilomycterus* shows no disposition to gyrate as do some other pectognaths on the Dry Tortugas.

Turned in $12^{\underline{00}}$.

June 20 Turned out $7^{\underline{30}}$. After the rain last night a strong breeze sprang up which cooled off everything. Bright and sunny this a. m. The fish caught last night showed a good survival this morning.

Went to Boca Grande in the morning for supplies. Got back to island by 1:30. About 7 porpoises seen just inside of Boca Grande Pass.

Spent most of the afternoon cleaning out the 8 aquaria in operation. They were fed a little too heavy yesterday and were becoming foul.

Two of the *Anchovia mitchilli* of last night are swimming as well as the *Synodus*. This was completely transparent last night except for its eyes and the characteristic black spots in the stomach. Today it rests on the bottom and while still semi-transparent shows the full adult "diamond-back" pattern, as well as the adult behavior.

42 The larvae of eggs 'P' remain the same with increase in vigor, but no gross change observable through a hand lens.

While in swimming (there were 6 adults and 3 children; Ethel and me, Verllie and her nephew, Bob and Mary and their 3 kids) one of the party dove up a board with an *Opsanus* nest of advanced young still attached to their stalks. While examining this standing in water about shoulder deep the guarding parent attacked the feet of 3 of us. I was one and while I could distinctly feel it close its jaws over my great toe strongly enough it did not bite hard enough to cause discomfiture. The others had similar experiences.

The tide was quite full and the board was laid, eggs up, at the end of the dock to see if the parent would go on guarding them. Since the water here was about 4' deep at this stage of the tide it was impossible to follow it further - until the tide falls.

How this fish associated its troubles with our feet is not clear !

The male *Hippocampus zosterae* gave birth to one young about $6^{\underline{30}}$. Premature? Set up the camera for possible further photographs.

The two *Anchovia mitchilli* are just out of the "serpentine-striking" stage as they should be on a basis of their size. They feed directly as an ordinary fish. Took some photos of them in an aquarium.

43 Spent most of the evening taking pictures of these fish and *Sardinella* young and the young *Achirus* plastered on the aquarium walls. Below their coloration is almost plain black and white; grayish-white anteriorly changing rather abruptly to black caudal. Is this *A. lineatus*?

Bob used the night light, about the same place we did last night - see map. Much the same stuff was obtained. Fewer Atherinids and more *Hyporhamphus*. All the

Engraulids were dead - preserved. The living material was added to the aquaria - *Sardinella*, *Hemiramphus*, *Strongylura*. No large *Strongylura* were caught.

Turned in $12^{\underline{00}}$.

June 21 Turned out $8^{\underline{30}}$. Cloudy with light showers.

The male *Hippocampus zosterae* which delivered one young one last night had its entire brood discharged this morning. Attempted to photograph it.

The larvae of 'P' eggs still going well. They are clearly darker and more vigorous although they hold the same general form and pigmentation.

Spent the morning taking photographs which included *Hippocampus zosterae* and young, *Anchovia mitchilli*, *Synodus foetens*, the one which transformed last night (night before last proper) and a larger fully transformed specimen for pattern comparison, both in a bowl and *Sardinella* and *Mugil cephalus*, both young in a school.

44 The board holding the *Opsanus* eggs was examined at low tide. The young fish were gone. Taken off by parent or eaten by other fish. A *Spheroides harperi* was in the vicinity. However these fish were about to leave their point of attachment and it would seem that the parent would go on guarding them. It is especially to be noted that these eggs were on <u>top</u> of the board originally and it was kept in that position - moved about 20' from where found, with the parent following at a distance. The egg marks on the board looked normal - as though the fish had left voluntarily at the end of their time.

Bob went seining at low water on the Useppa flats. The attempt was to get ripe *Strongylura*, *Hyporhamphus*, or *Lactophrys*. Only ripe males could be found.

They also took a ripe ♂ *Chaetodipterus* - evidently they are still spawning. Preserved most of the material. Kept alive 2 *Diplodus holbrooki*, 2 *Monacanthus hispidus* and 1 *Spheroides harperi*.

Placed the *Monacanthus* in the dark room at 2:15 for study in regard to light reactions.

The *Hippocampus zosterae* photographed with its young this morning actually produced by count 39 young fish. All were released in the general sea horse aquarium. The young are slightly phototropic.

Yesterday one of the land-hermits which Bishop planted last year showed up near the laboratory. These were placed at the back of the island. Verlie then reported having seen several at various times. These were originally taken near

45 Key West and have clearly been able to winter over on Palmetto Key. The specimen found was large and I would judge had grown to a larger size than any that were released.

No one has seen any sign of the armadillos for several months.

One of the two *Anchoviella mitchilli* kept for observation was seen to strike like the smaller sizes always do. Apparently the habit is not completely relinquished at this size.

Bob seined the beach and right at the laboratory dock got a ripe ♀ *Strongylura notatus*. Attempted stripping and fertilizing. The resulting eggs do not look too good but the fish was apparently dead ripe. Fertilization at 3:30 P. M.

At 4:15 (2 hours later) entered the dark room and flashed light on the 2 *Monacanthus*. No results. They were obviously aware of the light and showed some slight avoiding reactions and color changes but no locomotor disorganization. Returned to lighted lab. No other change than color reactions. These fish were 40 to 45 mm s. l. The light used was a 3 cell flash light.

At 4:30 placed in dark room a much smaller *Monacanthus* and a comparable *Chilomycterus* just caught on the beach by Bob.

Established 4 large *Anchoviella mitchilli* in aquaria for comparison with larval specimens. Three of these quickly expired. Took photographs of the fourth, which gave every indication of survival.

At 6:30 (2 hours later) treated the smaller *Monacanthus* and *Chilomycterus* as 46
the two larger (see page 45). The results here too were negative. The file fish merely hid in a dark corner of the aquarium. The box fish turned its rear to the light evidently letting its bulk protect its eyes. In both cases, this end with the larger fish the light was applied for over 3 minutes - much longer than necessary to get results at Tortugas. The fish in this second case measured as follows:

Monacanthus hispidus 15 mm s. l.

Chilomycterus schoepfi 12 mm s. l.

As with the first these were returned to day light without any disturbance of locomotor function.

These fish were just about the size of those used in the most successful of the *Tortugas* experiments.

Scorpions, the day before yesterday and the day preceding that, were a bit of a scourge in the laboratory. See page 38. The last two nights none appeared and but one was taken in the day yesterday. Insects also seem to have fallen off in numbers except mosquitoes and sand flies.

Made a sketch of larvae 'P'. All five are doing well and are being fed plankton by pipette.

Left the laboratory in darkness as night fell until 9:30 when the lights were switched on suddenly. No disorganized locomotion displayed by any of the fishes.

Tonight is very still and the sand flies are bad. A half-moon is brilliant. 47

Turned in $10^{\underline{00}}$.

June 22 Turned out $8^{\underline{00}}$. Cloudy and generally overcast. Spent most of the morning taking pictures of the young *Anchovia* striking at food. They now show the serpentine-strike nicely but it is so quick that it is hard to time photographically. Also took some of a very small *Hemiramphus* in a bowl.

The large Anchovy strikes its food very like a small trout, which of course is reminiscent of the larval behavior but only feebly so. For these studies it was found that a fine stream siphoning in through a pipette on the end of the siphon tube delivered just enough plankton to insure feeding and this plus in the inflow held the fish nicely in one place.

Bob used the shrimp trawl and got the usual assortment. They then spent the rest of the morning tarpon fishing with no luck.

In the afternoon seined the beach for needle fish. Got many a few of which seemed ripe. Tried stripping again but the resultant eggs were like those of yesterday - not quite ready. Got a large series of *Eucinostomus* and 2 *Ogcocephalus*.

At 4:30 took a swim. Rain is threatening and a breeze is springing up.

There are three kinds of Mangrove trees recognizable hereabouts described 48
below in the order of regression from the shore:

Red mangrove: Produces aerial roots which drop down and anchor in the sea bottom. Also produce "viviparous" seeds.

Black mangrove: Produces upstanding numerous shoots from roots, like cypress "knees" but more numerous and more slender.

White mangrove: Growth more ordinary, producing neither of the above "adventitious" growths.

While these are considerably mixed there is an ecological tendency for the red to be most seaward and the white on nearly dry ground with the black intermediate.

It is the first (or red) only which produces abortive seeds that look like young *Chaetodipterus*. The others produce very different flowers that do not have a hard resistant part.

There is now only one young spade fish left in an aquarium. The cause of death was traced down to their picking at one another. It was first thought that other fish were responsible, equally small *Archosargus probatocephalus* or *Chaetodon capistratus*, but complete isolation eliminated these. They were observed to circle one another in the surf as already noted, which was just thought to be some sort of aggregating tendency, but is apparently merely a jockeying to get in position to pick. The dead young were preserved. This habit is perhaps responsible for their thin distribution along an open shore.

49

50 [TEMPERATURE DATA AT THE END OF THE DIARY]

According to Bob in September fish an inch or two long begin to appear and these are simply miniature adults. We have seen slightly larger specimens in January. See collections for measurements. There are none but breeding adults and these small black ones at this season.

For purpose of future reference the following rates of expense at the station are listed below.

Board per day	$2.00
Bob Spearing and boat per day	7.00
(gasoline extra) about per day	1.00
R. R. fare from New York (incl. lower berth)	56.44
Round trip for one incl. tips food etc.	171.52

The R. R. fare is up considerably but the other costs are as before. This can be used for future figuring.

Developed some test negatives in the evening.

Tried out the night light at the end of the dock but just as it got arranged the moon came out bright and ruined the effect.

Turned in $10^{\underline{00}}$.

June 23 Turned out $8^{\underline{30}}$.

The final 2 larvae of egg 'P' expired during the night - preserved.

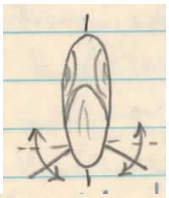
51 The mechanical features of the locomotion of the larval *Anchovia* indicate they are in an unstable equilibrium and considerably heavier than water. Their large air bladder is centrally located at the ventral profile. This and the fact that they clearly sink when not actively swimming could introduce a turning couple leading to their sinking in a back down position. This is countered by appropriate fin movements as near as can be seen in such small fish.

