Bulletin; Gulf Biologic Station
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With the compliments of F. C. Glase

SECOND REPORT

OF THE

Gulf Biologic Station

1903.

BULLETIN No. 2,

ISSUED MAY, 1904.

ISSUED BY THE LOUISIANA STATE BOARD OF AGRICULTURE AND IMMIGRATION,

J. G. LEE, COMMISSIONER.

NEW ORLEANS.
AMERICAN PRINTING CO., LTD.
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GULF BIOLOGIC STATION.

CAMERON, LA., (Mouth of Calcasieu Pass).

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Gulf Biologic Station,
Cameron, La.

Office of the Director,
Baton Rouge, La., May 2, 1904.

His Excellency, Gov. W. W. Heard, President of the Board of Control of Gulf Biologic Station, Baton Rouge, La.:

Sir—I beg to submit the Second Report of the Gulf Biologic Station. This report embraces the results of investigations conducted at the Station Laboratory during the summer of 1903.

Very respectfully yours,

H. A. Morgan, Director.

GULF BIOLOGIC STATION,
Cameron, La.

OFFICE OF THE DIRECTOR,
BATON ROUGE, LA., May 2, 1904.

Letter of Transmittal.

Hon. J. G. Lee, Commissioner of Agriculture and Immigration, Baton Rouge, La.:

SIR—I herewith present to you the Second Report of the Gulf Biologic Station, and request that you publish it as Bulletin No. 2.

Very respectfully,

H. A. MORGAN, Director.

PREFATORY REMARKS.

The organization of the Gulf Biologic Station and the erection of the Laboratory were, of necessity, delayed on account of the limited appropriation made in 1900 and the difficulty in getting labor and building material to complete the work rapidly. The appropriation of 1902 and 1903 permitted the completion of the building and its equipment, and gave an opportunity to pursue investigations for which the Station was created.

In July, 1903, the Station was formally opened and the Laboratory dedicated by Governor W. W. Heard.

Throughout the summer months of 1903 the investigations embraced in this Report were made, and it is hoped that the future will provide ample opportunity for the completion of many of the studies begun with so much promise, and that the Station will add greatly to the scientific and economic development of the oyster and other interests of the coast of Louisiana.

The present Report is divided into two parts:

PART I. The Conditions for Oyster Culture at Calcasieu Pass, by O. C. Glaser, Johns Hopkins University, Baltimore, Md.

PART II. Preliminary Lists of the Fauna and Flora of the Gulf, with Notes.

(1) Marine Fauna of Cameron, by O. C. Glaser, Johns Hopkins University, Baltimore, Md.

(2) A Preliminary Contribution to the Protozoan Fauna of the Gulf Biologic Station, with Notes on Rare Species, by J. C. Smith, New Orleans, La.

(3) Report of the Flora in the Vicinity of the Gulf Biologic Station, by R. S. Cocks, New Orleans, La.

(4) A Contribution to the Entomology of the Region of the Gulf Biologic Station, by James S. Hine, University of Ohio, Columbus, O.

(5) Notes on the Free-Swimming Copepods of the Waters in the Vicinity of the Gulf Biologic Station, by E. Foster, New Orleans, La.

(6) Report on the Condition of Bird Life as Noted at the Gulf Biologic Station, by H. H. Kopman, New Orleans, La.

(7) Insects Injurious to Stock in the Vicinity of the Gulf Biologic Station, by James S. Hine, University of Ohio, Columbus, O.

(8) Some Economic Considerations with Reference to the Tabanidae, by James S. Hine, University of Ohio, Columbus, O.

The results of the investigations on the mosquitoes of the coast have been withheld in order to include them in an illustrated bulletin on "The Mosquitoes of Louisiana," to be published shortly by Dr. J. W. Dupree and myself.

Articles 7 and 8, by Prof. James S. Hine, are reprints from the Proceedings of the Economic Association of American Entomologists, issued by the Department of Agriculture, Bureau of Entomology, 1904.

For the summer of 1904 arrangements have been made with Dr. James L. Kellogg to continue the oyster investigations—with Dr. R. P. Cowles to assist Dr. Kellogg, and to continue investigations of the marine fauna and flora of the Gulf.

The National Department of Agriculture, through the Bureau of Entomology, has already requested Prof. Hine to continue the Tabanid (horsefly) investigations.

A number of other investigators have arranged to spend the summer at the Station, and to continue their studies, or pursue other lines of investigation.

PART I.

THE CONDITIONS FOR OYSTER CULTURE AT CALCASIEU PASS.

By O. C. Glaser.

INTRODUCTION.

The following report is based on observations and experiments made at the Gulf Biologic Station of Louisiana during the summer of 1903. It is a pleasure to acknowledge my indebtedness to Director H. A. Morgan for his kind and enthusiastic co-operation, and to Mr. Frank Roberts, Treasurer of the Station, for the liberal manner in which he met the expenditures connected with the work. I am also glad to acknowledge my obligations to Dr. Caswell Grave, Director of the United States Fish Commission Laboratory at Beaufort, for suggestions, and a knowledge of the methods used in the investigation of the problems connected with oyster culture.

Calcasieu Pass, in Southwestern Louisiana, has throughout its length of seven miles from Lake Calcasieu to the Gulf a great number of natural oyster beds composed of thin, highly elongated shells. These beds during the summer of 1903 were beginning to recover from the great freshet of the preceding spring, but the surviving adults were so scattered that many problems had to remain unsolved. To some extent the scarcity of full-grown oysters was overcome by the "jetty oysters" growing on one of the great stone jetties which project for a mile from the mouth of the river outward into the Gulf. The oysters growing there could be collected at very low tides in considerable numbers; and, being out of the main current of the river, were in very fair condition at a time when most of the oysters growing elsewhere in the neighborhood had succumbed. The oysters growing on the scattered reefs are of poor flavor, thin-shelled and very elongated as a result of overcrowding. In this respect they compare unfavorably with the "jetty oysters," which are well shapen, thick of shell, and have a very much better flavor. That two classes of oysters differing so markedly in important economic characters should grow within a few hundred yards of one another is a very instructive fact and shows how local some of the influences are which determine their market values.

PHYSICAL CONDITIONS.

CONDITIONS IN CALCASIEU PASS.

One of the physical factors of great importance from the point of view of the oyster grower is the character of the bottom. The bed of the Calcasieu River is composed of soft, black mud. Along the banks of the river at low tide this mud is a menace to horses and cattle, which not infrequently become helplessly bogged. During the period when my observations were made, the water in the river was never clear, and after heavy rains or heavy blows it was often dark brown with flocculent suspended matter. The mud is probably never washed about in sufficient quantities to suffocate many of the oysters which happen to be living in the pass, but its constant presence has a deleterious effect on their flavor. How serious a matter it is, may be gathered from the great deposits of silt and loam which are formed on both sides of the east jetty since this was built in 1897. In the intervening period of six years about a quarter of a mile of land, now covered with grass and shrubbery, has formed to the west of this jetty, and almost half a mile, still barren where it is washed by the Gulf during high tides and winds, has grown southward on the east side.

Though the character of the bottom is very good on the two sand bars near the mouth of the pass, and is capable of artificial hardening where it is at its worst, a similar control cannot be exercised in the case of the water over these places. During the summer the conditions of salinity are very favorable. With Calcasieu Lake and the Gulf to furnish fresh and salty water from the head and mouth of the pass respectively, an almost ideal condition obtains. Unfortunately this condition is subject to unfavorable fluctuations which may be expected to have serious consequences every spring when "high water" in the river is the rule.

During such times of high water the salinity in the pass falls, and last April it was zero in the river as well as in the Gulf near by. Freshets occur every spring, and in spite of the fact that the oyster is a brackish-water animal, endowed with a wonderful amount of adaptability to adverse circumstances, it is not able to withstand prolonged floods. The freshet of 1903 endured so long that the majority of the oysters in the pass were killed. Some of the deeper beds, however, have survived even this year's catastrophe to such an extent that they still yield about half a barrel of edible adults as the result of a hard day's tonging.

The damage done by the last high water is well illustrated by counts made at various places. In St. John's Bayou, near the head of the pass (see map) three living adults were found among two hundred hinged shells; one among one hundred hinged shells on reef No. 1; three among two hundred hinged shells on reef No. 2, and one among one hundred shells on reef No. 3. These figures will give an idea of the destruction caused by the freshet in certain places, but they should not be taken to indicate that the proportion of living oysters to dead ones is the same everywhere. In the case of St. John's Bayou, the count was made on those reefs in its mouth which are exposed at low tide. The counts for reefs 1, 2 and 3, however, were made at places which could be conveniently reached with a pair of 12-foot tongs and give an accurate estimate of conditions only at that depth. At greater depths the proportion of living to dead is in all likelihood greater. This is not only rendered probable by an experiment to be described later, but is shown by the fact that tongers found it profitable last summer to work beds in from 16 to 20 feet of water. The explanation why a greater proportion of oysters has survived at these depths than at lesser ones is found in the relation between the salinity of the water and its depth. Within certain limits salinity increases with depth. At Calcasieu Pass, differences of .0005 to .0007 were detected between the salinity at the surface and that at six feet below, when the two were taken simultaneously. The higher densities at greater depths might be taken advantage of by the culturist, but the areas available over which a degree of salinity permitting survival even during great floods obtains, are either inconveniently located or too small. Were it not for these fluctuations, nothing could be more admirable for oyster cultivation than the average salinity of the water as shown by the records taken in July, August and September. These measurements were made almost daily and on many occasions, a number of times daily, so that the averages in the following table are based on a large number of observations.*

*For a full record of densities taken at different places under various conditions of tide and wind, see Appendix A.

TABLE I.

Month.	Average Density in Calcasieu Pass. Number of Observations.	Average.
July..	31	1.0084
August	32	1.0074
September	17	1.0143
Average for Summer		1.0100

CONDITIONS ON THE WEST JETTY.

The physical conditions along the west jetty are different from those which have been just described for the pass, and the oysters which grow under these two sets of circumstances differ as much as these do themselves. Whereas, the oysters in the pass are long, narrow, thin-shelled, and of poor flavor, those growing on the jetty are isolated, well rounded and have a very good taste. These differences are due partly to the fact that the west jetty is out of the main channel of the river, which flows closely to the east jetty; that the water as a general rule is more salt, and never less so. than that in the river; and, finally, that these oysters instead of growing in densely crowded clusters are attached to the rocks singly, and have every opportunity for normal development.

As I shall try to show later on, something in the local conditions causing a "banking up" of the free swimming fry may account for the fact that the oysters in the pass are crowded together, and if the explanation which I shall offer tentatively is the true one, the ocurrence on the west jetty of better but fewer oysters than elsewhere, is due in part to the fact that a smaller number of spat settle there. But this is not the only reason. The water is always as good as the best in the pass, and usually better, both as regards salinity and food contents. This is certainly the reason why in spite of the great hardships which all the oysters in Calcasieu Pass were forced to undergo early in the season, the "jetty oysters" not only survived in greater proportion than the others, but actually were fat and of good flavor.

BIOLOGICAL CONDITIONS.

ENEMIES.

The two important biological conditions which were considered were the enemies and the food of the oysters in the pass. As regards enemies, the Calcasieu oysters are well off. Star fishes do not occur; the sheeps-head, although browsing among the jetty oysters, is not a serious menace; boring sponges are absent, and boring mussels and conchs are rare.

The only enemy which was found in abundance, especially in the jetty oysters, was the parasitic trematode, *Bucephalus cuculus.* This parasite, which has the form of a little worm with two long horns at one end, is microscopic in size, although the tubes in which it is formed can readily be seen with the naked eye. Bucephalus is apparently harmless to man, but Mr. D. H. Tennent who has been at work on its life history at Beaufort, N. C., finds that it is extremely destructive to oysters. He has also discovered the second host of the parasite, for Bucephalus like the liver fluke, passes different periods of its life in different animals. The smallness of the parasite, its habits, and distributon, make the suggestion of any remedial measures premature.*

FOOD.

The food conditions were very difficult to study, and no satisfactory results are deducible from the figures which have been obtained. There are two reasons for this failure; in the first place the natural economy of the pass and the Gulf was totally upset by the freshet, and those marine plants which serve as food for oysters were often unable to live and thrive in the water in which the oysters themselves barely held on to life; in the second place, the only locality where oysters could be gotten with comparative ease was on the west jetty where they were procurable at exceptionally low tides. These were not frequent enough to permit a regular examination of the oysters, and if they had been the results would have been vitiated by the fact that the examination would have been made always at the same stage of the tide.

In the stomach contents of the jetty oysters almost always four species of edible diatoms, *Pleurosigma spenceri, Eupodiscus radiatus, Navicula didyma,* and *Coscinodiscus perforatus,* were found.

*I am indebted to Mr. Tennent for kindly allowing me to refer to his as yet unpublished notes.