Usually when not actively feeding they are found inclined at an angle of about 20° from the horizontal. In this position they sink for about $^1/_2$ their own length and they swim forward and up regaining their former level when they allow the sinking to again take place. When actively feeding this is so interspersed with other active swimming movements as to be nearly lost.

The adults seem to be more nearly the specific gravity of water, but are evidently ever so slightly heavier. There is just the barest suggestion of the correction of sinking in their swimming.

In neither is there any evidence of a tendency to turn over but the pectoral fins are in constant motion, irregularly, as though beating down to correct an ever so slight roll. In death or near it both young and adults sink, back up.

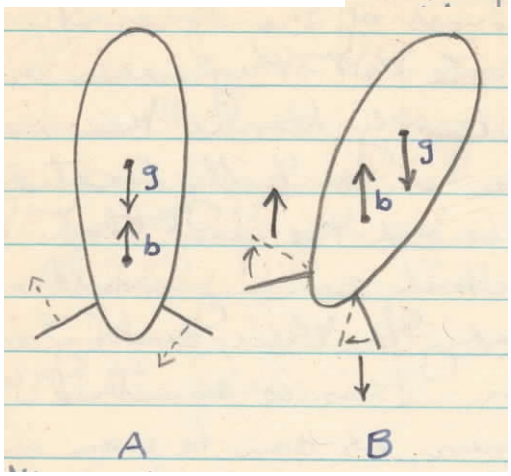
Motion of the pectorals in an adult anchovy apparently correcting a tendency to turn over. This would presumably work in accordance with the following diagram.



A. - A body like an *Anchovia* in unstable equilibrium. 52

g - Center of gravity

b - Center of buoyancy



The pectorals by nature of their position tend to check the rolling couple as they must be moved at right angles through the water as indicated by the dotted arrows.

B - When rolling once starts it is corrected by quick movements of the right and left pectoral in <u>opposite</u> directions, as indicated. The fins are then folded to the body and thrust out in the positions shown in 'A'. It will be noted that the position in 'A' makes them available for the correction of a right or left roll equally well.

Operational procedure is out of the question in these fishes because of their delicacy, but the slightest disturbance disorganizes them and they sink inverted. It must be borne in mind that these movements are very slight and difficult to detect. Simultaneously with this activity is an intermittent down beating of them in unison to lift the head for swimming diagonally upward. It may also be that these fish are ever so slightly head heavy as in the downward inverted sinking of a dead or weak specimen the head tends to lead, but this may merely be due to the stream line orientation. Unless placed in a vertical position beak down they do not ordinarily in short distances rotate to that position, however.

One of the young anchovies has a copepod attached to its dorsal fin. This seems 53
to not inconvenience it at all - and shows in some of the photographs.

The swimming of these fish is one of sinking by jerks (as discussed by Lockhead 1942). In the open sea they do considerable chasing about at considerable speed but may spend much time in the vicinity of piling "resting" quietly. This is well seen in aquaria, the fast swimming only being resorted to in the case of fright. In reference to what Lockhead states, quite properly, about the sinking of dead fish, these specimens in a state of rest certainly tend to approximate such a condition.

The young *Synodus* continues to develop and shows at this stage what is essentially adult behavior. It is apparently just as heavy as they are and the pattern is fully present and becoming heavier. The flesh is still somewhat translucent and can be seen through spaces in the pattern. It rises in vicious dives at passing plankton of larger size. Otherwise it sits propped up high on its ventral fins.

Mounted the 'P' larvae on slides.

Bob used the shrimp trawl on Patricia Shoals. They got.

3 *Rissola marginata*

5 *Neomaenus synagris* (small)

1 *Uranoscopus trigitatus*. (These have a pit below the eyes into which the eyes are retractile - somewhat like a *Periopthalmus*.)

1 very small *Lactophrys* 54

Several *Monacanthus* of various sizes and the usual assortment of miscellany.

One of the scorpionfish stuck me in the hand. Blood immediately gushed forth out of a ridiculously tiny puncture. The pain was intense and swelling prompt. Bob says that sometimes fishermen are laid up with such stings, and all are respectful of them.

Preserved most of the material.

Placed 1 small *Lactophrys*, 4 small *Monacanthus* and 1 *Chilomycterus* in the dark room at $1^{\underline{00}}$ p. m.

Went seining with Bob on Patricia Shoals in the P. M.

Got *Hyporhamphus* (none ready for stripping)

Chloroscombrus (several)

Opisthonema (several)

Sardinella (several)

Eucinostomus (several)

Preserved most of the collection.

Caught several young *Oligoplites* at the laboratory dock. They occur in "solitary" aggregates of a few individuals each. They tend to land head down or diagonally with a twist in their bodies. They are greenish brassy and look something like a floating leaf or bit of debris.

Placed in an aquarium they become silvery and looked very like some *Sardinella* of similar size. With these they made some irregular and desultory attempts at schooling, but for most part kept to themselves.

55 At $5^{\underline{00}}$ took a swim.

At $8^{\underline{30}}$ ($7^1/_2$ hours later) flashed a light on the aquarium in the dark room identical with the earlier experiment. See page 46 for details of that. There was no positive result. In addition to the fish in that experiment there were the following.

3 *Monacanthus hispidus* (up to 20 mm s. l.)

1 *Lactophrys tricornis* (8 mm s. l.)

These sizes clearly range down to those used at Tortugas. The aquarium was then returned to the lighted room. It is clear that these fish are aware of the light and display simple avoidance reactions only.

A single scorpion was taken in the laboratory to-night. This is the first seen since they disappeared several days ago. See page 46.

Turned in $11^{\underline{00}}$.

June 24 Turned out $8^{\underline{30}}$.

The finger stung with the scorpion fish is no longer painful - but still swollen - hard and stiff. This is the base of the index finger on the right hand. The small puncture is evident now. The joint at the base of the finger felt "rheumatic" during the active part of the inflammation.

The little anchovy that had a copepod attached to its dorsal is missing this morning. Died and decomposed?

55 Spent the morning taking photographs of young *Strongylura* and writing letters.

Bob went tarpon fishing - with no luck. He saw some - but no bites. He brought back a collection of misc. fishes for presentation.

Weather very heavy and "draggy" - rain has now been threatening for several days.

Bob seined for *Lactophrys* near Captiva Pass on the inside beach. Got a number among which was a large ripe female about 10" long. The rest smaller mixed male and female - 4 to 5" long. Succeeded in fertilizing the eggs with active sperm from some of these males. The testes were little grayish strings of not an inch in length that showed no evidence of "white fish milt". However there were many active sperms.

Spent the rest of the P. M. working near these eggs which are clearly egg 'P' of the outside tows. Although 'P' floated these sank on fertilization. The single oil globule is potent in orienting them animal pole down.

Made sketches of the various stages of development.

Made up bowls #14 and #15 of these positively identified eggs. See page 9.

Rained in the late P. M. which has been threatening for several days and then stopped.

Prepared apparatus to take photomicrographs of *Lactophrys* eggs. This should check with last year's note !

In reference to fish with an unstable equilibrium as diagrammed on page 52 it must be kept in mind that this is a continually varying factor. Every bit of food ingested, digestion in progress and excrement voided alters the delicate balance. In the case of tarpon the respiratory gulps influence it as can be seen by their movements. They too tend to sink and this seems to be a general normal condition in many of the physostomi. Any air bladder remaining open would have this effect. In the physostomi the changes should be similar but slower. Perhaps the unstable equilibrium requires an open duct. It would seem that the physostomi are more apt to be equal to their displacement of water. 57

From this it follows that not only do *Anolis* adjust for the immediate maintenance of equilibrium but must constantly change the nature of these adjustments to meet their momentary change of displacement or arrangement of varying weighted parts within their body such as the nature and location of food in their digestive tracts.

This has bearing on the work of Lockhead (1942) in that it further loosens up his concepts in an immediate down to home sense. Probably in fishes with a stable equilibrium this is not nearly so important and would become so only when it raised the center of gravity above the center of buoyancy, in which case they would be confronted with the same problems as the anchovies. Do they have their large swim bladder placed so low as to present any possibility of reaching a stable equilibrium? This work might be aided by some use of Edgerton's high speed movies. The whole problem of the significance of a static stability as opposed to a dynamic one should be examined from a physostomi standpoint. 58

In the evening took photomicrographs of the developing *Lactophrys* eggs. Most of the details concerning their development is contained in the pages of sketches. These eggs should hatch about $8^{\underline{00}}$ p. m. June 26. The photos. made at 9:15 p. m.

Took photographs of the small *Lactophrys* (it is *tricornis*) that was used in the orientation experiments (see page 55).

Stayed up late to get rate of development of the *Lactophrys* eggs. See notes on drawings. These now well overlap the tow net eggs.

Turned in $12^{\underline{00}}$.

June 25 Turned out $6^{\underline{00}}$. Examined the *Lactophrys* eggs immediately. In the early half-light they seem to have all died during the night. This is of small moment as they will overlap the tow-net eggs and the data now runs from the unfertilized egg to the advanced larvae as far as it has been possible to carry them in a bowl.

This year there was a curious confusion about the eggs. Actually most of the data on 'G' eggs refer to 'P' eggs which are *Lactophrys tricornis*. Those 'G' eggs which produced isospondyle larvae are still another thing which may or may not be tarpon. The original, alleged tarpon egg still stands unchallenged. 59

In reference to the survival of larvae in the bay in must be indicated that *Lactophrys* is apparently in this class or at least a harder-line case. Although they hatch in 2 days the larvae are large, vigorous and able to swim with directed effort by virtue of the immediately functional large pectoral fins. Actually these larvae

have turned up in the tow from time to time. Not a large number - say 1 in every other tow or thereabouts.

The second larval *Anchovia mitchilli* disappeared in the night. The *Synodus* is advancing rapidly. Any connection?

The swelling in the index finger due to a *Scorpaena* sting has gone down considerably and the finger is returned to usefulness. However it is still very sore to the touch in an area about $^1/_2$" in diameter around the wound.

Took plates of the young *Lactophrys* in a bowl. Dorsal view of that taken in aquaria last night. Took photos of the transformed *Synodus* larvae in a bowl. This is the second shot of the fish. The first was taken on June 21 (see page 43). It has advanced considerably since that time.

The large *Anchovia mitchilli* which was caught June 21 is still going strong and behaves like any ordinary "aquarium fish". It avoids the sides and other objects easily and in this regard differs from many other schooling fish. It is notable that
60 the larvae, although planktonic do likewise. That is they are planktonic at night and presumably hug the bottom in the daytime. In an aquarium these larvae show no disposition to seek shelter in the brighter hours, at all times disporting themselves in open water. The adults, while usually occurring in large dense schools, frequently are to be found in association with piling or other under water structures. One of the reasons they are sometimes caught in pound nets of large mass is that after wandering in as a body they will not approach the net, staying in a compact group, usually milling remote from each retaining wall.

Took a swim at $4^{\underline{30}}$.

Made tow #14 by tying the net off the end of the dock in an unusually strong tidal flow.

Bob made tow #15 in usual place at 6:30. Spent the evening working over this material.

Bob made tow #16 at $10^{\underline{00}}$ (after dark). Worked on this until near midnight. It contained a good number of so-called 'G' eggs.

Turned in $12^{\underline{00}}$.

June 26 Turned out $8^{\underline{30}}$. Continued work on last night's tow.

61 The little *Lactophrys* photographed yesterday found dead this a. m.

The large *Anchovia* which has been doing so well caught by a hermit crab. Probably this was a pure accident.

Made sketches of a number of the eggs.

Took photo-micrographs of eggs G_1, G_2, O, Q, P.

The egg passing for 'G' is clearly 2 kinds of very similar eggs, one slightly larger than the other - see notes on sketches.

Eggs 'K' hatched out over night in bowl #18.

Eggs 'O' hatching when transferred to bowl #19 - 12:15 noon.

Eggs 'Q' in bowl #20 - only 2 eggs. This actually is egg 'P'.

Spent most of the P. M. working over eggs.

Mounted some larval fish taken in tow #16.

Wrote letters.

Took a swim at $4^{\underline{30}}$.

A storm threatening.

Yesterday and today there were some extremely low tides leaving extensive flats exposed.

Most of the eggs hatched in bowl #17 hatched by $6^{\underline{00}}$.

Bob dug in the sand for Amphioxi at extreme low tide. They are far and few between. He got 2 only but they were large.

Thunder squall struck at 6:30 - plenty of rain. Just before it saw another land hermit - in a different shell.

In the evening at $9^{\underline{00}}$ sacrificed one larvae 'G' from bowl #17 and one 'P' from bowl #16 to chloratonize for micrography. After photographing both preserved for slide making.

The rain has ceased and the sand flies are bad. 62

Turned in $11^{\underline{30}}$.

June 27 Turned out $9^{\underline{00}}$. Weather clearing. Bob went outside to make a blue water tow.

He made tow #17 and #18 - see schedule - see map also.

Spent the A. M. working over the material.

Made up bowl #21 of G_1 & G_2 eggs. This is combined of tow #17 to 18 which in spite of being taken in blue and green water is of identical make up, differing in quantities only - more plankton being present in #17.

Made up bowl #22 (actually a 1 gal aquarium) of further egg G_1 & G_2 from rows #17 & #18. By $3^{\underline{00}}$ P. M. all these had hatched.

Cleaned up all the aquaria with fish for N. Y.

The complex of eggs and larvae is greater than first thought. Either many eggs of different species look much alike or there is considerable difference between the sizes of eggs of one species. This can best be established by work on the preserved material. Compare with data on eggs from Nassau and from Dry Tortugas. Some seem be the same. Also compare with data of Hildebrand et al.

Squall threatening from $3^{\underline{00}}$ on - Hit hard $4^{\underline{00}}$.

Made up bowl #23 of 'H' eggs - flounder.

Made up bowl #24 of 'I' eggs - elongate Anchovy eggs 1.1 x 0.6 mm (approximate) - only a few eggs.

[TOW NET CONTENTS DATA AT THE END OF THE DIARY] 63

In the evening took photos of fish from bowl #17 and #18. Those represent a 24 hours advance from last night's photos. Sacrificed these fish and preserved for slide making. Developed a few negatives for checking exposure etc. - O. K.

A porpoise passed the dock feeding at 9:45. 64

Turned in $12^{\underline{00}}$.

June 28 Turned out $8^{\underline{30}}$.

The laboratory toilet had become plugged with roots. Fixed it this morning.

'G' larvae in bowl #17 all died - discontinued.

Spent the morning working over the various bowls.

In the afternoon did some shrimp-net trawling in Pelican for specimens for the "Aquaria". Got a number of small sheepshead (about 1").

Also

Lactophrys trigonis 1 - $^1/_2$"

Blennius sp. small

Hippocampus zosterae small

Paraclinus marmoratus 2 (half grown)

and the usual other things, including a number of *Cynoscion nebulosus* - 2" - 6"

Later Ethel went to the outer beach (La Costa) with Bob and family.

Took a swim at $6^{\underline{00}}$.

Climbed the water tower at sundown and took some Kodachromes of the sunset.

A squall just before made a spectacular cloud effect.

In the evening took photomicrographs of Larvae 'P' from bowl #16 (same series as the last 2 nights) and Larvae 'H' from bowl #23.

Turned $12^{\underline{00}}$. Light intermittent rains.

65 June 29 Turned out $9^{\underline{00}}$. - Clear and hot. Several of the fish for N. Y. died during the night. Spent the morning fixing them for shipment.

Spent the a. m. working over the bowls of larvae. Mounted the specimens in balsam that had been photographed the last two days.

This material packed alive for N. Y.

Can #2		Can #5	
Sea anemones	17	*Epinephelus morio*	1
Sea urchins	8	*Mycteperca bonaci*	3
White starfish	2	*Prionodes phoebe*	2
Red starfish	12	*Archosargus probatocephalus*	5
Sea cucumber	1	*Chilomycterus schoepfi*	1
Can #4		Can #6	
Dactyloscopus tridigitatus	1	*Hippocampus punctulatus*	1
Achirus lineatus	3	*Hippocampus zosterae*	18
Red starfish	18	*Syngnathus* sp.	1
		Blue conch	2
		Red starfish	10

66 Preserved a series of young *Archosargus probatocephalus*. The stripes (vertical) on the smallest seem to be more numerous and regular than the larger. There is evidently some sort of transformation in these bands as the fish grow. Measure, compare and count these. This series should be adequate. Then compare with those in other collections; New Haven, and N. Y. It might be worth while to compare the youngest with *Abudefdus saxatalis* as at this size they bear an evidently similar appearance. Do many or all vertically banded fish (Cichlids for example) tend to approximate a similar number and disposition of such marks? This of course refers to deep bodied Acanthops only. As they go on in ontogeny and their specific specialization their primary simple marks then go on to the adult modifications. Since most small acanthops superficially tend to resemble each other more than the adults do may it not be that the two primary fish patterns (vertical bands and a longitudinal stripe) also tend to approximate a more primitive condition? Where do the two merge and why this 'right-angled' difference? Other more complicated markings all seem to be specializations of these "metaneral" bands or "fascial" stripes. Gregory's isomerism and anisomerism applied to pattern.

In the afternoon took an inventory of the equipment attached to the laboratory.

A squall broke at $4^{\underline{30}}$ and cooled things considerably.

Bob took the shipment of live stuff to meet the Boca Grande train at 5:40.

Today the remaining soreness from the sting of *Scorpaena* has nearly left - just the faintest twinge in the joint when it is pressed. There is no longer any evidence of the slightest swelling.

Continued intermittent light rains all evening.

Front bedroom			
Iron cots	2	Dark room	
		Brown bottles for developer, etc	8
Mattresses	2		
Pillows	2	Laboratory	
Table	1	China bowls	7
Light fixture	1	Enamel trays	1
Coat hangers	9	Enamel basin	1
Shades (window)	2	Enamel pail	1
		Galvanized pail	1
Toilet		Pencil sharpener	1
Towel racks	2	Boxes of various sized vials	
Mirror	1	(no corks)	8
		Cyanide bottle	1
Back bed room		Aquaria (various sizes)	9
Iron cots	2	Photomicrophic lamp	1
Mattresses	2	Light fixture (4 way)	1
Pillows	2	Extension lamp	1
Grass rug	1	Siphons (rubber)	4
Coat hangers	12	Small overboard light	1
		Aquaria dip nets	4
Store room		Large dip nets	3
Heligoland trawl	1	Window shades (west wall)	4
Shrimp trawl	1	Flit gun	1
Silk tow-net	2	Broom, (2 chairs)	1
Tarpon rod and reel	1	Assorted straight and bent	
Outboard motor	1	glass tubes	24
Ash cans (small)	3	Also a dozen or so various sized jars,	
Lantern	1	bottles, etc; steel wool, darris root, sand	
Oil heater	1	paper, etc.	
Iron tub	1		
Over-board light	1	18' skiff for use with outboard motor	1

At night took photomicrographs of larvae 'P' from bowl #16 and larvae 'H' from bowl #23. Preserved those photographed. 68

Mounted these on slides for future reference.

Turned in $11\frac{30}{}$.

June 30 Turned out $8\frac{30}{}$.

Worked over bowls. #18, 19 and 20 are dead. Discontinued.

Went to center of island and tarpon pool to take some movies. Extremely hot and mosquito ridden just now.

Another land-hermit crab appeared at the laboratory today. Like the two former ones it was moving west across the concrete verandah. This was definitely smaller than the other two. Is some kind of migration in progress? It may be that they are moving to higher ground from the low place where planted because of the excessive rains we have been having lately. Probably there is a better reason than this however.

Took a swim at 5:30 with a squall threatening.

Sorted the old specimens Bishop left in the lab and packed them for shipping.

The squall broke about $6^{\underline{30}}$ - a good rain. Each day for the last several we have had a squall about this time of day.