Of these the smallest, *Coscinodiscus perforatus* was by far the most abundant and on all the occasions but one when the water in the pass was examined, this species was found to be more numerous than the others. A notable exception to this was one afternoon in September when the surface of the Gulf was almost covered with a pure colony of *Eupodiscus radiatus.* This form was never seen in such quantities before or after; neither was one highly nutritious diatom, *Melosira punctata,* ever found in the stomachs of the oysters after a preliminary examination made in April. These facts show how fluctuating food conditions were.*

OBSERVATIONS ON THE NEW GROWTH.

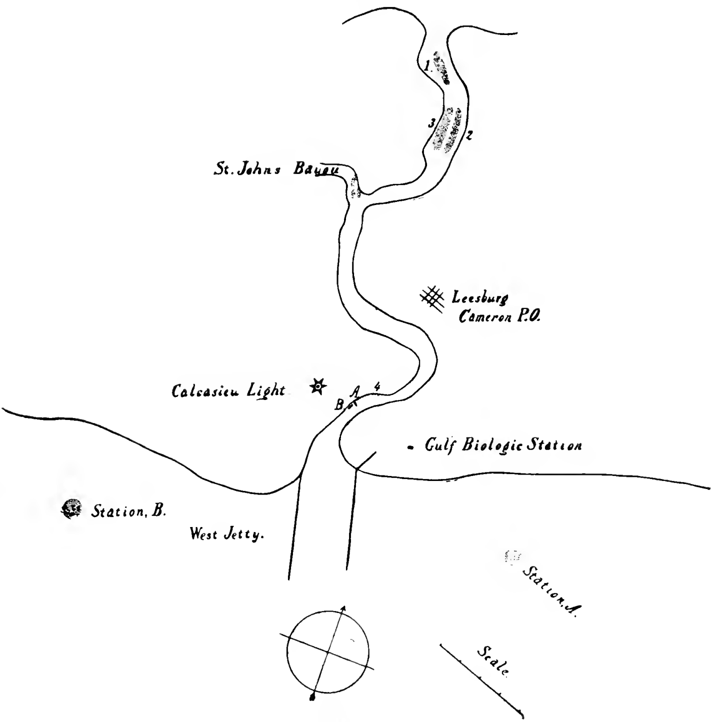
NUMBER OF SPAT CAUGHT.

In place of the adult oysters exterminated by the freshet a promising new growth has appeared which under favorable conditions will completely restock the old reefs. On July 9th in an examination of reef No. 1 (see map) near the head of the pass 22 young oysters were found on 100 shells. This number is what might have been expected from the location of the bed in the least salt water of the pass. On September 22nd when a second count was made on this reef a great increase in the number of spat was found. At this time there were 156 young oysters attached to 100 shells, 109 being on the inner surfaces, and 47 on the outer. Thus almost 70 per cent. of all the spat caught was attached to the inner and cleaner surfaces of the shells.

On reef No. 2 (see map) one of the first of the two so-called "Sister Reefs," there were on July 9th, 57 young oysters on 100 shells and on September 22nd 109, of which 77 were on the inner surfaces, and 32 on the outer. Here almost 71 per cent. or about the same proportion as on reef No. 1 had settled on the cleaner surfaces of the shells. The total number found on September 22nd on reef No. 2 was less than on reef No. 1 in spite of the fact that the former is further down the pass than the latter. The explanation of this may be that such counts as can be made give only an approximate idea of the general conditions of a reef, but the discrepancy nevertheless illustrates a point of great importance—the absolute necessity of taking local circumstances into consideration in oyster culture.

*A table of figures obtained from the examination of water and stomach contents may be found in Appendix B.

Westward, and separated from its sister reef by only a narrow channel, is reef No. 3 which had on July 9th 62 young oysters on 100 shells and on September 22nd 128, of which 90 were on the inner surfaces of the shells and 38 on the outer. Here again 70 per cent. of the young oysters had settled on the cleaner surfaces.



MAP

SHOWING LOCATION OF THE NATURAL REEFS EXAMINED, AND OF THE PLANTINGS MADE.

Two counts of the spat on the oyster reefs exposed at low tide in the mouth of St. John's Bayou, were made, one in July and another in September. In the former instance there were found on 100 shells 126 young oysters, of which 81 were attached to the inner, and 45 to the outer surfaces. Here only 64 per cent. were attached to the inner surfaces. This percentage was somewhat lower than in the case of the other reefs and may find its explanation in the fact that these shells were almost "mudded up," so that there was less than the normal difference between their inner and outer surfaces. The count made in September in the same locality showed on 100 shells only 120 living young oysters of which 61 per cent. were on the inner surfaces. Thus the total number of spat counted was smaller than earlier in the season. Even had it been equal to the former number, the second count would have shown, as compared with results from reefs 1, 2, and 3, which were clean compared with those in the mouth of St. John's Bayou, the deleterious effects of mud, the constant and overwhelming presence of which not only reduces the surface available for the attachment of new spat, but kills that which has been unfortunate enough to settle within range of its deadly influence.

Two observations on the number of spat caught on reef No. 4, the "Light-house reef," (see map) were made in August and September. In the former count 398 young oysters were found on 100 shells of which 300 or 75 per cent. were on the inner surfaces and 98 on the outer. The count in September showed only 349 young oysters on 100 shells, 249 of which were on the inner surfaces. This discrepancy between the two counts is due partly to the fact that a number of young oysters died during the intervening period, and partly also to the fact that one end of reef No. 4 runs almost up to high water mark whereas the other end extends outward into the deepest part of the river. Thus it is probable that the physical conditions between these two extremes may account for the fact that more oysters were found at the first count than at the second as the former was taken farther from shore than the latter.

RATE OF GROWTH.

The rate of growth of the young oysters was determined by comparing the lengths of a chosen number at two different times. For this purpose 20 young oysters still attached to shells were selected, carefully measured, and marked to facilitate recognition. The distance from the tip of the umbo of the upper valve to the middle of the anterior edge of that valve was taken arbitrarily as the length. On August 27th the oysters selected had the lengths given in Table II and on September 27th one month later the proportions given in Table III.

TABLES

II.	Aug. 27. Length cm.	Sept. 27. Length cm.	III.	Aug. 27. Length cm.	Sept. 27. Length cm.
1	1.7	2.3	11	2.4	3.2
2	2.1	3.3	12	2.4	3.2
3	3.5	3.5	13	1.6	2.0
4	3.3	4.1	14	4.5	4.7
5	.9	1.8	15	2.2	3.2
6	4.0	4.6	16	2.4	3.4
7	3.1	3.6	17	1.8	3.0
8	3.6	4.1	18	2.5	3.4
9	3.7	4.5	19	3.1	3.5
10	1.7	2.6	20	4.4	6.1

According to these observations the average increase in length in 30 days was .76 cm. If oysters grew at this rate in older stages they would reach a marketable size of 3.7 inches in a year, but as growth takes place more slowly with advancing age one year would be too short, though two years, with a favorable supply of food might well be long enough.* If this prove true Louisiana oysters under favorable conditions grow faster than those in northern waters, a fact which might be expected from the differences in the rate of growth exhibited by northern reefs. Thus Moore (Manual of Fish Culture, P. 275) states that "in South Carolina oysters not more than 6 or 7 months old were found to have reached a length of 2½ inches, and in the warm sounds of North Carolina they reach a length of 1½ inches in from 2 to 3 months. In the coves and creeks of Chesapeake Bay they attain about the same size by the end of the first season's active growth, and by the time they are two years old they measure from 2½ to 3¾ inches long and from 2 to 3 inches wide. On the south side of Long Island the growth of the planted oysters is much more rapid than in Connecticut, it being stated that "two-year plants" set out in spring are ready for use in the following fall, while upon the Connecticut shore it would require 2 or 3 years to make the same growth. On the south side of Long Island, oysters 1⅜ inches long in May have increased to 3 inches by November of the same year."

These observations on the new stock of the natural reefs give good grounds for the hope that in two years from the date of the

*These observations were suggested by the fact that a certain enthusiastic member of the State Oyster Commission had on exhibition a five inch oyster said to be one year old. While my measurements do not show that such phenomenal growth may not take place under exceptional conditions, they do show that 5 inches of growth during the first year is not general.

last freshet, provided another destructive one does not occur in the meantime, the reefs will be restocked sufficiently to make tonging as profitable as it ever was.

CONDITIONS UNDER WHICH A "SET" MAY BE SECURED.

In the language of oystermen a "set" is a collection of young oysters, or spat, attached in such quantities to the "cultch," or material used to catch them, (shells, gravel, fagots, etc.) as justifies the hope for a profitable yield even if the majority should die before reaching maturity. The value of a set varies with the local conditions which determine the chances of survival. Thus two young oysters on a shell would be a set if they were certain to survive, whereas 100 on a shell if they were doomed to an early death, would not constitute a set worth having. Under favorable conditions from 15 to 20 young oysters on a single shell is considered a set.

The conditions which determine whether a set shall be secured are not perfectly understood. It frequently happens that of two plantings of cultch made under what appears to be similar conditions, the one secures a set, and the other, even though it be only a short distance removed, may remain barren. Such occurrences are so frequent that intelligent oystermen usually withhold their opinions regarding the fitness of the locality until the desired set has been secured. Experience teaches that even then there is only a likelihood, not a certainty, that the same good fortune will repeat itself.

In spite of the many uncertainties connected with the problem of securing a set a few conditions are a *sine qua non,* and where these obtain are certain to favor the culturist. Among these conditions are the presence of spawning oysters somewhere near clean cultch, and the existence of currents to transport the free swimming young to it. After this has been done, and the young oysters have metamorphosed and settled down for life, while no longer dependent on the currents for transportation, these nevertheless still enter vitally into their lives. Being fastened to one spot, the oysters cannot prey upon their food, but this must be brought to them. The microscopic plants upon which they feed are washed about by the currents and are entrapped by the thousands of vibratile filaments on the gills of the oysters. Not only are the oysters thus dependent on the currents for their food but also for air, and for the removal of waste products.

The existence of currents fitted to perform all these functions is not within human control, but the presence of spawning oysters and suitable cultch, are controllable and such control is an imperative necessity wherever oyster beds are undergoing depletion at the hands of dredgers and tong men.

Only in localities where the oyster beds have been almost exterminated, or where such beds have never existed, is it necessary to introduce adult spawners. In every locality, however, where the number of oysters fished annually exceeds the number that find room for attachment, there is an urgent need for cultch. The most important attribute which such cultch should have is cleanness. The importance of this is shown by the fact that 70 per cent. of the new growth in Calcasieu Pass is attached to the inner surfaces of the old shells. A still clearer demonstration of the value of clean shells as spat collectors is given in the results of the following experiment:

EXPERIMENT I.

TO DETERMINE WHETHER A SET CAN BE SECURED IN CALCASIEU PASS

On July 28th, two plantings each of 15 bushels of clean shells were made in the lower end of Calcasieu Pass south of the Lighthouse Reef (see map). Planting A was made in a ridge perpendicular to the current; planting B. in a ridge parallel with the current. On September 1st, 100 shells were taken at random from each of these ridges and the living as well as the dead young oysters on both sides of the shells were counted. These counts are given in Tables III and IV.

TABLE III.

Spat Found on 100 Shells from Planting A.

Number of Shell.	Living Spat on Inner Surfaces.	Living Spat Outer Surfaces.	Dead Spat on inner Surfaces.	Dead Spat Outer Surfaces.
1	43	5	27	14
2	30	2	8	30
3	4	2	153	19
4	35	38	95	45
5	10	23	121	149
6	38	15	242	183
7	17	27	33	5
8	8	5	17	84
9	22	1	11	6
10	..	8	..	..
11	..	12	16	61
12	..	..	..	..
13	5	9	3	4
14	6	8	29	16
15	106	50	36	16
16	3	..	1	..
17	10	..	8	..
18	15	7	19	4
19	..	..	..	..
20	5	15	24	11
21	9	..	3	..
22	2	10	3	3
23	40	21	29	5
24	28	2	19	..
25	38	18	22	35
26	2	1	..	1
27	2	7	4	1
28	..	16	..	10
29	40	2	7	11
30	6	13	12	6
31	6	..	3	..
32	14	3	55	11
33	3	14	..	29
34	..	..	..	..
35	4	5	14	42
36	8	16	4	17
37	..	..	..	..
38	10	3	11	8
39	10	18	26	46
40	..	..	..	..