70 Bob got some Coquinas from the outer beach. We had broth for supper. These differ from last year in that the majority are white. They are not nearly as colorful in a pail. He noted that the smaller ones were more brilliant - presumably this year's crop. It makes one wonder about a possible "alteration of generations" in the certainly non-adaptive coloration of these mollusks.

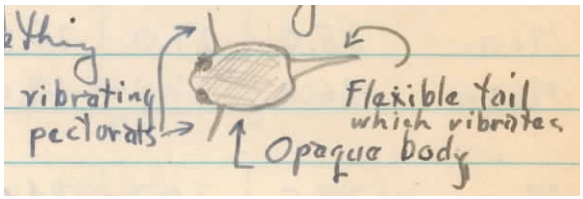
Bob made tow #19 just before sunset. Preserved larvae found in it.

Took photos of 'P' larvae out of bowl #16 and 'H' larvae out of bowl #23. Also a dorsal view of 'H' or some other form that looks superficially like it. Preserved the 'P' larvae but lost the other two in staining.

A steady rain set in about $9^{\underline{00}}$ - light but persistent.

The top (eggs) of tow #19 poured in a large developing tray without sorting. Dead plankton had fallen to bottom by this time (2 hours later). This should check the survival. Presumably only 'P' larvae should be found after a few days.

In bowl #16 one 'P' larvae is left. This seemed to be relatively advanced over the rest. What appears to be the formation of the test is appearing and the back part closes just where the pigment abruptly ended in the earlier larvae. Past this the tail sticks out (very like adult) and is flexible only from there on. Likewise the pectorals are flexible. In a week from here on the essential *Lactophrys* features are present and the fish is already beginning to closely resemble the small "pill" stage that is common in many places. A rough sketch of its dorsal view is something like this.



71

Bob made tow #20 at 9:45 in the rain. See schedule for data. The many fish larvae preserved. At the same time he worked the overboard light. With it he got a good series of Anchovia. Some kept alive in aquaria for study and some preserved. He also took a small *Trachinatus* (*falcatus*?), several small eels and a *Strongylura*.

Preserved nearly the entire tow in formalin except for the extracted fishes.

Turned in $12^{\underline{00}}$ - steady rain.

69 Identity of eggs in tow nets

The present understanding of the tow net eggs, collated with material of previous years and the notes based thereon follows. These are the letters as used in this year's notation.

A	Winter	1.2 mm. 1 small globule
B	"	0.8 mm. 1 large globule
C	"	1.5 x 0.8 mm
D	"	1.1 x 0.65 mm
E	"	0.9 mm. oil droplets
F	"	2.1 mm. segmented yolk
G	Summer	No "O" Tarpon? 1.70 mm. Photo in Bull.
H	"	0.75. oil droplet. *Heterosomata.* Photo in Bull.
I	"	1.1 x 0.6 mm. No "3" Same as D?
J	"	?
K	"	0.8 x 0.6 mm
L	"	0.85 yellow dots
M	"	?
N	"	0.9 mm

O	"	0.65 1 large globule
P	"	Cowfish
Q	"	= 'P'

Probably some of these letters represent more than one species. Comparison with the extensive preserved material should clarify the whole situation. Also with other eggs described in the literature.

July 1 Turned out $9^{\underline{00}}$ - clear. 71

Seined the tarpon out of the laboratory pool. Measured it, took scale samples, and returned it to the pool. It measured S. L. $14^{3}/_{4}$ T. L. $18^{1}/_{4}$. This is the fish the Dontzin measured in Dec. 1941. It is not fat, nor is it exactly poor.

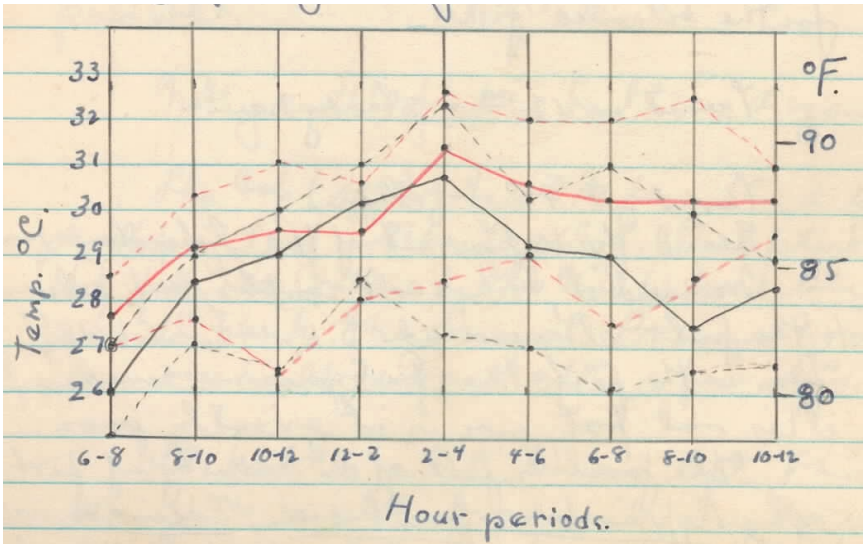
The pool is full of a variety of fish - young *Cyprinodon*, *Gambusia*, *Eucinostomus*, and a dozen or so *Mugil* of about a foot in length. Several of these taken and preserved. 72

Ethel calculated the mean temperatures of air and water for June as follows, by 2 hour periods.

Hours	6-8	8-10	10-12	12-2	2-4	4-6	6-8	8-10	10-12
Max	27.0	29.0	30.0	31.0	32.3	30.2	31.0	30.0	29.0
Min	25.0	27.0	26.5	28.5	27.2	27.0	26.0	26.6	26.7
Mean	26.0 $_{2}$	28.4- $_{16}$	29.0- $_{11}$	30.1+ $_{6}$	30.7+ $_{19}$	29.2+ $_{6}$	29.0+ $_{9}$	27.4+ $_{12}$	28.3+ $_{4}$
Water									
Max	28.5	30.3	31.0	30.5	32.6	32.0	32.0	32.5	31.0
Min	27.0	27.5	26.5	28.0	28.3	29.0	27.4	28.5	29.5
Mean	27.7+ $_{2}$	29.1+ $_{16}$	29.6+ $_{11}$	31.1- $_{6}$	30.7+ $_{18}$	30.3+ $_{5}$	30.3- $_{9}$	30.4- $_{12}$	30.4+ $_{4}$

This concerns the period of June 4 to June 30 inclusive. The small subscript numbers represent the number of readings. The periods of two hours include the higher stated figure.

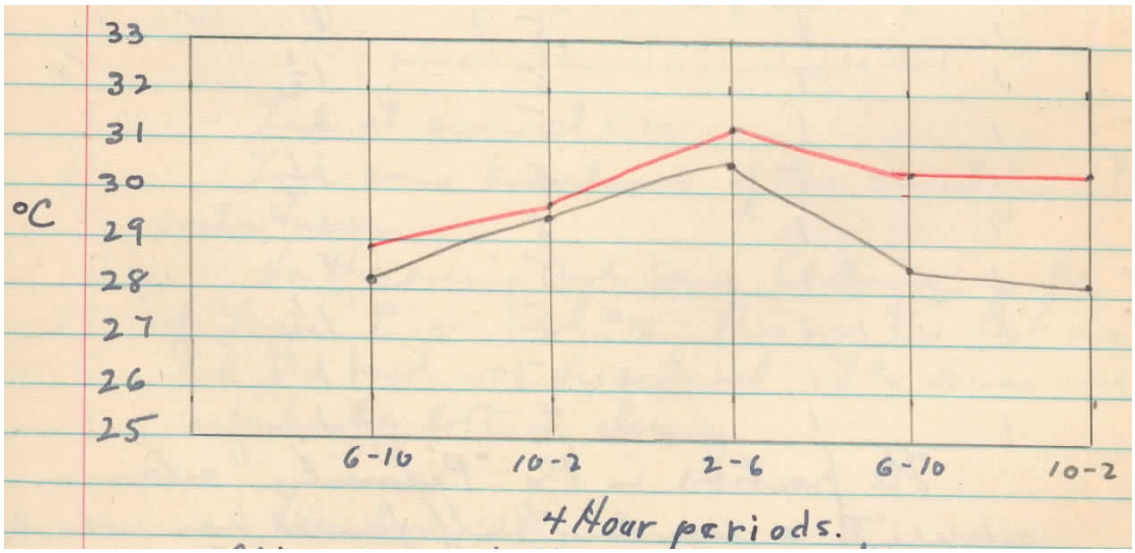
A graph of this follows.



73 It is evident from this data that the mean water temperatures are considerably in excess of the air and that direct solar radiation in this shallow bay had a considerable influence on the condition. Also that the trend of the water temps. follow those of the air with a not too great lag.

These figures in classes twice as great give the following values.

Hours	6-10	10-2	2-6	6-10	10-2
			Air		
Mean	28.1-	29.4-	30.4+	28.5+	28.3+
			Water		
Mean	28.9+	29.6-	31.1+	30.3+	30.4+



This gives a better picture of the water over air temperature. As in the first graph the red line represents water and the black air. Dotted lines are reversed for extremes (max. and min.).

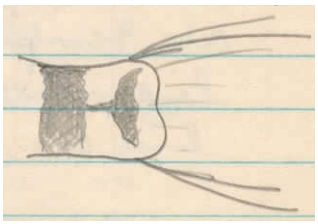
74 Spent the afternoon writing letters, correcting proof and mounting larval fish in balsam or microscope slides. Sent Bob off fishing for large tarpon. Saw some in the back of the island but was able to get none.

Noting the apparent differences in the bars on young *Archosargus probatocephalus* the following measurements were made as against the possibility of fading.

S. L. in mm.	Over eye	Predorsal	Subdorsal	Pendincular	[Total]
31.0	1	1	5	1	7
31.5	1	1	4	1	6
27.0	1	1	5	1	7
28.0	1	1	5	1	7
24.0	1	1	5	$1\frac{1}{2}$	$7\frac{1}{2}$
25.5	1	1	5	1	7
24.5	1	1	5	1	7
25.5	1	1	5	$1\frac{1}{2}$	$7\frac{1}{2}$
24.5	1	1	5	1	7
21.5	1	1	5	$1\frac{1}{4}$	$7\frac{1}{4}$

22.0	1	1	5	1	7
22.5	1	1	5	1	7
19.5	1	1	5	$1\frac{1}{4}$	$7\frac{1}{4}$
41.0	1	1	5	1	7
27.5	1	1	4	1	6

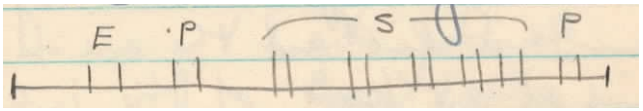
The fractions in the "Peducunlar" column represents a secondary half formed bar which in the first apparent somewhat like this.



Aside from this the only quantitative difference in these bars is shown by two fish with 4 subdorsal instead of 5. This is so striking as to make it look quite like a different fish.

In Breder's Field Book the same number of bars are shown (8) as seems to be typical. This was based in a Jordan & Evermann (1897) cur. If there is a change in the number of these bars with age the present limited material does not show it. 75

It should be worth figuring those striking differences which could lead to an erroneous interpretation. Since the 4 subdorsal condition is evidently scarce and more noticeable in the larger sizes it could easily lead to a supposition of change. Study the form of these bars with reference to the width of the black and their position on the body. A tables of a line marked off as follows should be useful:



Took a swim at 5:30.

Took some Kodachromes of the sunset from the water tower. 76

In the evening took some photomicrographs of larvae 'P' in bowl #16. This was the last one and the bowl was discontinued. The larvae was unfortunately lost in clearing.

Turned in $10^{\underline{30}}$.

July 2 Turned out $8^{\underline{30}}$.

Went to the back of the island, but the tide was a little too high to get on the beach for photographic work.

Examined the tray of plankton put up on June 30 (see page 70). There was a considerable amount dead on the bottom but much was still living - principally the abundant *Calanus*-like form. Not a fish or fish egg of any kind was to be found, confirming in another way the data on planktonic predation already found.

Took photographs of the Synodus in a bowl. Now no longer the least larval in character. A fully developed lizard-fish. Returned it to aquarium.

Sent Bob off Tarpon fishing in the P. M.

On the page opposite is a list of things used during the prosecution of this work. Omitted from this list and the one on page 67 are such things as are part of the island's own equipment such as chairs, hammers, soldering irons and monkey wrenches which among other things are called into play from time to time.

For future reference, in addition is given a list of the chief expenditures and other data pertinent to the cost of operation of this station, on page 81.

They got no tarpon, but did a 50 - 60 pound jewfish. Also a number of groupers. In catching bait they got a *Lactophrys* with a bad case of lymphosistis. Saved for Nigrelli. The lighter markings on the jewfish was decidedly yellow - whereas those

from Key West are usually whitish. Bob says the yellow coloration is normal hereabouts.

77

Inventory of equipment not left in laboratory

After 5 years of this laboratory the following items have been found of value and are regularly taken to and from it.

Binocular 'scope
Compound 'scope
4x5 view camera
Leica
16 mm marine camera
Photo flood lamps
Photo flash lamps
Weston light meter
Tripod
3 Flash lights
Extra batteries
Developer
Hypo
Photo-synchronizer
Changing bag
Developing trays
Traverse hood
Monocular (Luty model)
Shipping tanks (formalin)
Thermometers (several)
Micro slides plain
Micro slides hollow ground
Micro slide boxes
Alcohols, xylol and Alizarin
Hand magnifiers
Field book of fishes
Typewriter
Paper, envelopes, etc.
Notes from other years and scientific papers
Camera lucida
Haversack
Electrical extensions
Photo-flood reflectors
Rulers (several) slide rule
Triangles
Dividers
Dissecting kit
Slide micrometer
Ink, pens, etc.
Insect bottle
Tilting top for tripod
Flat base for camera
Notebook, pads, blotters, etc.
Colored pencils
Screw drivers, pliers, etc.

(With what is listed on page 67 as permanent equipment and expendable supplies, such as formaldehyde, vials, corks, mason jars, films, etc. all is covered except materials for special problems - such as oscillographs, etc.)

78 Watched the sunset from the water tower.

Larvae dead in bowl #23 - discontinued. No bowls running now.

The scorpion fish sting still gives an occasional twinge when pressed, although normally I am now quite unaware of it. Examine the spines of this species for hollowness and basal glands. It is known locally simply as "Red Robin".

Worked the overboard light at the end of the dock. Caught nothing of moment. *Hyporhamphus*, *Strongylura* and *Atherina* were about the only fish seen. *Felichthys* and *Lagodon* were about on the bottom and the usual invertebrates.

Turned in $11^{\underline{00}}$.

July 3 Turned out $7^{\underline{00}}$. A young black *Chaetodipterus* seen on the beach. Set up cameras for photography but was too slow. It slipped away while getting apparatus in shape.

While working on this matter found a *Gobius* sp. (the kind with the dark blotch) working under a clam shell. Took several pictures of it. A rain squall suspended this study.

This is *Bathygobius soporator*. After the squall which did not amount to much took further photos of the Goby. It is noted that the fish came out of its nest hole about every 3 minutes. When it left the nest cavity about half the length of its body it never backed in but then came all the way out and entered head first. When it left 80
less than that distance it would back in. It was seen to attack crabs some distance from its nest hole.

After these observations were made the nest was collected, which proved to be full of eggs in a fairly advanced condition - to the number of perhaps a thousand or more. They were attached Goby-fashion to the roof of the nest, which was formed of a clam shell. This had a heavy set of fairly large oysters on it. The floor of the nest was fine sand which had quite evidently been excavated by the parent. The shell literally crawled with the small flat crab common hereabouts. Evidently the presence of the fish is of real importance as these eggs would certainly form food for the crabs if unguarded.

The eggs themselves, remarkably elongate and with a knob on the distal end are the most unusually shaped fish egg that I have seen (Teleost).

Took photos of the nest intact and then unwound some eggs for microscopic study. Made sketches.

After lunch returned to the site and caught the attendant fish, evidently a male and two others not distant which were evidently females.

The location of this nest is west of the big dock about 30' from shore just about far enough to be kept covered at all times in the present period of neap tides. In 82
periods of low spring tides this place becomes exposed. The area is one of large clam shells in a pile over which there is a good growth of oysters. This pile if about 10' in diameter and represents household discards from chowder making. It is surrounded by white sand not well strewn with shells. The three fish taken are presumably the entire *Bathygobius* population of this shell "island". The species is not very common hereabouts.

The shell and eggs were placed in <u>their</u> normal position in an enamel hand basin. Some of the eggs were removed and placed in a glass bowl.

These eggs, presumably laid 3 to 4 days ago were just after the last spring tide exposing these flats. Do these fish adjust their spawning so that they lay at the last of a spring tide and thereby take advantage of the neaps?

Spent the P. M. working over these eggs. A rain squall in the late afternoon cooled things considerably. Note in temp. records the difference and relation between air and water temp.

In the evening made <u>photomicrographs</u> of the *Bathygobius* eggs. Those held in the bowl developed further than those more or less suffocating in a ground slide. Have photos of both.

Developed some test negatives and ran some of the eggs through the alcohol for mounting.

Turned in $12^{\underline{00}}$.

81

Breakdown of Costs of Station Operation

Building Laboratory	2500 00
Boat ($45 returned on resale)	355 00
Board (man days)	
Hire of man with boat @ $7 00 a day	
Misc hiring of fishermen and others	
Transportation North & South (times)	
Gasoline for boat and light plant	
Nets, fishing gear and misc equipment (outside)	
Bottles, aquaria, photo supplies etc (inside)	

	Man days in field	No of persons involved	Days open
1938			
1939			
1940			
1941			
1942			
Total			
Average			

Pro-rata Costs

Per year	$2,000 00
Per man day	
Per day open	
Per day operation (equipment excluded)	

July 4 Turned out $7^{\underline{30}}$. 83

The *Bathygobius* eggs developing faster than expected. Changed their water first.

Made sketches of the advancing embryos and mounted some in balsam.

Took photos of the adults in a bowl - the male (?) largest above and the 2 females (?) smaller together are showing a dark and the other a light phase.

As near as can be told these eggs are all in one stage and would seem to be the product of a single spawning. If so it is a large number. Preserved the three fish for internal examination.

Examination of more eggs, by removal from the clam shell shows that at least three stages of eggs are present - thus at least three spawnings. The eggs figured thus far are all of the most advanced stage found.

Spent the afternoon working over these eggs. (see notes)

It is oppressively hot and thundering in the distance. When the temp, taken at $5^{\underline{00}}$ was read 33° off the dock, the fringe of warmer water at the shore line was 39°C ! This approximates the temp. that the *Bathygobius* eggs could be in if left in place !

Took a swim at $5^{\underline{30}}$.

In the evening took one photomicrograph of the developing *Bathygobius* eggs.

A heavy squall broke about $10^{\underline{00}}$ which cooled things well.

July 5 Turned out $8^{\underline{30}}$. Cooler. Spent the morning working over the *Bathygobius* eggs, 84
which are advancing well. Took photomicrographs of them. The fit which they show in the egg capsule is remarkable. Actually the strange form of this capsule is such that it represents the simplified outline of a larval fish !

The shell pile on which this nest was found was completely dry today at $2^{\underline{00}}$ p. m. Yesterday's temperature and the lack of water would seem to make it impossible for survival.

Rain began falling at $2^{\underline{15}}$.

Bob found a very small young *Chaetodipterus*. Am holding it for sunshine so as to be able to photograph it in the surf.

Rain stopped about $4^{\underline{30}}$.

From then on intermittent heavy showers until after $8^{\underline{00}}$.

The larval *Bathygobius* not hatched yet. Little further change. Pigment increasing and yolk diminishing.

Took no microphotos in the evening as the changes in the eggs did not warrant it.

Turned in $11^{\underline{00}}$.

July 6 Turned out $8^{\underline{00}}$. The *Bathygobius* eggs developing well. The yolk small. Should hatch soon.