Number of Shell.	Living Spat on Inner Surfaces.	Living Spat Outer Surfaces.	Dead Spat on inner Surfaces.	Dead Spat Outer Surfaces.
41	28	..	12	..
42	..	..	..	..
43	5	24	50	15
44	7	5	3	3
45	3	6	..	3
46	15	..	4	..
47	4	19	41	18
48	6	..	63	..
49	2	..	1	..
50	2	9	3	..
51	17	5	54	3
52	11	3	10	1
53	1	..	..	..
54	31	5	13	7
55	14	16	202	49
56	34	2	76	8
57	14	17	91	13
58	8	..	1	2
59	..	..	..	..
60	..	..	..	..
61	..	3	..	5
62	..	..	..	...
63	6	5	10	21
64	17	20	30	11
65	15	7	49	12
66	63	2	94	..
67	10	..	14	..
68	55	6	44	9
69	..	..	1	..
70	..	15	4	6
71	5	20	10	4
72	..	..	..	..
73	..	..	9	4
74	15	8	32	28
75	14	9	45	3
76	9	5	21	20
77	5	6	2	3
78	11	1	3	27
79	4	23	11	27
80	3	6	4	7
81	13	14	51	32
82	7	..	..	..

Number of Shell.	Living Spat on Inner Surfaces.	Living Spat Outer Surfaces.	Dead Spat on inner Surfaces.	Dead Spat Outer Surfaces.
83	..	..	..	..
84	12	11	25	45
85	8	..	12	..
86	4	7	10	3
87	3	5	..	4
88	12	30	38	52
89	5	19	1	7
90	20	12	105	91
91	42	20	127	12
92	11	..	14	..
93	4	2	55	..
94	9	11	112	6
95	19	17	122	20
96	9	10	123	5
97	29	..	22	..
98	12	7	38	40
99	14	4	272	240
100	..	..	..	..
Total	1,256	792	4,929	1,740

TABLE IV.

Spat Found on 100 Shells from Planting B.

Number of Shell.	Living Spat on Inner Surfaces.	Living Spat Outer Surfaces.	Dead Spat on inner Surfaces.	Dead Spat Outer Surfaces.
1	52	5	31	4
2	60	4	5	..
3	32	3	6	3
4	39	4	35	54
5	28	25	43	2
6	33	9	9	1
7	26	12	10	3
8	30	43	..	..
9	10	1	11	20
10	9	13	13	4
11	9	6	7	11
12	27	4	..	..
13	17	1	59	10
14	18	24	45	16
15	25	4	38	3
16	..	.	3	6

Number of Shell.	Living Spat on Inner Surfaces.	Living Spat Outer Surfaces.	Dead Spat on inner Surfaces.	Dead Spat Outer Surfaces.
17	21	2	23	14
18	11	8	11	4
19	8	23	36	28
20	7	29	18	14
21	29	1	3	..
22	6	1	..	..
23	1	..	..	1
24	..	..	..	..
25	..	..	..	..
26	1	11	..	..
27	..	43	..	8
28	1	2	2	1
29	..	11	..	1
30	..	..	..	..
31	..	6	..	12
32	16	1	73	2
33	21	..	..	..
34	29	29	2	6
35	17	92	3	6
36	9	5	10	2
37	31	40	3	10
38	..	..	..	..
39	..	3	..	4
40	..	3	..	7
41	10	24	37	5
42	6	..	5	..
43	9	9	52	28
44	14	19	2	10
45	3	1	..	..
46	1	7	..	5
47	7	41	47	5
48	31	20	3	19
49	43	5	24	4
50	4	7	4	2
51	..	..	..	2
52	5	6	15	21
53	11	16	4	..
54	32	1	12	2
55	..	..	..	..
56	..	..	..	..
57	2	..	3	..
58	..	6	..	8
59	1	2	..	..
60	38	38	104	13

Number of Shell.	Living Spat on Inner Surfaces.	Outer Surfaces.	Dead Spat on inner Surfaces.	Outer Surfaces.
61	3	1	7	..
62	24	29	28	8
63	43	66	78	31
64	54	2	5	3
65	9	5	2	..
66	9	71	50	43
67	5	7	..	3
68	8	8	..	1
69	1	20	..	7
70	25	..	3	..
71	10	..	11	..
72	21	18	36	21
73	1	..	1	3
74	55	43	8	8
75	..	..	..	..
76	..	..	..	..
77	13	3	5	2
78	42	3	11	..
79	25	4	22	..
80	..	..	..	..
81	3	..	5	..
82	..	15	..	14
83	12	15	5	3
84	25	6	23	12
85	5	2	29	..
86	24	38	18	36
87	14	4	15	..
88	35	5	22	8
89	21	..	56	..
90	..	14	..	7
91	2	..	3	..
92	38	2	13	..
93	67	3	23	5
94	25	9	27	33
95	..	..	..	..
96	52	45	7	9
97	41	60	64	6
98	60	58	2	3
99	45	12	33	5
100	3	9	1	..
Total	1,660	1,227	1,424	652

Thus 6977 young oysters were caught on 100 shells of the ridge perpendicular to the current, and 4963 on 100 shells of the ridge parallel to the current.

DISCUSSION OF RESULTS.

The number of spat caught in this experiment is certainly very remarkable as it is usually considered that from 10 to 20 young oysters on a single shell is a set. In the present instance there was an average of 49 young oysters encrusted on each of 100 shells from the ridge parallel with the current, and 69 on each of 100 shells on the ridge perpendicular to the current. The result is all the more remarkable when it is considered that in the year during which it was secured the majority of the oysters in the Pass were killed by a freshet. As a matter of fact more spat were caught than could live, as the high death rate shows.

It is somewhat difficult to account for the size of the two sets, but there are a number of considerations which together make a plausible explanation. In the first place not all the oysters in the pass were killed by the freshet and those which survived though scattered singly here and there and especially in the deeper portions of the river, must in the aggregate have made up a considerable number. In the second place the nature of the currents in the river is most peculiar and may have had a very important influence on the result.

The work of currents, already emphasized in connection with the transportation of spawn and food, is very important in the process of spawning itself, as it insures the thorough mixing of the sexual elements discharged freely into the water by the adult oysters. In Calcasieu Pass as in the mouth of every river that opens into a tidal basin, complex currents due to wind, river, and tide, occur and it may appear almost commonplace to lay much emphasis on these three factors. However, in this locality, the wind, when sufficiently strong, controls the direction of flow even when opposed by the tidal and river currents. This circumstance, traceable to the physical geography of the region, gives rise to most anomalous irregularities, and as these seem to me to be important, not only as they affect fertilization and the transportation of spawn and food, but in another connection, as yet not emphasized by oyster culturists, I shall tabulate the various conditions which were observed.

FLOOD TIDE.

(*A.*) *Flood Tide with no Wind.*—In this case the tide has merely to overcome the descending river current. During the early part of the flood tide the tidal current on the bottom of the river goes up and the river current on the surface goes down. As the strength of the tidal current increases the river current grows weaker and weaker and is finally overcome and obliterated.

(*B.*) *Flood Tide with Southerly Wind.*—This combination results in a very high "tide." The salt water coming in from the Gulf creeps along the bottom of the pass while the downward current of the river is retarded, or even reversed by the wind. If the wind is sufficiently strong and continues long enough the "tide" may rise for a much longer time than is theoretically normal.

(*C.*) *Flood Tide with Northerly Wind.*—When this condition obtains the upper river current is very strong depending on the strength of the wind, and the actual rise of the tide is lessened. Indeed if the wind is very strong the tidal current may be unable to overcome the combined efforts of river and wind currents and the tide may fail to rise, or may even fall.

EBB TIDE.

(*A.*) *Ebb Tide without Wind.*—Under these circumstances a strong current, compounded of a receding tidal current and the river current, flows down the pass into the gulf.

(*B.*) *Ebb Tide with Northerly Wind.*—If at the time of ebb tide a strong northerly wind is blowing an irresistible current flows into the Gulf. Not only is it impossible to row against it, but on many occasions the headway of the water driven by tide, river, and wind, is so great, that the "tide" may fail to rise for several days.

(*C.*) *Ebb Tide with Southerly Wind.*—If the ebb tide meets with a head wind the current due to the receding tide and river currents strives for mastery over one driven in the opposite direction by the wind. Ordinarily the tide falls slightly but if the wind current is sufficiently strong this may overcome both the tidal and river currents, and the tide may rise when theoretically it ought to fall. Under the influence of strong southerly winds the tide may rise for a day.

What is known as the "tide" in Calcasieu Pass is therefore very complicated, and of the three factors which determine it, the wind often is the most important. This preeminence in determining the direction of the flow in the mouth of the Calcasieu river is due partly to the strength of the winds there prevailing, and partly to the physical geography of the region. Calcasieu Pass connects two large bodies of shallow water, Calcasieu Lake and the Gulf of Mexico. In Lake Calcasieu the average depth is 12 feet. The Gulf near the pass is also very shallow for about half a mile from shore and it is necessary to go out three miles to draw 27 feet. The hold of the wind on such shallow water is very great and the currents which it produces gain such momentum as they are forced through the narrow pass from one end to the other that they are able frequently to obliterate the combined effects of the river and tidal currents.

But the direction of the wind is unsteady, and though it prevails in different directions at different times of the year, during the present summer there were several shifts often on the same day. These changes of direction do not appear on the records of the Weather Bureau because the wind is recorded but once daily at six o'clock. But this makes no difference to the wind; its effects are not lessened, and may in determining the size of a set be very great. The frequent shifts and their ability to change the direction of the flow in the pass so that the "tide" rises when it is expected to fall, or falls when it is expected to rise, or rises for a brief time and then falls again, or vice versa, prevent the free swimming young oysters from escaping periodically into the Gulf. Indeed conditions often conspire to hold the free swimming larvae in the pass and at such times suitable cultch is certain to secure a set.*

Two other results of this experiment deserve mention. The value of clean shells as spat collectors is proven beyond doubt. This fact is by no means new but its importance is not always recognized in localities where oyster culture is not practiced. A comparison of the new growth of the natural reefs and the spat on the shells of the experimental ridges brings out in striking contrast the difference between old shells and clean cultch. The shells on the reefs caught per hundred on an average 183 spat, whereas those on the ridge parallel with the current caught per hundred over 4000 and those on the ridge perpendicular to the current over 6000. That cleanness is largely responsible for this set is further

*The possible importance of such bankings of the contents of the pass was not recognized until the results of this experiment were secured. In consequence no careful records were kept. Such "banking up," however, did occur a number of times between July 28th and September 1st.

emphasized by the distribution of the spat on the shells. Of the 4963 in the one case 3084 were on the inner surfaces, and of the 6977 in the other case 4445 were on the inner surfaces which because of their smoothness remained clean for a longer time than the rough outer surfaces.

Besides the cleanness of the cultch another factor contributed to the result—the shells were planted in ridges. The advantage of ridges is four fold; as the shells are strewn thicker most of them are higher off the bottom than they would have been if they had been planted broadcast and the young spat is less likely to be "mudded up;" in case large tracts are planted the open areas intervening between the ridges give an opportunity for the development of the food supply which is chiefly made up of plants living on the bottom; the ridges interrupt the currents and produce more irregularities and disturbances than an evenly strewn bottom would make; and they offer a better resistance to the currents which bring the young free swimming oysters, and thus are enabled to catch more spat. This last fact is well illustrated by a comparison of the results gotten from the ridge planted parallel with the current and the one planted perpendicular to it.

EXPERIMENT II.

TO DETERMINE WHETHER A SET CAN BE SECURED IN THE GULF.

Various rumors concerning the supposed existence of natural oyster reefs in the Gulf together with the certainty that at some historic time, the oysters now in Calcasieu Pass must have come from elsewhere, led to an experiment to determine whether at present any spat may be caught in the Gulf. In order to answer this question it was necessary to plant cultch at points likely to be outside of the range of the river which as observation had shown was full of free swimming fry. The number of shells available for experimental purposes was very small and only two plantings could be made.

One of these was made in 12 feet of water about 2 miles west of the west jetty and the other in 12 feet of water about one mile and a half east of the east jetty (see map). In choosing the localities particular care was taken that they might be well out of the range of the river currents produced by the southwest and southeast winds. During the summer these two winds prevail more than any others. The east planting Station A., was made east of a line running southwest and northeast past the mouth of the river. This line was assumed to be the outermost limit of the current produced by the effect of the southwest wind on the mouth of the river. As a matter of fact when a southwest wind was blowing a tide rift indicated the limits of the river current midway between Station A. and the east jetty.

The west planting, Station B., was made with reference to the same factors as Station A. Station B. was placed outside of the probable course of river water when driven by the southeast wind, and as in the case of Station A. a tide rift was usually seen slightly west of the west jetty when a southeast wind was blowing.

On August 29th 15 bushels of shells were planted broadcast at Station A. and a similar number at Station B. On September 23rd some of these shells were taken up and carefully examined. No trace of spat was found at either station.

DISCUSSION OF RESULTS.

The completely negative result obtained in experiment No. II is not without meaning and may in the future lead to more important results. At present it shows definitely only that Stations A. and B. were beyond the range of the currents of the river due to the southwest and southeast winds, and that there is little likelihood of obtaining a set outside of these ranges. In other words, there is no fry in the Gulf near the Calcasieu River except what comes from the river itself.

The chief bearing which the results at Stations A. and B. have are on a point which was not primarily considered when the plantings were made. Up to the present no experiments have been published which show how far from its point of origin the oyster fry travels before settling down. The question is obviously of great importance to planters who do not care to stock their beds with seed. Two views are held on the subject; one that the young oyster does not travel very far and that it is of great advantage in consequence to plant sexually mature oysters with the shells intended to catch spat; the other, that the young oyster in its free swimming state travels so far that the chance of its settling down near the place where its parents are is one in infinity.

The question is not an easy one to decide because the number of factors which govern the distance travelled by a young oyster larva is very great. The independent motion of the larva is one, but the currents and eddies into which it may come are many. It seems probable that these currents are of far greater importance than the independent motion of the larva. The question, therefore, how far from its parents an oyster larva travels before settling down finds its answer in the strength and direction of the currents which may carry it. Stations A. and B. were, the one a mile and a half, the other, two miles, from a great source of young free swimming oysters; however, no currents were present to transport the larvae and neither of the stations showed any signs of spat.* Thus it is probable that of its own exertions an oyster larva cannot travel the distance between the mouth of the jetties and the experimental stations in the Gulf. In planting, therefore, the question whether the prevailing currents are likely to bring free swimming fry to the planted area must be carefully considered. If there is no such source of free swimming young oysters artificial seeding must be resorted to although the introduction of spawners may be quite as effective if the currents are regular, and sweep alternately with equal force in opposite directions.

SUGGESTIONS.

The suggestions which my study of the conditions for oyster culture at Calcasieu Pass enable me to make may be divided into two classes—those offering immediate results, and those offering results which need not only a larger experimental basis but also capital and improved market facilities.

I.

The Condition and Yield of the Beds in the Pass May Be Improved by Dredging.

In an earlier part of this report I have emphasized the great differences between the ordinary elongated oysters in the pass and the well rounded oysters on the jetty. Part of the inferiority of the former is due to over-crowding which if relieved would give these oysters as good an opportunity for normal development as their more fortunate relatives have on the west jetty. It is a well known fact among dredgers, that natural reefs which are systematically dredged not only increase in size but also in the quality of their yield. The increase in the size of the beds is due to the fact that whenever the dredge runs over the margain of a reef a number

*This was not due to opposed currents making impossible the headway of the larvae, for had this been the case one or the other of the stations would have been reached by the fry.

of shells are dragged over and a few perhaps spilled out of the net. In this way the reef spreads and in the course of a few seasons may be very much larger than its original size. If dredging were carried on in Calcasieu Pass the reefs would become wider and longer than they are, and there is no reason why a continuous bed of oysters from the head to the mouth of the pass might not be brought about. If this were done the bed of the river would in a few years be solid and firm from one end to the other and the danger from mud would be considerably lessened.

As important as the increase in size is the increase in the value of the catch. Oysters taken from beds which are dredged every season, rarely suffer from overcrowding, as the dredges in their passage over the beds break up many of the clusters which they strike and liberate large numbers of oysters from the oppressive conditions under which they have theretofore grown. Experiments have shown conclusively that such oysters are able to regain a normal well rounded shape.

But the dredge is useful in yet another way. In Calcasieu Pass the question is not so much to increase the total number of oysters, as to increase the value of those which are there. Besides breaking up clusters of overcrowded shells the dredge kills a great many young oysters, and this is most desirable in a locality where spat may settle on clean cultch in such excessive quantities as happened in my experiments. By killing a large number of young oysters either by crushing them or by turning them under so that they are suffocated by the mud, the chances of the survivors to grow normally and to secure an abundance of food, are greatly increased.

If dredging accompanied by yearly additions of clean shells to the beds, were practiced, the value of the Calcasieu natural reefs would be greatly increased in a short time without great expense. The danger of freshets, of course, cannot be avoided, but the yield from the artificially improved beds would be so much better in good years than it is now, and no worse in poor ones, that the comparatively small investment would yield a large interest to the community.*

II.

The Possibility of an Oyster Industry.

The other suggestions which I have to make are not for the improvement of the natural beds already in existence but for the

*The great objection to this plan is the existence of a law against the use of a dredge. As the purpose of dredging in the present case is not to capture oysters but to cultivate them. A steam rake or a harrow would serve equally well.

establishment of true artificial ones for the rearing of seed and adults. I have placed these suggestions together in a second division because they cannot be carried out without further observations and experiments, nor unless markets are developed and capital invested.

While the observations made on the oysters in the Calcasieu River, and on the conditions of life to which they are subjected by uncontrollable factors, show that oyster culture in its widest sense would be a very uncertain and risky undertaking, they also show that Calcasieu Pass is most admirably suited for the capture of seed oysters. The fact that oysters grow in a given locality does not prove that this locality is a fit place in which to cultivate them, but since they do grow in Calcasieu Pass in spite of the many untoward conditions to which they are subject, there is no reason why they should not be taken advantage of to the utmost. This utmost advantage I conceive to be the collection and transportation to more favorable localities of the abundant offspring which are yearly produced by these oysters and yearly allowed to waste. As has been shown by the plantings made in the river during the past summer a most unusual amount of spat can be caught there; and has been shown in the preceding pages, there may be something in the natural conditions of the region which peculiarly fits it for the seed industry.

The chief problem at present is that of securing a market for the seed. If the artificial cultivation of oysters east of Calcasieu Pass is increasingly practiced year by year, such a market will be a natural development. Its development may perhaps be stimulated by immediate experimental proof that the purchase of Calcasieu seed and its transportation to suitable planting grounds is profitable.

However, it may be possible to create a market for Calcasieu seed near at hand by the establishment of deep water beds in the Gulf near the mouth of the river. Excepting the possibility of a shifting bottom, yet to be investigated, there is nothing in the Gulf so far as it has been studied, to make deep water beds impossible, and a number of things give good reasons for expecting success.

Deep water planting has been carried on with great success in the New England states and elsewhere, where the enterprise of private individuals has proven that natural oyster rocks may be established by artificial means at depths at which oysters do not normally occur in nature. These rocks are truly natural rocks, because after they are once started by the preparation of the bottom and the introduction of seed and adult oysters, they are left alone except for the removal of the crop and the addition of clean shells to catch spat.

The Gulf near the mouth of the Calcasieu River presents a great variety in its bottom. At places this is extremely soft and muddy, in others it is composed of sticky clay and in still others of a mixture of hard sand and mud. Some places are only covered by a few inches of mud under which is a hard substratum. Many such pieces of bottom in 40 or more feet of water are of this composition which together with other places not so composed might be utilized for the establishment of deep water beds.

Besides the presence of suitable bottom two other conditions of prime importance are fulfilled. The water in the Gulf near the mouth of the river is not sea water but "oyster water." In the pass during the summer months the maximum salinity is excellent for the growth of oysters. Unfortunately it fluctuates with every rain and in the spring at the time of high water the pass may become entirely fresh at all but its greatest depth. The Gulf on the other hand at the proper distance from shore and at the proper depth would always be of the proper salinity and there would be no need to fear a total loss of investment by freshets.

The other condition which is well fulfilled is the presence of abundant food. Means for studying the food conditions at 30 to 40 feet depth were not available, but if the condition of the water at other depths, and on the surface be a criterion, there is present an abundant supply of food. Among the diatoms which have been shown to have the greatest food value in other localities is *Eupodiscus radiatus,* and this form which is only one of a number of food forms occurring in the Gulf, is present in such abundance that at times almost pure colonies containing nothing else may be collected by means of the tow-net.

Another fact to be taken into consideration is the absence of star fish and the scarcity of conchs. These two enemies which in the localities where they occur often cause a great loss of wealth need not be reckoned with in the establishment of deep water beds near the mouth of the Calcasieu River.

Certain accessory conditions fulfilled in Calcasieu Pass and in St. John's Bayou, would be of the greatest service to deep water oyster growers. The pass in addition to being an excellent source of seed would together with certain places in St. John's Bayou be an excellent fattening ground on which the oysters could be allowed to remain for a brief period before being taken to the market. It has been found by the most successful culturists in Virginia, Maryland and elsewhere that it pays to handle the oysters a number of times before taking them to market, and that they may be treated and improved like any other crop. Thus it has been found profitable to prepare pieces of bottom for the reception of seed; to collect seed; to plant it, and to allow it to reach a saleable size. After this size has been attained, the oysters are ready for the market, but their volumes can be so increased by the bloating process which takes place in fresher water, that when shucked, the yield is almost or quite double. The experience of a well known firm at Hampton, Virginia, is a yield of 4 or 5 pints per bushel from oysters when taken directly from the rocks where they were planted as seed. The same oysters, however, when first carried to a fattening ground yield 8 pints to the bushel. By this means the yearly income of the house is increased from $20,000 to $30,000 more than it would be if the oysters were not transported, from the beds on which they grew to maturity, to the fattening grounds.

Though the natural conditions of Calcasieu Pass make it a good place in which to collect seed, and though the Gulf near the mouth of the river may turn out to be a good place for the establishment of deep water fisheries it must not be thought that the success achievable can be won without hard work and foresight. A great many facts and circumstances must be taken into account and only men who can afford to learn by experience should undertake anything on a large scale. It is possible to make 25 per cent. on invested capital by the rational cultivation of oysters, but to realize such gain, oyster farmers must work on business principles and get the utmost good out of every phase of their enterprise. This they can do best by remembering that the crop of an oyster farm is like a crop raised on land, for its value is in direct proportion to the care and intelligence with which the farm is chosen and operated.

Gulf Biologica Station,
March 29th, 1904.

APPENDIX A.

RECORD OF DENSITIES OBSERVED IN 1903.

Date.	Station.	Density.	Time.	Tide.	Wind.	Weather.	Water.
July 7	Wharf	1.0007	9:30 a. m.	Low	S. E.	....	Muddy
July 7	Sea buoy	1.0065	....	Flood	......	....	Fairly clear
July 10	Sea buoy	1.0041	11:00 a. m.	Ebb	......	....	Muddy
July 10	Wharf	1.0076	4:15 p. m.	Ebb	......	....	Muddy
July 12	Wharf	1.0030	9:00 a. m.	.....	S. W.	Fair	Fairly clear
July 12	Wharf	1.0130	12:00 m.	Ebb	S. W.	Fair	Fairly clear
July 12	Wharf	1.0081	4:15 p. m.	Ebb	S. W.	Fair	Fairly clear
July 12	Wharf	1.0081	4:45 p. m.	Ebb	S. W.	Fair	Fairly clear
July 12	Wharf	1.0090	6:00 p. m.	Ebb	S. W.	Fair	Fairly clear
July 12	Wharf	1.0076	6:30 p. m.	Ebb	S. W.	Fair	Fairly clear
July 12	Wharf	1.0070	7:00 p. m.	Ebb	S. W.	Fair	Fairly clear
July 13	Wharf	1.0065	9:45 a. m.	Ebb	S. E.	Rainy	Muddy
July 13	Wharf	1.0053	10:15 a. m.	Ebb	S. E.	Rainy	Muddy
July 13	Wharf	1.0066	10:45 a. m.	Ebb	S. E.	Rainy	Muddy
July 13	Wharf	1.0062	11:15 a. m.	Ebb	......	....	....
July 13	Wharf	1.0054	11:45 a. m.	Ebb	......	....	....
July 13	Wharf	1.0047	1:00 p. m.	.....	......	....	....
July 13	Wharf	1.0040	2:45 p. m.	.....	......	....	....
July 13	Wharf	1.0038	6:08 p. m.	.....	......	....	....
July 14	Wharf	1.0059	9:30 a. m.	Ebb	......	....	....
July 14	Sea buoy	1.0084	4:30 p. m.	.....	......	....	....
July 14	Wharf	1.0043	5:50 p. m.	.....	......	....	....
July 19	Wharf	1.0074	6:00 p. m.	Low	......	....	Fairly clear