Took photomicrographs of them. 85

Turned the little black *Chaetodipterus* loose in the surf and took Kodachrome movies and stills as well as black and whites of it against its natural background, as normally seen when first found.

In the P. M. went to Boca Grande to arrange for a train back to N. Y.

Squally in the afternoon.

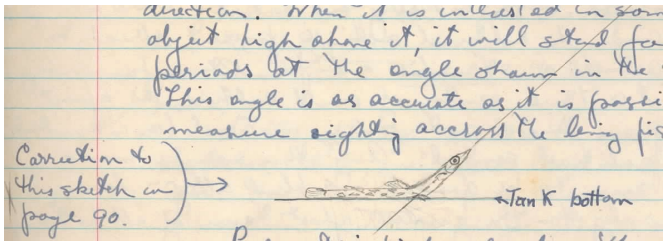
Changed the water in the little *Synodus* which is still going strong.

The *Bathygobius* eggs are still unhatched but developing well - see notes.

For the last several days the *Synodus* which stands on its tail and ventrals has shown an increasing ability to bend its back in a vertical direction. When it is interested in some food object high above it, it will stand for long periods at the

angle shown in the sketch below. This angle is as accurate as it is possible to measure sighting across the living fish.

86



Preserve this fish and redraw the above for publication based on the exact anatomy of the specimen. Clear or dissect some others to determine the nature of the joint or joints that make it possible for this to take place. Apparently the very young cannot do it to as in marked extent, they showing only a long smooth curve. Larger ones have not been noted to do it so well either. Examine some of the leptocephalid larvae also. It seems as though the serial centra developed a specialized condition at about the origin of the dorsal and this subsequently stiffened up as age advanced.

Below is <u>not</u> an ichthyological note.

It appears that if N. Y. is not to become a ghost town it could become the cultural center of America. With the change of control from the business-men to the politicians and the consequent shift to Washington (which has been growing by leaps and bounds) there seems little excuse for N. Y. city to retain its primacy. The N. J. meadow factories have been decentralizing for long. N. Y. could still be a port of no great importance and would shrink as the population shifted with industry and

87

control. There is enough cultural activity present already to act as a stimulus and foundation for making it a true center of world culture, as apart from civic enterprise, national (or international) political control. Any other course would seem to be doomed - a blind alley - leading only to the greatest ghost town of all history.

- - -

The above can be considered a great opportunity, a challenge, or a disaster.

- - -

In the evening worked on methods of getting *Bathygobius* eggs into xylol without destructive distortion. A drip method of adding xylol to absolute alcohol was finally employed. It appeared to be working at first but on the final reaching of pure xylol distorted as did those in simple transfer even although the amount of alcohol present most have been very slight. The impermeability of the membrane may have to do with this - reaching a certain threshold before breaking down.

The *Bathygobius* eggs began hatching in the evening - see notes. Took photomicrographs and made sketches of the larvae and hatching eggs. the larvae are remarkably sturdy and able to take care of themselves. This checks with the idea that breeding in the bay is confined to fish with advanced hatching.

Turned in $12^{\underline{00}}$.

July 7

Turned out $8^{\underline{30}}$. Spent the a. m. working over the *Bathygobius* larvae.

Seined some *Fundulus,* etc, at the lab beach.

In the afternoon went to the north end of La Costa Island, just inside Boca Grande Pass. There is an outcrop of beach rock which occurs more or less in ridges. This is a type of environment which I had not previously examined. It is for a considerable part covered with a brilliant red calcareous sponge and in spots there is some bright green calcareous algae. It is the "brightest" locality hereabouts

underwater. Fishes are numerous, and we made a good collection of *Sardinella* about 2" long.

Smaller ones just transforming were in immense schools in a *Zostera*-like growth which was interspersed. Made a collection - some held alive in aquaria. 88

Around a hulk were some of the most brightly colored young gray snappers I have ever seen. Questioned their identity at first. Here also a *Chaetodon capistratus* of about 5".

On the flat rock ridges were seen *Lutjanus griseus*, *Archosargus probato-cephalus, Mugil cephalus*, *Scianops ocellatus*, all large and in water waist deep. Many small *Doryctis* about (sub-adult *D. sabinus*?).

Came home by way of Pelican Pass.

Had a swim at 6:30 and got lightly stung by the 12' tentacles of some small Medusa with an umbrella of about 5". 89

A heavy squall hit at $8^{\underline{00}}$. Over $8^{\underline{15}}$. There have been the most unusual continued squalls - nearly every day - for a long time. See temp. records. Ordinarily at this time of year rain is almost absent at any one place. While squalls can generally be seen the complaint is that they "never" hit Palmetto Key. The vegetation reflects this apparent change in the storm "track".

Studied the behavior of the young *Sardinella*. The mechanics of their swimming efforts appear to be identical with that of the young *Anchovia* described on page 51 et sub. The present are in a stage ever so slightly advanced over the *Anchovia*. Compared the preserved material and made figures for reproduction. Have not yet had a chance to study feeding habits as they are now just about forming a "normal" school.

The *Bathygobius* larvae strong and vigorous. Made no sketches on photos tonight - changes not sufficient to warrant it.

Turned in $10^{\underline{30}}$.

July 8 Turned out $8^{\underline{30}}$.

The *Bathygobius* larvae progressing. Plan to take pictures of them tonight. Preserved the shell of the nest with adherent eggs.

Spent the morning mostly getting things together for packing. Sent Bob out to collect some "outside" spiders. He got a good serious near the hog pen.

Fed the larval *Sardinella* some plankton. They fed eagerly and identically with the young Anchovia. That is they assumed an 'S' shape and struck vigorously in the same manner. Some of these were even more advanced than the *Anchovia* but still continued the same kind of attack. As this tank is full of a number of stages the demonstration was most striking. The most advanced have already a silvery peritoneum showing through, are quite deep bodied, have a considerable amount of surface pigment and are beginning to lose their transparency.

These latter have apparently a better locomotion control, showing no hesitancy to roll over through about 45° to eye a bit of plankton above them.

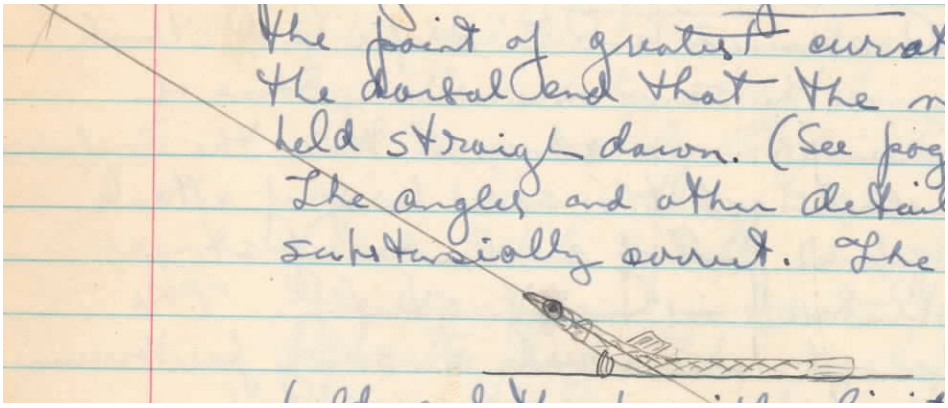
Incidental to this the larger size of 2", collected yesterday for Hildebrand were feeding at the surface when caught. These are in a true "adult" form. They were so numerous that their feeding strikes at the surface, which were decidedly trout-like, caused a continual audible "kissing" sound. 90

The break in behavior seems to come between these two stages, examples of each of which were preserved.

This eel-like striking stance is apparently common to the Clupeid isospondyles. It is absent in the Salmonids since they are tied to a large yolk until way past any such stage and start striking like trout. Have Krumholz look at white fish fry.

A better opportunity to examine the pose of the small *Synodes* showed that the point of greatest curvature is behind the dorsal and that the ventrals are held straight down. (see page 85)

The angles and other details are however substantially correct. The exact angle held and the possible limits can be determined from the preserved fish. It is, of course, determined by the position of the pectorals. The further back they are folded the lower the angle made. In making a sketch of these, these features should be kept in mind.



91 In the afternoon set up a feeding drip for the small *Sardinella* for photographic work tonight.

The sea water temperature - 33.7 at 3:15 the hottest yet noted !

Took a swim $5^{\underline{30}}$ - not long too hot !

Sent Bob for more plankton for feeding studies.

The small *Synodus* strikes with such speed that it is a mere streak - similar to a fresh-water darter but greatly faster. There is nothing in this bottom stage to suggest an apodal strike - but such would not be expected. If leptocephalids of this fish were available such would seem very likely.

In the evening took a photomicrograph of the developing *Bathygobius* larvae and made sketches and notes.

The set up for the young *Sardinella* was not successful. If no lights were on bright the school broke up although the fish could still be easily seen and did not feed. A bright light by an arrangement that was photographically possible always caused the school to form in some unsatisfactory manner although the first went on feeding. Plan to try it tomorrow in daylight,

Turned in $11^{\underline{00}}$.

July 9 Turned out $8^{\underline{30}}$.

Took 3 photos of the young *Sardinella* in the early morning. They schooled nicely as before - the last 3 4 x 5 negatives.

92 Took also 1 Kodachrome.

The small *Bathygobius* are progressing nicely - mounted one in balsam.

Spent most of the morning getting down to packing things for shipment.

In the afternoon went to the outside beach in La Costa. Had a swim and collected some coquinas. Learned that the war regulations deemed that all boats shall be at their dock between $^1/_2$ hour before and $^1/_2$ after sunset. All lights in buildings to be dimmed. This virtually stops night work in the laboratory.

It is perhaps just as well that the trip is about over, since the regulations are becoming onerous.

Gave the evening up to resting. Turned in $10^{\underline{30}}$.

July 10 Turned out $8^{\underline{00}}$.

The small *Bathygobius* still going strong.

Spent most of the morning packing.

Finished off the actual work of the trip.

Preserved the *Bathygobius* fry, the young *Synodus* and the young *Sardinella*.