Date.	Station.	Density.	Time.	Tide.	Wind.	Weather.	Water.
July 22	Station A	1.0152	10:00 a. m.	Ebb	N. E.	Fair	Fairly clear
July 22	Station B	1.0132	11:30 a. m.	Ebb	N. E.	Fair	Fairly clear
July 22	Head of Pass	1.0145	3:05 p. m.	Flood	......	Fair	Fairly clear
July 22	Jetty	1.0050	6:45 p. m.	Low	......	Fair	Muddy
July 23	Wharf	1.0156	10:00 a. m.	Flood	......	Fair	Fairly clear
July 25	Wharf	1.0160	7:00 p. m.	Ebb	......	....	....
July 26	Wharf	1.0160	12:00 m.	Flood	......	....	....
July 27	Jetty	1.0151	6:00 p. m.	Falling	S. E.	Stormy	Muddy
July 27	Wharf	1.0150	....	.....	......	Showers	Fairly clear
July 28	Wharf	1.0052	....	.....	......	Showers	Fairly clear
July 29	Wharf	1.0150	....	.....	......	Showers	Fairly clear
July 30	Wharf	1.0150	....	.....	......	Showers	Fairly clear
July 31	Wharf	1.0150	....	.....	......	Showers	Fairly clear
August 1	Wharf	1.0090	3:00 p. m.	Low	......	....	....
August 2	Wharf	1.0089	1:00 p. m.	High	......	....	....
August 3	Wharf	1.0090	....	High	......	....	....
August 4	Wharf	1.0070	4:30 p. m.	Low	......	....	....
August 5	Wharf	1.0022	7:00 a. m.	Ebb	N. W.	Clear	Muddy
August 6	Wharf	1.0092	7:00 a. m.	Slack low	......	Clear	Muddy
August 6	Wharf	1.0042	6:00 p. m.	Low	N. N. W.	Stormy	Muddy
August 7	Wharf	1.0028	8:00 a. m.	Low	N. W.	Clear	Muddy
August 7	Wharf	1.0029	10:00 a. m.	Ebb	N. W.	Clear	Muddy
August 7	Wharf, 6 ft. below surface	1.0034	10:00 a. m.	Ebb	N. W.	Clear	Muddy
August 8	Wharf	1.0029	8:00 a. m.	Ebb	S. W.	Clear	Muddy

Date.	Station.	Density.	Time.	Tide.	Wind.	Weather.	Water.
August 8	Wharf, 6 ft. below surface	1.0036	9:00 a. m.	Ebb	S. W.	Clear	Muddy
August 9	Wharf	1.0015	5:00 p. m.	Flood	S. W.	Clear	Muddy
August 12	Wharf	1.0058	12:00 m.	Ebb	S. W.	Clear	Muddy
August 13	Wharf	1.0059	4:00 p. m.	Slack	S. E.	Clear	Fairly clear
August 14	Wharf	1.0074	8:00 a. m.	Slack	......	....	....
August 15	Wharf	1.0139	9:00 a. m.	Slack	......	....	....
August 16	Wharf	1.0148	8:00 a. m.	Slack	......	....	....
August 17	Wharf	1.0159	4:00 p. m.	Flood	......	Squally	....
August 18	Wharf	1.0044	11:00 a. m.	Ebb	......	Squally	Fairly clear
August 19	Wharf	1.0130	6:00 p. m.	Ebb	N. W.	Squally	Fairly clear
August 20	Wharf	1.0100	4:00 p. m.	Ebb	N. E.	Clear	Muddy
August 22	Wharf	1.0142	4:00 p. m.	High	S. W.	Fair	....
August 23	Wharf	1.0140	3:00 p. m.	High	S. E.	Squally	....
August 24	Wharf	1.0136	2:30 p. m.	High	S. E.	Squally	....
August 25	Wharf	1.0118	4:30 p. m.	High	S. E.	Squally	....
August 27	Wharf	1.0010	6:00 p. m.	Flood	......	Fair	Muddy
August 28	Wharf	1.0020	8:00 a. m.	....	S. W.	Fair	Fairly clear
August 28	Wharf	1.0018	6:00 p. m.	Flood	S. W.	Fair	Fairly clear
August 29	Wharf	1.0019	5:00 p. m.	Ebb	S. W.	Fair	Fairly clear
August 29	Station B	1.0142	4:00 p. m.	Ebb	S. W.	Fair	Fairly clear
August 30	Wharf	1.0150	11:00 a. m.	Ebb	S. W.	Fair	Fairly clear
August 31	Wharf	1.0152	10:00 a. m.	Ebb	S. W.	Fair	Fairly clear
September 1	Wharf	1.0150	6:00 p. m.	Ebb	S. W.	Fair	Fairly clear
September 2	Wharf	1.0152	9:00 a. m.	Flood	S. W.	Fair	Fairly clear
September 3	Wharf	1.0160	12:00 m.	Flood	S. W.	Fair	Fairly clear

Date.	Station.	Density.	Time.	Tide.	Wind.	Weather.	Water.
September 4.....	Wharf	1.0164	5:00 p. m.	Ebb	S. W.	Fair	Fairly clear
September 5.....	Five miles off shore	1.0162	3:00 p. m.	Flood	....	Fair	Fairly clear
September 7.....	Wharf	1.0158	5:00 p. m.	Flood	....	Fair	Fairly clear
September 8.....	Wharf	1.0152	6:00 p. m.	Flood	....	Fair	Fairly clear
September 9.....	Wharf	1.0157	6:00 p. m.	Flood	....	Fair	Fairly clear
September 10....	Wharf	1.0142	....	....	....	Fair	Fairly clear
September 11....	Wharf	1.0157	....	....	....	Fair	Fairly clear
September 14....	Wharf	1.0009	6:00 p. m.	Ebb	Northerly	Fair	Fairly clear
September 15....	Wharf	1.0092	6:00 p. m.	Ebb	Northerly	Fair	Fairly clear
September 18....	Wharf	1.0167	4:00 p. m.	Ebb	N. E.	Fair	Fairly clear
September 19....	Wharf	1.0162	5:00 p m.	Ebb	N. E.	Fair	Fairly clear
September 20....	Wharf	1.0153	6:00 p. m.	Flood	N. E.	Fair	Fairly clear
September 21....	Wharf	1.0154	5:00 p. m.	Flood	N. E.	Fair	Fairly clear
September 22....	Wharf	1.0160	6:00 p. m.	Flood	N. E.	Fair	Fairly clear
September 24....	Wharf	1.0152	6:00 p. m.	Flood	S. W.	Fair	Fairly clear

APPENDIX B.

TABLE A.

EXAMINATIONS OF STOMACH CONTENTS.

Date.	Locality.	No. of Oysters Examined.	—No. Diatoms Found per Oyster.— Pleurosigma spenceri.	Eupodiscus radiatus.	Navicula didyma.	Cosmodiscus perforatus.
July 21	Jetty	2	93.75	375.00	93.75	30750.00
Aug. 4	Jetty	3	93.75	562.50	93.75	2531.25
Aug. 22	Jetty	3	0	0	0	8495.83
	Wharf	4	93.75	187.50	375.00	4218.75

TABLE B.

EXAMINATIONS OF WATER IN CALCASIEU PASS.

Date.	Locality.	Amount Examined.	—Edible Diatoms per Liter.— Pleurosigma spenceri.	Eupodiscus radiatus.	Navicula didyma.	Cosmodiscus perforatus.
July 9	Reef No. 1	500 cc	0	0	37500.00	112500.00
July 9	Reef No. 2	437 cc	0	0	56250.00	431250.00
July 9	Reef No. 3	464 cc	0	0	18750.00	393750.00
Aug. 12	Reef No. 4	1000 cc	0	0	0	37500.00

PART II.

AN INCOMPLETE LIST OF THE MARINE FAUNA OF CAMERON, LA.

BY O. C. GLASER.

The following is an incomplete list of the marine fauna found at Cameron, La.

POLYZOA.

Among the Polyzoa species of the following genera are abundant: *Bugula; Membranipora; Plumatella; Vesicularia.*

COELENTERATA.

Hydroida:—*Hydractinia echinata; Plumularia sp.?*

Hydromedusae:—A number of as yet undetermined Hydromedusae occur.

Siphonophora:—*Physalia arethusa.*

Scyphomedusae:—Among the Scyphomedusae, *Stomolophus meleagris* occurs in surprising abundance in all stages of development. At times the gulf and the river are so filled with this form that it is impossible to put one's hand in the water without touching half a dozen. Other forms which are less abundant are a species of *Chrysaora,* and the Cubomedusa, *Chiropsalmus quadrumanus,* which at times is very abundant in the gulf.

Actiniaria:—Among the actinians found were *Aiptasia pallida, Heliactis bellis,* and another species of *Heliactis* on the gulf weed.

Alcyonaria:—Alcyonarians are rare. Among the forms which were found were specimens of *Renilla renniformis,** and of *Leptogorgia virgulata.*

Ctenophora:—Apparently two species of *Mnemiopsis* occur.

ANNELIDA.

The only annelid which was found was *Nereis pelagica.* The tubes of another as yet undetermined form are very abundant.

MOLLUSCA.

Lamellibranchs:—In addition to the oyster several small species of clam-like forms are found. Among the better known genera and species are: *Arca transversa; modiola plicatula;* and a small

*This form was found between Cameron and Galveston.

Pholas. The large *Pholas costata* is very abundant on some of the hard mud flats of the gulf shore. It is styled a "clam" by the inhabitants of Cameron who use it as food.

Gastropods:—Several species of prosobranchs are common, among them *Urosalpinx cinerea*, and *Neverita duplicata. Purpura haemastoma* is extremely abundant on the west jetty where its capsules may be found by the thousands.

Cephalopods:—One species of squid as yet undetermined was found in considerable numbers. It is used as food by the fishermen.

CRUSTACEA.

Decapods:—Among the common decapods are: *Panopeus herbstii;* the southern edible crab; *Ocypoda arenaria; Gelasimus pugnax; Eupagurus longicarpus; E. pollicaris.*

Other Groups:—Among the other groups of Crustacea are: *Peneaus setifurus; Squilla empusa; Palaemon* sp.?; and *Alpheus heterochelis.* The cirripeds are represented by *Balanus eburneus; Lepas anatifera; Dichylaspis mülleri.* The isopods are represented by *Caligulus rapax; Cymothoidae* sp.?; *Ceratothoa linearis;* and some other parasitic forms.

VERTEBRATA.

Selachians:—The selachians are numerous in individuals but the number of species represented is not very large. Several species of ray including the southern sting-ray are very numerous. Among the other selachians are: *Dasyatis say,* the bonnet-nosed shark; the sharp-nosed shark—*Scoliodon terrae-novae;* the butterfly ray—*Pteroplatea maclura;* and the saw-fish—*Pristis pectinatus.*

Teleosts:—The more common teleosts are the following: The alligator gar, *Lepisasteus trisoechus;* the tarpon or Grande Ecaille, *Megalops atlanticus;* the swell toad, *Chilomycterus schoepfi;* the sea robin, *Prionotus tribulus;* the angel fish, *Chaetodipterus faber;* the sole, *Achiurus fasciatus; Gobiesox virgatulus;* and a species of menhaden. Among the edible forms are the rock fish; the channel cat,*Trachysurus felis;* the southern flounder, *Paralichthys lethostigma;* the croaker, *Micropogon undulatus;* the sheeps-head, *Archosargus probatocephalus;* the sea trout; the mullet, *Catostomus teres;* the common sucker; and the red fish,*Sciaena ocellata.*

Other Vertebrates:—Other vertebrates, living in or near the water, are: The porpoise which is extremely abundant; the alligator, *Alligator mississipiens;* and the diamond-back terrapin.

A PRELIMINARY CONTRIBUTION TO THE PROTOZOAN FAUNA OF THE GULF BIOLOGIC STATION WITH NOTES ON SOME RARE SPECIES.

J. C. SMITH.

(Read before the Louisiana Society of Naturalists, December 12, 1903).

The faunal lists of this paper were made in the laboratory of the Gulf Biologic Station during a week's stay in September, 1903, and from material gathered in the vicinity of the Station. The time at my disposal was so short that no effort was made to do any systematic collecting and, in consequence, there are no data to warrant any valuable or interesting conclusions; therefore, these lists may be considered merely as a contribution to the fauna of this region and a small addition to the already scant literature on marine forms of the Protozoa of this country.

Faunal lists are usually uninteresting to all save special students, but the want of such lists as relate to the Protozoa of this country was made very evident at the time when Schewiakoff ('93) compiled his work on the geographical distribution of the Protozoa (1893).

I find the more lists we have, that are carefully made, the more cosmopolitan the Protozoa are shown to be.

In these lists I have several forms recorded for the first time in this country and one recorded for the first time since its discovery. I have also incorporated a few notes in which are embodied some additions to, and corrections of the original descriptions of some apparently rare species.

Collections were made from three distinct points: From St. John's Bayou, the littoral zone of the Gulf, and surface plankton from the Gulf.

Strictly speaking, the Gulf in the neighborhood of the Station has no true littoral zone, as the sloping sand beach, which is washed continually by the waves, affords no foothold for any vegetal growth. The material collected here consisted of stray pieces of marine algae, comminuted vegetable tissues and membraneous tubes of worms (?) with the water in which they were found.

The plankton from several surface hauls, six or seven miles out in the Gulf, was secured with a modified Birge net made of No. 20 millers' silk. Besides the protozoa listed, a very large number of typically marine diatoms were taken in this plankton and are recorded in an appendix to this contribution.

St. John's Bayou is a fairly large body of brackish water which empties into Calcasieu Pass, a few miles from the Gulf. It has a natural oyster reef, the yield of which is very uncertain on account of the rapid changes in the salinity of its waters. This bayou was examined with special reference to the diatoms, which were found in fairly large numbers; the genera agreeing with those recorded from the plankton of the Gulf with the exception that *Bacillaria paradoxa* was present and in great abundance.

All material collected was examined alive on the same or next day. While this method is not as convenient as that of killing and examining at one's leisure, one is more certain of a positive identification.

Forms from the Beach (Littoral zone):

Amoeba proteus Leidy.
Gringa filiformis Frenzel.
Pamphagus hyalinus Ehr.
Actinophrys sol Ehr.
Actinosphaerium eichornii Ehr.
Oikomonas termo Ehr.
Bodo caudatus Stein.
Bodo globosa Stein.
Phyllomitus amylophagus Klebs.
Rhynchomonas nasuta Stokes, sp.
Tetramitus descissus Perty
Euglena acus Ehr.
Trachelomonas lagenella Stein.
Petalomonas abscissa Duj.
Cryptomonas ovata Ehr.
Peridinium cinctum Ehr.
Lacrymaria lagenula C. & L.
Prordon teres Ehr.
Prorodon edentatus C. & L.
Mesodinium acarus Stein.
Lionotus fasciola Ehr.
Loxophyllum setigerum Quenn.

Loxodes rostrum O. F. M.
Chilodon cucullulus Ehr.
Uronema marinum Duj.
Loxocephalus granulosus Kent.
Paramoecium caudatum Ehr.
Cyclidium glaucoma O. F. M.
Lembus velifer Cohn.
Tillina megastoma Smith.
Blepharostoma pigerrima Cohn sp. (=*Colpoda pigerrima* Cohn and*Cryptochilium fusiforme* Gourret & Roesser.)
Metopus sigmoides C. & L.
Condylostoma patens O. F. M.
Strombidium caudatum From.
Urostyla grandis Ehr.
Gonostomum pediculiforme Cohn sp.
Oxytricha pellionella O. F. M.
Stylonychia pustulata O. F. M.
Stylonychia mytilus O. F. M.
Euplotes harpa Stein.
Euplotes charon Ehr.
Aspidisca lynceus Ehr.
Aspidisca turrita C. & L.
Aspidisca costata Duj.
Uronychia transfuga O. F. M.
Diophrys appendiculatus Stein.

This list represents 46 species and 40 genera, and includes of the Rhizopoda 3, Heliozoa 2, Mastigophora 11 and Infusoria 30 species.

Forms from the Surface Plankton of the Gulf:
Discorbina sp.
Acanthochiasma sp.
Perdinium divergens Ehr.
Ceratium tripos Ehr.
Ceratium fusus Ehr.
Ceratium furca Ehr.
Tintinnopsis beroidea Stein.
Blepharostoma pigerrima Cohn sp.
Diophrys appendiculatus Stein.

This represents 9 species and 7 genera, consisting of Rhizopoda 2, Mastigophora 4 and Infusoria 3. Of the latter, the two last quoted are evidently littoral forms transported.

Forms from St. John's Bayou:
Amoeba proteus Leidy.
Dactylosphaerium radiosum Ehr.
Biomyxia vagans Leidy.
Nuclearia simplex Cienk.
Rhynchomonas nasuta Stokes sp.
Euglena acus Ehr.
Euglena viridis Ehr.
Euglena pisciformis Klebs.
Phacus triquetra Ehr.
Peranema tricophorum Ehr.
Scytomonas pusilla Stein.
Tracheloccrca phoenicopterus Cohn
Mesodinium acarus Stein.
Loxophyllum setigerum Quenn.
Urocentrum turbo Ehr.
Parmoecium caudatum Ehr.
Cyclidium glaucoma O. F. M.
Lembus velifer Cohn.
Pleuronema chrysalis Ehr.
Metopus sigmoides C. & L.
Strombidium caudatum From.
Vorticella alba From.
Urostyla grandis Ehr.
Gonostomum pediculiforme Cohn sp.
Holosticha flava Cohn.
Oxytricha pellionella O. F. M.
Oxytricha parallela Eng.
Stylonychia pustulata Ehr.
Euplotes harpa Stein.
Euplotes charon Ehr.
Aspidisca lynceus Ehr.
Uronychia transfuga O. F. M.

This list represents 32 species and 28 genera, and includes of the Rhizopoda 4, Mastigophora 7 and Infusoria 21 species.

A summary of the Beach and Bayou forms shows a total of 60 species, 28 of which were found on the beach only, while 14 were confined to the bayou. I have not the least doubt but that a careful and prolonged search will treble this number.

There was no quantitative analysis made of the forms found in the surface plankton of the Gulf, but a rough estimate places the two rhizopods as occasional, the flagellates very abundant and *Tintinnopsis beroidea* abundant, while the two last recorded ciliates were very scarce and probably foreign to the normal plankton.

So far as I have been able to consult the literature, the following forms appear to be recorded for the first time in this country: *Gringa filiformis*, (also the first time since its discovery in Argentina) *Euglena pisciformis, Phyllomitus amylophagus, Blepharostoma pigerrima* and *Gonostomum pediculiforme. Tillina megastoma* I have found abundant in the brackish waters of Lakes Pontchartrain and Borgne.

NOTES ON SOME FORMS RARE AND OTHERWISE.

GRINGA FILIFORMIS Frenzel ('97).

This is a rhizopod whose shape resembles that of a filiform pseudopod of a Euglypha, leading an independent existence. It is many times longer than wide and usually attenuated at one or both extremities. Its mode of progression is peculiar, and, I believe, limited to itself. This takes place backwards or forwards in a straight line, very slowly and without the emission of pseudopodia or any other disturbance of its shape, excepting an occasional spirillum-like twist of its whole body. While moving in this manner it bends its front extremity from side to side as if seeking food. When it changes its course, it does so by emitting from its apical extremity a pseudopod, which originates from a cleft in this extremity and then resembles the beginning of long fission. One segment of this cleft becomes a pseudopod, which inclines to one side and indicates its direction of movement, while the other segment remains intact and gradually slips down, so to say, until it reaches the posterior extremity, where it disappears. This whole process may also take place from the posterior extremity. I have never seen the animal take food. Its endoplasm is slightly granular throughout and contains three sub-central and quite distinct contractile vacuoles as well as a small round nucleus with a central nucleolus. This nucleus is placed in the anterior fourth of the body and with the contractile vacuoles show the same relative position as is usual with the lobosa. This form was taken in abundance from the beach and lived quite awhile in the moist chamber. The size varied from 30 to 50 microns in length and from 2 to 4 microns in width.

This description agrees very closely with that of Frenzel ('97), excepting in size and the presence of a nucleus, which he admits he was unable to find, notwithstanding the employment of the usual technic. I found no difficulty in supplying this deficiency, as the nucleus was made exceedingly distinct (1/8-in. obj.) after killing under the cover glass with 1 per cent. osmic acid and staining for two hours with picro-carmine. I have repeatedly found this rhizopod in widely separated localities of the littoral region of Lake Pontchartrain, the water of which is brackish. I have never taken it in fresh water, the habitat given it by Frenzel ('97).

BIOMYXIA VAGANS Leidy.

This rhizopod, the existence of which as a good species is doubted by many students, has come under my observation a number of times, and I have had good opportunity to give it critical study, which has resulted in convincing me that it is entitled to its place as a true species.

It has been reported a number of times from different parts of the world and is therefore cosmopolitan. I have often taken it in fresh water and also in the brackish waters of Lakes Pontchartrain and Borgne. Recently, I have found it in the Gulf. The description of it given originally by Leidy ('97) can only be amended so as to include the presence of very many small round and unconnected nuclei, which were first demonstrated by Gruber ('84) and has been repeatedly corroborated by me.

PHYLLOMITUS AMYLOPHAGUS Klebs.

According to the records, this asymmetrical flagellate seems to be quite uncommon and its habitat heretofore confined to fresh water as originally given by Klebs ('92). I have taken it repeatedly from Lake Pontchartrain (brackish water) and now record it from the Gulf.

Klebs' ('92) description is correct in every respect, and I have only to add that in virtue of this form lending itself readily to cultivation, I have been enabled to observe its mode of increase, which is by long fission, as is the rule among the flagellates (*Oxyrrhis marina* and some of the Craspemonadina being the only exceptions). This fission may originate at the anterior extremity, as it usually does, at the posterior extremity or simultaneously at both extremities. This is a unique departure from the customary mode of fission, and I believe has no other representative, excepting *Scytomonas pusilla*, in which the fission may originate at either extremity.

It is a voracious feeder. I have repeatedly seen a form with a fungal filament, which it had incepted, protruding from both extremities so as to make it appear as if it had been impaled on a spit.

LOXODES ROSTRUM O. F. M.

My interest in this form was first awakened some years ago by the diverse descriptions of its nuclear elements. This diversity ranges from a single macro-nucleus, with its attached micro-nucleus, to a multiplicity of the same.

Wrzesniowski ('61) and Kent ('82) describe and figure it as a string of macro-nuclei with the micro-nuclei attached either to the macro-nuclei or to the funiculi.

Calkins ('01) figures this same string of nuclei as one of the types of the Ciliata.

Stein ('78), Claparède and Lachman ('60), Delage and Hérourd ('96) and Roux ('01) describe many disturbed macro-nuclei, each with its attached micro-nucleus.

Bütschli ('87) says there are from one to many unconnected nuclei, according to the size of the animal.

Stokes ('88) *(L. vorax)* and Engelmann ('62) *(Drepanosoma striatum)* figure and describe *Loxodes rostrum* as having two nuclei, subcentrally placed. Schewiakoff ('93) found it in the Sandwich Islands with but a single oval nucleus, centrally placed.

Since 1900, I have had hundreds of these forms from widely separated localities in Louisiana, with fresh and brackish water habitat, and recently from the Gulf; all varying in size, from the small colorless to the very large (625 microns) brown or golden-colored ones. I have killed and stained hundreds of them with the invariable result of demonstrating but two macro-nuclei, each with an attached micro-nucleus. They were unconnected (shown by isolation) and sub-central, one in each half of the animal. The structure of the nuclei corresponded with the descriptions and figures given by different authors—that is, they were round and contained what resembled a nucleolus, thus imitating the typical nucleus of a rhizopod.

It is worthy of remark that, while it is usually difficult to differentiate the micro-nuclei with picro-carmine, in these cases they stained almost as brilliantly as the macro-nuclei.

The conclusion then to be drawn from these facts is, that *Loxodes rostrum* may have one, two or many unconnected nuclei, or a series connected by funiculi, thus giving us four distinct types of nuclei for a ciliate whose body form is constant.

LEMBUS VELIFER Cohn.

In 1898 I described *Lembus ornatus* ('98) as a new species. Since then I have had this form quite frequently under observation, taken from the original locality (Lake Pontchartrain) and recently from the Gulf.

As a result of these further observations I have this to add to my original description: It has two vibratile membranes—one on each side of the oral furrow, the left one being striated and the larger. When food is abundant, as in decaying infusions, the animal reaches its greatest size and the annulations tend to disappear; in many cases becoming entirely obliterated.

Not infrequently, forms are met with containing two central nuclei, presumably the beginning of fission. When well fed a number of clear vacuoles often appear in the posterior half and usually obscure the contractile vacuole.

A careful examination of the descriptions and figures of the five following forms has led me to conclude that they are one and the same species seen under more or less varying conditions, and, therefore, that the last four should be classed as synonymous with *Lembus velifer* Cohn.

Lembus velifer Cohn '66.
Lembus striatus Fabre-Domergue '85.
Lembus intermedius Gourret & Roeser '86.
Lembus ornatus Smith '98.
Lembus infusionum Calkins '02.

Lembus elongatus C. & L. ('60) is, I think, too imperfectly described for any consideration with the above group, although Bütschli ('87) has placed *L. velifer* as synonymous with it.

A review of the following features will explain my reasons for the above conclusion.

The variation in size is much less than holds for many other ciliates and is, therefore, of no value; the same may be said with respect to the position of the oral aperture.

All the authors agree in making special mention of the transverse striae on the vibratile membrane, excepting Gourret & Roeser ('86 *L. intermedius*) but who figure these striae very distinctly (Pl. XXX, fig. 2, q. v.).

The annulations are described and figured for *L. velifer, intermedius* and *ornatus*, figured, but not described for *L. striatus* and absent in *L. infusionum*. The absence of the annulations in *L. infusionum* may be explained, I think, by one of my notes mentioned above.

In all species but one, the contractile vacuole is single and posterior, while Calkins ('02) describes and figures several in the posterior extremity of *L. infusionum.* I have noted above, a condition which tends to produce an accumulation of clear vacuoles in the posterior extremity, and the figures of *L. velifer, striatus* and *intermedius* contain several such vacuoles in that extremity, in addition to the contractile one. Cohn (*L. velifer*) did not see the nucleus, Gourret & Roeser (*L. intermedius*) describe and figure two central nuclei, while the other three authors describe and figure a single central nucleus. The two nuclei of *L. intermedius* may be the initial stage of division, or if not, it should not weigh against the identity of species (*Loxodes rostrum,* vide supra).