Spent the rest of the day packing up things and cleaning the laboratory so that it may be left in order.

There are six pieces of expressage - 2 to Mohawk and 4 to the Museum.

A good job was made of cleaning things up and everything is shipshape. 93

In the late afternoon took the last swim.

Watched the sunset; and then rested.

Turned in $10^{\underline{30}}$.

July 11 Turned out $8^{\underline{30}}$.

Spent the A. M. in last minute clean up and checking of items, as due to the war it is very uncertain as to the possibility of a return - for a long time at least.

Left the island $1^{\underline{30}}$. Stopped at the fish house to say good-bye to Charles DeWitt and then on to Boca Grande.

Got the 5:40 for Tampa just as a squall was about to break.

Arrived at 9:15 at Tampa. Had dinner in town. Got the 11:55 (The Palmland) for N. Y.

July 12 En route to N. Y.

Worked on an index for these notes - see page 95.

Worked over correspondence to be attended to soon.

Wrote a preliminary draft of a paper on the failure of young plectognaths to disorganize at any place except the Dry Tortugas.

Turned in $10^{\underline{00}}$.

July 13 Turned out $7^{\underline{00}}$.

Arrived N. Y. City (Penn Station) at $8^{\underline{55}}$ a. m.

Took a short line bus to Mohawk 10:35.

Arrived Mohawk about $11^{\underline{30}}$. 94

Finis

Tow-net contents
[COMBINED PAGES 5, 25 AND 63]

Tow No.	Remarks on eggs and larvae
1	'G' - about 2 day placed in bowl #1, eggs and large larvae of 'H' - larvae placed in bowl #2. Elliptical eggs 'K', also 'L'? To be checked.
2	Contained very few eggs - none of 'G'. In order of abundance were found 'K', 'O' and 'H'. One larger larval 'K' placed in bowl #2 with that of Tow #1. These fish are just about to turn over - sometime swimming upright near the surface and sometime laying prone on the bottom. Also a larval seahorse.
3	'G' eggs more numerous than ever seen before. Also present 'K', 'I', 'H' and 'O'. Also some unrecognized forms which could not be staged to study. Preserved a sample of the entire tow. The difference between this and tow #2 is most marked. Perhaps 'G' is spawned in the early evening as these eggs were hatching. Or perhaps the difference is temp. 29°C of #2 and 28.5° of the present affects the flotation so that yesterday they were below the reach of the net?
4	'G', 'H', 'K' and 'I' present. Not numerous. 1 larval *Hippocampus* - added to bowl #2. Made up bowl #12 and #13 from these eggs.
5	Very few eggs present - those only 'O' & 'K'. Tow made after dark. Preserved a variety of post-larval fish present.
6	Eggs 'G', 'H', 'I', 'K' and 'O' present but not numerous. Very few small fish - preserved.
7	Eggs 'G', 'H', 'I', 'K' and 'O' present - 'G' numerous. Made up bowls #9 and 10 without pipetting each egg - just drawing off
8	Net torn - no catch.
9	'P' egg - very like 'G' but somewhat smaller. New hatched larvae of this and 'H'. Plankton thinner and of a slightly different complexion from the inside waters. Also egg 'O' and 'H'.
10	Plankton somewhat intermediate between #9 and those earlier - probably a mixture. Very few eggs 'O' only and what appears to be 1 larvae of 'P'.
11	Bottom tow. No eggs except 2 'H'. No young larvae. They do not sink.
12	Net set in tidal flow off end of dock for four hours in p. m. no eggs or larvae or post larvae. see page 32
13	A good series of most of the eggs taken at this season. Preserved a sample and made sketches of several types.
14	Very few eggs, one each of 'O', 'K' and 'Q'
15	Eggs tentatively identified as 'H', 'I', 'K', 'O', 'P', 'Q'. Not a great many of any one kind. Probably some of the letters represent more than one type.
16	'G' eggs present in early stage - see sketch - also a few 'O'. 'P' and 'H' 2 larval Anchovies - 1 present.

63 17 Many 'G' some 'I', 'H', 'O', 'K' and 'P'. Preserved a general sample for reference as this tow is full of eggs.

18 Many 'G', some 'I', 'H'. 'O', 'K' and 'P'. Preserved a general sample for reference as this tow is full of eggs of most of the kinds generally found.

19 The usual eggs plus a variety of fairly small larvae which were preserved. The eggs, without sorting poured in a large developing dish to check survival.

20 Same as #19 but with many more fish larvae - preserved. Several *Amphioxus* present. Preserved nearly entire tow except for the extracted fish in formalin.

Temperature - air in laboratory and water off dock
[COMBINED PAGES 7, 17, 49 AND 79]

Date	Hour	Air	Weather	Water	Tide	Remarks
June 4	1:15 p. m.	29.6	Clear	28.0	high	Light breeze
	3:15	30.0	-	-	-	
	5:00	29.2	-	-	-	
	9:00	27.3	-	28.5	1/3 down	A squall passed near 6:00
June 5	7:30 a. m.	25.0	clear	27.0	1/3 up	Little tide
	2:00 p. m.	30.4	-	30.0	1/2 up	Neap period
	5:40 p. m.	29.2	-	30.5	flood	
	8:45 p. m.	29.2	-	29.8	-	
June 6	9:30 a. m.	27.5	clear	28.0	falling	
	1:15 p. m.	30.9	-	30.0	falling	
	6:15 p. m.	29.8	-	31.0	falling	
June 7	11:00 a. m.	30.0	clear	29.4	-	
	2:45 p. m.	27.2	just before rain	30.6	-	
	6:00 p. m.	27.0	just after rain	29.0	-	
June 8	10:00 a. m.	27.0	drizzle	28.2	-	
	1:30 p. m.	28.5	"	28.0	-	
	8:00 p. m.	26.0	"	27.4	-	
June 9	10:30 a. m.	26.5	rain just stopped	26.5	high	
	3:00 p. m.	29.0	windy	28.3	-	
	8:00 p. m.	28.8	"	28.3	-	
June 10	9:00 a. m.	28.0	clearing	28.0	high	
	2:00 p. m.	31.0	clear	30.2	falling	
	8:00 p. m.	29.0	"	30.0	"	
June 11	9:45 a. m.	29.0	"	28.8	low	
	1:00 p. m.	30.5	"	30.5	high	
	8:15 p. m.	29.0	"	31.8	low	
June 12	10:30 a. m.	29.5	"	30.0	high	
	3:15 p. m.	31.3	"	31.7	falling	
	9:00 p. m.	28.7	"	31.0	low	
June 13	9:45 a. m.	28.0	clear	29.9	flood	
	3:30 p. m.	29.9	"	32.0	falling	
	8:45 p. m.	28.8	"	31.5	low	
June 14	10:45 a. m.	28.8	"	30.5	rising	
	4:30 p. m.	30.2	"	32.0	falling	A good breeze
	11:00 p. m.	29.0	"	30.8	low	"
June 15	10:15 a. m.	29.0	"	30.0	rising	dead calm
	3:00 p. m.	30.1	"	32.4	"	light breeze
	10:20 p. m.	29.0	"	30.6	falling	stiff breeze
June 16	10:45 a. m.	29.0	"	30.0	"	calm
	3:30 p. m.	32.0	"	32.6	"	squall threatening
June 17	10:00 a. m.	29.0	"	30.3	"	
	2:30 p. m.	31.8	"	31.5	rising	
	6:30 p. m.	31.0	"	32.0	falling	
	10:15 p. m.	28.8	"	31.0	low	
June 18	10:00 a. m.	29.0	"	30.0	falling	
	2:45 p. m.	32.3	"	32.3	high	
	8:15 p. m.	30.0	"	32.5	falling	

Date	Hour	Air	Weather	Water	Tide	Remarks
June 19	9:30 a. m.	29.0	Cloudy	30.2	"	A light rain just before sunrise
	11:30 a. m.	30.0	"	31.0	"	
	8:00 p. m.	30.0	"	31.5	rising	light intermittent drizzles
June 20	9:15 a. m.	28.0	clear	30.0	"	
	3:30 p. m.	32.0	partly cloudy	32.0	"	
	8:00 p. m.	28.2	stiff breeze	31.0	falling	squalls all around
June 21	10:45 a. m.	27.5	cloudy-rain	29.5	"	
	2:30 p. m.	28.8	cloudy	30.0	low	light breeze
	7:30 p. m.	29.0	clearing	30.5	rising	
June 22	9:30 a. m.	28.2	cloudy	29.0	falling	
	12:00 noon	29.8	clearing	30.0	"	
	5:45 p. m.	30.1	cloudy	31.0	rising	
	9:30 p. m.	29.0	partly cloudy	30.0	high	light breeze
June 23	10:30 a. m.	29.7	"	29.5	falling	"
	2:15 p. m.	31.9	"	31.0	low	"
	7:45 p. m.	29.5	'	30.7	rising	"
June 24	10:00 a. m.	29.2	"	29.5	high	
	2:30 p. m.	29.9	cloudy	30.4	falling	rain threatening
	8:15 p. m.	27.5	clearing	30.0	rising	rained a few hours again
June 25	6:30 a. m.	27.0	"	28.5	"	(before sun up)
	10:00 a. m.	28.9	clear	28.9	"	
	3:00 p. m.	30.7	"	30.8	falling	
June 26	10:00 a. m.	27.5	"	29.0	high	good cool breeze all night
	3:15 p. m.	30.9	"	32.3	falling	
	9:15 p. m.	28.0	cloudy	30.5	rising	rain this afternoon
June 27	10:00 a. m.	28.5	clear	29.5	"	
	2:30 p. m.	32.0	"	31.6	falling	
	9:30 p. m.	26.9	cloudy	29.5	low	rain this p. m.
June 28	10:00 a. m.	28.4	clear	28.8	high	
	4:00 p. m.	31.0	"	31.0	falling	
	9:45 p. m.	28.0	cloudy	29.8	rising	rain this p. m.
June 29	10:45 a. m.	29.0	clear	29.5	"	rain in the night
	3:00 p. m.	32.0	"	31.4	"	no wind
	9:30 p. m.	26.6	cloudy	29.5	falling	much wind and rain
June 30	10:00 a. m.	28.5	clear	29.0	rising	
	3:30 p. m.	31.0	"	30.5	high	light breeze
	5:30 p. m.	31.5	"	31.2	falling	
	11:00 p. m.	26.7	rising	29.5	"	
July 1	10:00 a. m.	28.5	clear	30.0	rising	
	4:45 p. m.	31.5	"	31.7	high	
	10:15 p. m.	28.0	cloudy	31.0	falling	
July 2	9:15 a. m.	28.0	"	29.7	"	
	1:00 p. m.	31.1	clear	31.0	rising	