The caudal seta, which is not always very distinct, is mentioned for all but *L. velifer*, and Cohn's reason for not noting it may be similar to mine for not seeing the double membrane when I first met *L. ornatus* (vide supra).

Lembus striatus and *L. intermedius* seem to be well differentiated from all the other species by what is described and figured as transverse striae on the body, but if one will scan the figures (*L. striatus* Fab.-Dom. '85, Pl. XXIX, fig. 6; *L. intermedius,* G. & R. '86, Pl. XXX, figs. 2 & 3) it will be seen that these striae are coincident with the annulations, and that it is highly probable that they represent these annulations strongly accentuated.

BLEPHAROSTOMA PIGERRIMA Cohn sp.

In the brackish waters of Lakes Pontchartrain and Borgne, and recently in the Gulf, I have met with a ciliate, the features of which have led me to place it in the genus Blepharostoma as erected by Schewiakoff ('93). Its body is pliant, very transparent, somewhat fusiform and about twice as long as its greatest central width. It is very much compressed laterally, this compression giving its dorsal and ventral surfaces a width of about one-third its depth. Its anterior extremity is diagonally truncated towards the ventral surface and occupies about one-third of the body-length, constituting an oval oral fossa, at the lower extremity of which the oral aperture is situated.

The body is sparsely covered with fairly long and slowly-moving cilia. The entire edge of the oral fossa, excepting a small part in the immediate vicinity of the oral aperture, is provided with a single row of cilia which are distinctly longer and heavier than those covering the rest of the body. These cilia are always bent towards the oral aperture and have a movement which directs the food to this aperture as well as assisting in the locomotion of the animal.

The longitudinal body-striae are hardly perceptible. The round nucleus is single and sub-central, while the contractile vacuole, which is quite difficult to distinguish from the many vacuoles nearly always present, is near the posterior extremity. The length varies from 35 to 50 microns.

This form differs from *Blepharostoma glaucoma* Schw. ('93) in size (.015 mm) and shape (cylindrical) as well as in the position of the oral fossa, which in *B. glaucoma* does not reach the apical extremity, while in *B. pigerrima* it divides that extremity and makes it sharply pointed.

Cryptochilium fusiforme Gourret & Roeser ('88) agrees in very many details with my description and their figures (Pl. XIII, figs. 2 and 3) would be good if the preoral cilia were less numerous (6 from a side view), heavier and inclined downwards.

Colpoda pigerrima Cohn ('66), notwithstanding the striae described and figured, I am inclined to believe is the same form. Cohn failed to see the nucleus and describes as the true contractile vacuole, which is usually obscure, the food vacuole which is constantly being formed in close proximity to the oral aperture.

This form has nothing in common with the genus Cryptochilium (now Uronema) nor with Colpoda, but naturally belongs to the genus Blepharostoma as erected by Schewiakoff, and where I have placed it.

CONOSTOMUM PEDICULIFORME Cohn sp.

This hypotrichous ciliate one would suppose easy to identify on account of its unique shape. It is divided into two very distinct regions—an anterior neck-like portion and a posterior broader portion, together resembling, somewhat, a bass-viol. Cohn ('66) found it in a sea-water aquarium and gave a description of it (*Stichochaeta pediculiformis*) which Maupas ('83) has amended and found reason for placing it in the genus Gonostomum.

I had a fairly large number of these forms under my observation, and, in order to study them critically, I isolated several in a watch glass with a few drops of water, killed with 1 per cent osmic acid, then treated them as recommended by Schewiakoff ('98) and brought out the appendages very distinctly. The shape of the body agreed exactly with Cohn's figures and description. The size varied somewhat—the largest measuring 140 microns and the smallest 100 microns.

The greatest width was one-fifth of the length, and while the neck-like portion varied within small limits, its average size was about one-third the body length. The oral aperture, peristome, the very fine and closely-set peristomal cilia, heavy apical styles (6) and single linear row of frontal setae (8 to 10) were as described by Cohn.

Immediately under the oral aperture, down the entire length of, and parallel with the ventral surface, were two rows of setae, closely set and occupying the central third of that surface. Just below the termination of these rows were five anal setae, most of which projected over the caudal border. Hispid setae, as long or longer than half the greatest body-width, were very distinct on the margins and dorsal surface of the whole animal. There were no caudal setae. The color of the body was very like that of *Loxocephalus granulosus,* and the inclusions which gave it this color appeared to be of the same nature as those found in *L. granulosus.* In the live animal, no contractile vacuole could be positively determined. At times, what appeared as a single bright, irregularly-shaped space could be seen, while at other times the two clear spaces, which Cohn supposed to be the contractile vacuoles, were in evidence.

Staining with picro-carmine brought out scores of small, round nuclei distributed throughout both sections of the body. A successful effort to isolate these nuclei demonstrated that they were not connected. The tuft of cilia (Wimperbüschel), which Cohn mentions as protruding from the oral aperture, was determined in the live animal to be an extensile, trap-like membrane, similar to, but smaller than that of *Cyclidium glaucoma.*

It will be noted that my description differs from that of Cohn in that there are no caudal setae. The error in interpreting the membrane as a tuft of cilia was not an uncommon one at the time he wrote his description (1866). In all other respects we agree so closely that I am strongly inclined to believe that I had his species under observation.

The dorsal hispid setae were so very obvious along the margins that I think it quite probable that Cohn mistook them for the caudal series.

Maupas ('83) has done some work on this form and I regret that I have not his paper to consult.

Stichochaeta (*Gonostomum?*) *corsica* Gourret & Roeser ('88) resembles this species very much but the following differences are sufficient to separate them: The frontal series is double, ventral series diagonal, anal series absent, marginal series at the caudal border very numerous, the nucleus single and the oral membrane absent.

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APPENDIX.

DIATOMS FOUND IN THE SURFACE PLANKTON OF THE GULF.

These diatoms, recorded by genera, were taken in great numbers. They are listed in the order of their relative abundance:

Coscinodiscus, (several species).	Terpsonia.
Navicula, (several species).	Grammatophora.
Melosira, (several species).	Pleurosigma.
Biddulphia.	Surirella.
Rhizosolenia.	Triceratium.
Nitzschia, (several species).	Amphiphora.
Chaetoceros.	Actinoptychus.
Synedra.	Bacteriastrum.

REPORT OF THE FLORA IN THE VICINITY OF THE GULF BIOLOGIC STATION.

BY R. S. COCKS.

(Read before the Louisiana Society of Naturalists, December, 1903.)

This collection of plants is not an exhaustive catalogue of the Flora of the region of the Gulf Biologic Station. It is merely an attempt to supply a tolerably complete list of such plants as could be found in a week's collecting during the month of July, in about a two mile radius of the Station.

As was to be expected from the character of the soil so near the sea, the number of plants is not very large, but it is worthy of note that of this small collection of under three hundred plants, more than one-third are here recorded for the first time from the State. It seems therefore certain that this is the first time that this part of the State has been visited by anyone interested in the Flora.

Speaking generally, there are four types of plants found around the station. (1). There are the plants of the drifting sands within the tide line. (2). There are the plants of the salt marshes growing in water, or in soil more or less water soaked. (3). There are the plants growing on the ridges of higher ground which traverse the marshes. (4). There are those plants, which have followed in the wake of cultivation, generally described as weeds.

In addition to the plants listed, there are some forty others which have not been identified, as they were not in condition for satisfactory determination.

Very little can be said of the Cryptogamous Flora. Two species of Algae were collected in the salt pools that form on the jetties, and seven species of mosses. Fresh water Algae were not represented at all, and the collection and identification of the Fungi was not attempted.

It is greatly to be hoped that this list may serve as a starting point for further investigation, and that in the near future we may have a complete catalogue of the Flora of this most interesting region.

CATALOGUE OF PLANTS.

Menispermaceae—
Cocculus Carolinus D. C.

Nymphaeaceae—
Nuphar advena Ait.

Cruciferae—
Lepidium Virginicum L.
Cakile maritima Scop. var. aequalis Chap.

Portulacaceae—
Portulaca oleracea L.

Tamariscineae—
Tamarix Gallica L.

Caryophyllaceae—
Spergularia salina Presl.

Malvaceae—
Sida spinosa L.
acuta Burm.
Modiola multifida Moench.
Kosteletzkya Virginica Presl.
Hibiscus moscheutos L.

Meliaceae—
Melia Azederach L.

Oxalidaceae—
Oxalis corniculata L.

Rutaceae—
Xanthoxylon Clava-Herculis L.

Anacardiaceae—
Rhus radicans L.

Vitaceae—
Vitis cineerea Engelm.
Cissus bipinnata Nutt.
incisa Desmoul.

Sapindaceae—
Cariospermum Halicacabum L.

Leguminoseae—
Trifolium Carolinianum Michx.
repens L.
Daubentonia longifolia (Cav.) D. C.
Astragalus Nuttallianus var trichocarpus T. & G.
Vicia Ludoviciana Nutt.
Lespedeza striata Hook and Arnott.
Rhyncosia species.

Leguminoseae—Continued.
Erythrina herbacea L.
Centrosema Virginica Benth.
Phaseolus diversifolius Pers.
Galactia volubilis (L.) Britton.
mollis Michx.
Cassia occidentalis L.
nictitans L.
obtusifolia L.
Gleiditschia triacanthos L.
Mimosa strigillosa T. & G.
Acacia Farnesiana Willd.
Desmanthus luteus Benth.
Petalostemon emarginatus Torr.

Rosaseae—
Rubus trivialis Michx.
Crategus (three species)

Lythraceae—
Ammania coccinea Roettb.
latifolia L.

Onagraceae—
Jussiaea repens L.
Ludwigia palustris L.
laciniata Hill.
Oenothera species.
Gaura Michauxii Spach.

Passifloraceae—
Passiflora incarnata L.
lutea L.

Cucurbitaceae—
Melothria pendula L.

Cactaceae—
Opuntia vulgaris Mill.

Ficoideae—
Sesuvium maritimum (Walt.) B. S. P.
portulacastrum L. F.
Mollugo verticillata L.
Glinus lotoides Loefl.

Umbelliferae—
Hydrocotyle interrupta Muhl.
repanda Pers.
Sanicula Marilandica L.
Daucus pusilla Michx.

Umbelliferae—Continued.
Apium leptophyllum (D. C.) F. Muell.
Discopleura capillacea D. C.

Caprifoliaceae—
Sambucus Canadensis L.

Rubiaceae—
Gallium hispidulum Michx.
Crusea allococca Gray.
Diodia Virginica L.
teres Walt.

Loganeaceae—
Polypremum procumbens L.

Compositae—
Sonchus asper L.
oleaceus L.
Coreopsis cardanimaefolia (D. C.) T. & G.
Eclipta alba (L.) Haussk.
Xanthium strumarium L.
Ambrosia artemisiaefolia L.
trifida L.
Pluchea foetida (L.) B. S. P.
Euptaorium album L.
Erigeron repens A. Gray.
Canadensis L.
Philadelphicus L.
Aster spinosus Benth.
Borrichia frutescens (L.) D. C.
Iva frutescens L.
Helenium tenuifolium Nutt.
Verbesina Virginica L.
Pyrrhopappus Carolinianus D. C.
Gnaphalium purpureum L.
Krigia Dandelion Nutt.
Lepachys peduncularis T. & G.
Chrysopsis species.

Sapotaceae—
Bumelia lanuginosa Pers.

Primulaceae—
Samolus floribundus Kunth.

Bignoniaceae—
Tecoma radicans Juss.

Scrophulariaceae—

Herpestis Monniera Kunth.
nigrescens Benth.

Solanaceae—

Solanum nigrum L.
Capsicum frutescens L.
Physalis viscosa L.
angulata L.
Nicotiana longiflora Cav.
Lycium Carolinanum Michx.
Datura stramonium L.

Convoluvulaceae—

Ipomoea Pes-Caprae Sweet.
acetosaefolia R. & S.
purpurea Lam.
sagittata Cav.
Dichondra repens Forst.
Cuscuta Gronovii Willd.
compacta Juss.

Gentianaceae—

Sabbatia campestris Nutt.
Eustoma exaltatum Grisel.

Asclepiadaceae—

Acerates viridiflora Ell.
Seutera maritima Decaisne

Borraginaceae—

Helciotropium Curassavicum L.
Indicum L.

Verbenaceae—

Verbena Xutha Lehm.
Tampensis Nash.
Verbena species.
Lippia nodiflora Michx.

Labiatae—

Monarda punctata L.
Scutellaria aspera Michx.
Teucrium Canadense L.

Plantaginaceae—

Plantago lanceolata L.
pusilla Nutt.

Phytolaccaceae—

Phytolacca decandra L.

Amarantaceae—

Amarantus albidus L.
spinosus L.
Euxolus lividus Moquin.
Acnida cannabina L.

Chenopodiaceae—

Chenopodium album L.
anthelminticum L.
Atriplex hastata L.
Obione arenaria Mouquin.
Salicornia species.
Salsola kali L.