Date	Hour	Air	Weather	Water	Tide	Remarks
						The figures in this section refer to the bowl temp. of *Bathygobius soporator*.
July 2	3:30 p. m.	32.0	"	32.0	high	
	9:30 p. m.	29.0	"	31.3	falling	
July 3	8:45 a. m.	29.0	"	30.5	"	
	2:45 p. m.	32.3	"	33.0	"	29.8
	8:15 p. m.	28.0	"	32.0	rising	27.8 rained a little while ago
	11:15 p. m.	27.5	"	31.0	"	28.0
July 4	9:30 a. m.	28.0	"	30.0	falling	26.7
	1:00 p. m.	32.0	"	30.7	rising	29.0
	5:00 p. m.	33.0	"	33.0	"	30.0 squall threatening
	9:45 p. m.	30.5	cloudy	32.5	"	30.0 squall threatening
July 5	10:45 a. m.	29.2	clear	30.2	falling	27.0
	2:15 p. m.	30.6	rain just starting	32.0	low	29.0
	4:30 p. m.	30.0	rain just stopped	32.0	rising	29.0
	9:00 p. m.	28.0	clearing	31.3	"	28.0
July 6	10:00 a. m.	29.5	clear	30.0	falling	26.5
	5:00 p. m.	31.0	squally	32.5	low	29.5
	11:00 p. m.	29.5	cloudy	31.0	rising	29.0
July 7	10:00 a. m.	29.0	clear	29.3	"	27.0
	1:30 p. m.	31.2	"	32.4	falling	28.3
	8:15 p. m.	30.0	squall just passed	31.8	rising	29.0
July 8	10:00 a. m.	29.0	clear	30.2	high	27.0
	3:15 p. m.	32.0	"	33.7 !	falling	28.0
	10:30 p. m.	28.2	cloudy	31.6	rising	26.5 squalls before this reading
July 9	10:45 a. m.	30.0	clear	31.0	high	28.0
	6:00 p. m.	32.5	"	33.0	rising	30.0
July 10	9:45 a. m.	29.0	"	30.5	"	27.5
	3:00 p. m.	32.0	"	33.5	falling	(discontinued)
July 11	9:30 a. m.	29.0	"	30.8	rising	
	1:00 p. m.	32.0	"	-	falling	

Records of eggs in bowls

Bowl No.		Date	Eggs	Tow	Remarks
1	glass	June 4	'G'	No 1	[end June 6] (Bowl with wet rag #3 on page 2)
2	"	"	Larval 'H'	"	[end June 15] Second bowl with wet rags
3	"	June 6	'G'	No 3	All bowls [end June 7]
4	"	"	'G'	"	in water pan [end June 7]
5	china	"	'G'	"	with rags [end June 11]
6	"	June 11	'G'	No 6	see page 14, 32, 33 [end June 17]
7	"	"	Mixed mostly 'O'	"	see page 14, 32, 33 [empty end June 16]
8	aquaria	June 6	'G'	No 3	Small 2 gal aquarium [end June 11]
9	china	June 13	'G'	No 7	[end June 14] see page 23
10	"	"	'G'	"	[end June 14] see page 23
11	glass	June 15	'P'	No 9	see page 29 [end June 23] see page 50
12	bottle overboard	June 8	'G'	No 4	see page 12 [empty end June 16]
13	aquaria	"	'G', 'H', 'K', 'I'	"	18" x $9^1/_2$" x 11" water 6 dup - filtered [end June 13]
14	glass	June 24	*Lactophrys*	Stripped from	see page 56
15	"	"	"	fish	see page 56
16	"	June 26	'P'	No 16	see page 61 [end July 1] see page 75
17	"	"	G_1 - G_2	"	see page 61 [end June 28] see page 64
18	china	"	K	"	see page 61 [end June 30]
19	"	"	O	"	see page 61 [end June 30]
20	"	"	'Q' = 'P'	"	see page 61 [end June 30]
21	"	June 27	G_1 - G_2	No 17	see page 62 & 63 [end June 30]
22	aquaria	"	G_1 - G_2	No 17 & 18	see page 62 & 63 [end June 29]
23	glass	"	H	"	see page 62 & 63 [end July 2] see page 78
24	"	"	I	"	see page 62 & 63 [end June 29]

Temperatures in bowls
[COMBINED PAGES 11 AND 21]

Bowl No.	Date	Hour	Temp.	Bowl No.	Date	Hour	Temp.	
1	June 4	5:00 p. m.	27.6	6, 7		"	27.4	
		9:00 p. m.	26.5	13		"	29.3	
	June 5	7:30 a. m.	24.0	2	June 13	9:45 a. m.	26.2	21
		2:00 p. m.	26.8	6, 7	"	"	26.0	
		8:45 p. m.	27.5	13	"	"	28.0	
		10:30 p. m.	27.0	2, 6, 7, 9,				
	June 6	9:30 a. m.	25.1	10	"	3:30 p. m.	28.0	
		1:15 p. m.	27.4	13	"	"	29.0	
2, 3, 4, 5		6:15 p. m.	27.0	2, 6, 7, 9,				
8		11:00 p. m.	26.5	10	"	8:45 p. m.	27.0	
2, 3, 4, 5	June 7	11:00 a. m.	27.0	2, 6, 7, 9,				
8		11:00 a. m.	26.0	10	June 14	10:45 a. m.	27.0	
2, 3, 4, 5		2:45 p. m.	28.4	2, 6, 7, 9,				
8		2:45 p. m.	27.3	10	"	4:30 p. m.	28.0	
2, 5, 8	June 8	10:00 a. m.	25.0	2, 6, 7, 9,				
2, 5, 13		1:30 p. m.	27.5	10	"	11:00 p. m.	26.7	
8		"	26.0	2, 6, 7	June 15	10:15 a.m.	26.4	
5		8:00 p. m.	25.8	2, 6, 7	"	3:00 p. m.	28.2	
8		"	25.3	6, 7, 11	"	10:20 p. m.	26.7	
13		"	26.8	6, 7, 11	June 16	10:45 a. m.	27.5	
2, 5, 8	June 9	10:30 a. m.	25.0	6, 7, 11	"	3:30 p. m.	28.0	
13		"	26.0	6, 11	June 17	10:00 a. m.	26.5	
2		3:00 p. m.	27.4	6, 11	"	2:30 p. m.	27.0	
5, 13		"	27.0	11	"	6:30 p. m.	27.5	
8		"	26.5	11	"	10:15 p. m.	27.0	
2, 5		8:00 p. m.	27.3	11	June 18	10:00 a. m.	26.5	
8		"	27.0	11	"	2:45 p. m.	28.0	
13		"	28.0	11	"	8:15 p. m.	28.0	
2, 5	June 10	9:30 a. m.	26.9	11	June 19	9:30 a. m.	27.0	
8		"	26.0	11	"	11:30 a. m.	27.6	
13		"	27.0	11	"	8:00 p. m.	28.1	
2	June 10	2:00 p. m.	29.0	11	June 20	9:15 a. m.	26.6	
5		"	28.0	11	"	3:30 p. m.	28.0	
8		"	27.6	11	"	8:00 p. m.	27.0	
13		"	28.5	11	June 21	10:45 a. m.	26.0	
2, 5		8:00 p. m.	28.0	11	"	2:30 p. m.	25.6	
8		"	27.3	11	"	7:30 p. m.	27.4	
13		"	29.0	11	June 22	9:30 a. m.	26.0	
2	June 11	9:45 a. m.	27.0	11	"	12:00 noon	26.1	
8		"	26.8	11	"	5:45 p. m.	27.5	
13		"	28.3	11	"	9:30 p. m.	27.5	
2		8:15 p. m.	28.0	14, 15	June 24	4:30 p. m.	27.7	
6, 7		"	27.2	14, 15		10:30 p. m.	27.0	
13		"	29.0	14, 15	June 25	6:30 a. m.	25.8	
2, 6, 7	June 12	10:30 a. m.	27.0	16, 17, 18,				
13		"	28.0	19, 20	June 26	3:15 p. m.	27.5	
2, 13		3:15 p. m.	29.0	16, 17, 18,				
6, 7		"	28.0	19, 20		9:15 p. m.	26.9	
2		9:00 p. m.	28.0					

Bowl No.	Date	Hour	Temp.	Bowl No.	Date	Hour	Temp.
16, 17, 18,				16, 23	July 1	10:00 a. m.	26.0
19, 20	June 27	10:00 a. m.	26.0	16, 23		4:45 p. m.	28.8
16 to 21		2:30 p. m.	27.5	23		10:15 p. m.	27.0
16 to 24		9:30 p. m.	25.3	23	July 1	9:15 a. m.	26.8
16 to 24	June 28	10:00 a. m.	26.0	23		1:00 p. m.	28.0
16, 17 to 24		4:00 p. m.	28.5	23		3:30 p. m.	28.1
16, 17 to 24		9:45 p. m.	26.8	*Bathygobius*	July 3	2:45 p. m.	29.8
16, 17 to 24	June 29	10:45 a. m.	26.5		hard rain		
16, 18-21, 23		3:00 p. m.	28.0			8:15 p. m.	27.8
16, 18-21, 23		9:30 p. m.	25.8			11:15 p. m.	28.0
16, 21, 23	June 30	10:00 a. m.	26.5		new water	added	
16, 21, 23		3:30 p. m.	28.0	*Bathygobius*	July 4	9:30 a. m.	26.7
16, 21, 23		5:30 p. m.	28.0				
16, 23		11:00 p. m.	26.0				