Polygonaceae—

Rumex crispus L.
verticillatus L.
Polygonum acre Kunth.
hydropiperoides Michx.
aviculare L.
convolvulus L.

Euphorbiaceae—

Euphorbia polygonifolia L.
prostrata Ait.
maculata L.
Arkansana
Euphorbia species.
Croton glandulosus L.
capitatus Michx.
maritimus Walt.
Crotonposis linearis Michx.

Urticaceae—

Urtica dioica L.
chamaedryoides Pursh.
Parietaria debilis Forst.

Batidaceae—

Batis maritima L.

Ulmaseae—

Celtis occidentalis L.
pumila Pursh.

Salicaceae—

Salix longfolia L.

Lemnaceae—

Lemna minor L.

Typhaceae—

Typha latifolia L.

Alismaceae—

Echinodorus radicans Egelm.
Sagittaria lancifolia L.
graminea Michx.

Iridaceae—

Iris versicolor L.

Smilaceae—

Smilax tamnoides L.
rotundifolia L.

Juncaceae—

Juncus tenuis Willd.
acuminatus Michx.
Juncus species.
Juncus species.

Pontederiaceae—

Pontederia cordata L.
Piaropus crassipes (Mart.) Britton.

Commelynaceae—

Commelyna Virginica L.
Nashii Small.

Cyperaceae—

Cyperus virens Michx.
esculentus L.
articulatus L.
cylindricus (Ell.) Chap.
strigosus L.
erythrorhizus Muhl.
echinatus Britton.
rotundus L.
Kyllingia pumila Michx.
Eleocharis albida Torr.
tuberculosa R. Br.
acicularis R. Br.
Eleocharis species.
Scirpus lacustris L.
pungens Vahl.
martimus L.
lineatus Michx.
Dichromena leucocephala Michx.
Carex tribuloides Wahl.
Carex species.

Gramineae—

Aristida stricta Michx.
Cenchrus tribuloides L.
Chaetochloa imberbis (Poer) Scrib.
glauca (L.) Scrib.
Chloris petraea Sw.
Dactyloctenium Aegyptum (L.) Willd.
Diplachne fascicularis (Lam.) Beauv.
Distichlis spicata (L.) Guene.
Eatonia obtusata (Michx.) A. Gray.
Pennsylvania, D. C.
Eleusine Indica (L.) Gaert.
Elymus Virginicus L.
Eragrostis Purshii Schrad.
hypnoides (L.) B. S. P.
secundiflora Presl.
Eriochloa longifolia Vasey.
Hordeum pusillum Nutt.
Panicum proliferum Lam.
paspaloides Pers.
Capriolon dactylon L.
Paspalaum ciliatifolium Michx.
dilatatum Poir.
plicatulum Michx.
lividum Trin.
compressum (Sw.) Nees.
longpipedunculatum LeConte.
Phalaris angusta Nees.
Phragmites Phragmites (L.) Karst.
Poa annua L.
Spartina junciformis Engelm. & Gray.
polystachya (Michx.) Ell.
patens (Ait.) Muhl.
Sporobolus Indicus (L.) R. Br.
Steenotaphrum secundatum (Walt.) Kuntze.
Syntherisma canguinalis (L.) Dulac.
linearis (Kwk.) Nash.
Zizania aquatica L.
Zizaniopsis miliacea (Michx.) D. & A.

Algae—

Enteromorpha compressa (L.) Grev.

Ectocarpus Mitchellae Harvey.

These two species are found constantly, associated together in the shallow pools on the jetties.

Mosses—

Cryphaea glomerata B. S.

Cylindrothecium seductrix Sull.

Funaria hygrometica Sibth.

Thudium gracile B. S.

Raphidostegium microcarpum C. Muel.

Weisia viridula Brid.

A CONTRIBUTION TO THE ENTOMOLOGY OF THE REGION OF THE GULF BIOLOGIC STATION.

JAMES S. HINE.

This short paper is the result of some secondary work at collecting insects during a stay of two weeks at the Gulf Biologic Station in August 1903. Although many of the species mentioned are common the list given below will serve to give some idea of the insect fauna of the region at that season. All species mentioned are represented by one or more specimens actually collected and a number not yet determined are excluded from the list.

To the Division of Entomology at Washington under whose direction I took the trip, and to those in charge of the Gulf Biologic Station who granted me many privileges I wish to express my appreciation. I am also indebted to Professor Herbert Osborn of the Ohio State University for determining all the Hemiptera, and to Messrs Ashmead and Coquillett of the U. S. National Museum, and Mr. Charles Dury of Cincinnati for determining the Hymenoptera, Diptera and Coleoptera preceeded by an asterisk (*).

Since the primary object of my trip was the study of stock pests, the forms most attractive to me were mosquitoes, horseflies of the family Tabanidae, dragonflies, and a few species of predaceous Hymenoptera and Diptera.

Mosquitoes are abundant and consequently annoying to both man and beast. The salt-marsh species especially is furnished with ideal breeding grounds, and as its bites are very severe it is a pest of paramount importance. The question of its control furnishes an important insect problem which the director of the station has taken up with enthusiasm and if he reaches a successful solution the people of the locality will be greatly indebted to him.

The large dragonfly, Anax junius, is exceedingly abundant and swarms of the species appear in the evening and busy themselves at feeding on small insects. Although there is no way of knowing just how much good these predaceous insects do, it is certain that they should be considered in connection with the mosquito problem of the locality.

Not many species of horseflies were observed, but three species were abundant. The country furnishes abundant breeding grounds for these three species and for that reason the problem of their control is an immense one. Although the successful control of these flies has always been accompanied with difficulties I am of the opinion that a thorough study of their life histories and habits will yield good results. In Louisiana as well as in other states a number of predaceous insects contribute towards checking the ravages of these Diptera.

Among Hymenoptera the large horse guard, Monedula carolina, has striking predaceous habits. It is not uncommon to see from one to half a dozen of these flying around an animal catching horseflies which they carry away to their nests. I was much interested in the species and one who observes it for a time cannot help but admire its industry and skill. The regret is that it is not ten times more abundant at the season when horseflies are so plentiful.

Another species of the same family as the last, Bembex belfragei, was commonly observed catching Tabanids from grasses and sedges in marshy places. This species was common but on account of its habits was not so often observed as the preceding.

Another predaceous Hymenopteron, Crabro 10-maculatus, was of a great deal of interest but its habits when catching its prey were different from either of the others. This species was always observed flying around the building watching for flies resting on the siding; when one was located it hovered for a time three or four feet from its prey, then making a dash so rapidly that the eye could scarcely follow it, secured and flew away with its prize.

As Tabanids were so common everywhere I suspect many predaceous insects that usually fed on other species, fed upon them largely during the time my observations were made. Some of the robberflies were rather common about the fields where the cattle were pasturing and were busy capturing horseflies which had filled themselves with blood and had left the animal and alighted on a weed or blade of grass.

Most of the general collecting I did was done close to the station building, and many of the species were taken by sweeping, but some were taken from windows and some were found resting on the siding of the building.

Beetles of the family Cicindelidae were numerous in individuals but not many species were noted. T. carolina was observed in a few cases at dusk running on the ground and in one or two cases I came across it by turning over boards or rubbish. C. togata is a very pretty and active species. It appears to be rather common but only a few specimens were taken. C. repanda and dorsalis were extremely common.

The species of Eristalis taken were common among the flowers of composite plants that grew in abundance on the higher ground.

E. vinetorum was plentiful and the sound of the vibrations of their wings could be heard on every hand when one entered a patch of flowers.

The Tachina flies were quite plentiful in individuals but the number of species was rather limited. Beskia aelops was the most interesting to me of all these flies taken, as I had never seen it before and it is rather attractive when on the wing. All the other Tachinids given below were procured in numbers and the widely distributed Archytas analis could be seen on every hand.

The earwig I have identified as Labidura riparia was abundant at one spot but I saw it no where else. Under a board that lay near where I often passed I observed a large number of specimens in various stages of development. They had burrows into the ground beneath the board but seemed to leave these at times and crawl some distance away.

One of the most interesting Hemipterons to me is the one called Tinobregmus vittatus. It is a large species of the family Jassidae and appears to have selected as its food-plant the common woody composite that seems to agree with the description of Iva frutescens. Professor Osborn has treated this insect in the November number of the current volume of The Ohio Naturalist.

Odonata—Ischnura ramburii Selys. Anomalagrion hastatum Say. Anax junius Drury. Pantala flavescens Fabr. Tramea carolina Linn. Micrathyria berenice Drury.

Euplexoptera—Labidura riparia Pall.

Orthoptera—Schistocerca obscura Fabr.

Hemiptera—Cicada tibicen Linn. Stictocephala festina Say. Acutalis calva Say. Bothriocera bicornis Fabr. Scolops dessicatus Uhler. Phylloscelis atra Germ. Stobaera sp. Pissonotus sp. Clastoptera xanthocephala Germ. Macropsis robustus Uhler. Agallia cinerea O. and B. Agallia constricta V. D. Xerophloea grisea Burm. Tettigonia hartii Ball. Draeculicephala reticulata Sign. Tinobregmus vittatus V. D. Athysanus texanus O. and B. Athysanus exitiosa Uhler. Platymetopius frontalis V. D. Chlorotettix viridia V. D. Phlepsius sp. Ceroplastes cirripediformis Coms. Oebalus pugnax Fabr. Mozena lunata Burm. Ischnodemus sp. Pamera longula Dall. Pamera bilobata Say. Poecyloscytus basalis Reut. Phymata erosa var. fasciata Gray.

Neuroptera—Brachynemurus abdominalis Say. Myrmeleon tectus Walker. Ululodes hyalinus Latr.

Lepidoptera—Hylephila phylaeus Drury. Prodena eridania Cramer. Paectes abrostoloides Guen.

Diptera—Odomtomyia cincta Oliv. Nemotelus trinotatus

Meland. Chrysops flavidus Wied. Tabanus lineola Fabr. Tabanus costalis Wied. Tabanus atratus Fabr. Tabanus quinquevittatus Wied. *Deromyia (?) ternata Lw. Atomosia puella Wied. Erax maculatus Macq. Exoprosopa dodrans O. S. Anthrax lucifer Fabr. Heterostylum robustum O. S. Synechus simplex Walker. Microdon coarctatus Lw. Pipiza pulchella Will. Mesograpta politum Say. Mesograpta marginatum Say. Volucella fasciata Macq. Eristalis albiceps Macq. Eristalis latifrons Lw. Eristalis vinetorum Fabr. Myiolepta aenea Wied. Hypostena floridensis Towns. Beskia aelops Walker. Pachyophthalmus signatus Meig. Senotainia trilineata v. d. W. *Brachycoma intermedia Towns. Trichophora ruficauda v. d. W. Archytas analis Fabr. *Johnsonia elegans Coq. Chrysomyia macellaria Fabr. Pseudopyrellia cornicina Fabr. Musca domestica Linn. *Haematobia serrata Desv. Stomoxys calcitrans Linn. Limnophora cyrtoneurina Stein. Tetanocera pictipes Lw. Chaetopsis aenea Wied. Eumetopia rufipes Macq. Eumetopia varipes Lw. Sapromyza quadrilineata Lw. Dichaeta furcata Coq. *Psilopa flavida Coq. Psilopa fulvipennis Hine. *Notiphila (?) erythrocera Lw. Caenia spinosa Lw. *Hippelates pusic Lw. *Oscinis dorsata Lw. Agromyza aeneiventris Fall.

Coleoptera—Tetracha carolina Linn. Cicindela repanda Dej. Cicindela dorsalis Say. Cicindela togata Laf. Anisosticta seriata Melsh. *Scymnus caudalis Lec. *Lacon rectangularis Say. Photinus umbratus Lec. Collops tricolor Say. Collops balteatus Lec. Canthon laevis Drury. Malledon melanopus Linn. Leptostylus aculiferus Say. *Exema conspersa Mann. *Pachybrachys luridus Fabr. *Systena blanda Melsh. Opatrinus notus Say. *Paratenetus punctatus Sol. *Mordellistena pustulata Melsh. Eudiagogus pulcher Fah. *Copturus quercus Say. *Centrinus (?) rectrirostris Lec. *Sphenophorus pertinax Oliv. *Sphenophorus (?) sayi Gyll. Calandra oryzae Linn.

Hymenoptera—Myzine sexcincta Fabr. Pelopoeus cementarius Drury. Chlorion caerulium Drury. Sphex lauta Cr. *Bembex belfragei Cr. *Monedula carolina Fabr. *Crabro 10-maculatus Say. Xylocopa micans St. Farg.

NOTES ON THE FREE-SWIMMING COPEPODS OF THE WATERS IN THE VICINITY OF THE GULF BIOLOGIC STATION, LOUISIANA.

E. FOSTER.

(Read before the Louisiana Society of Naturalists, December 12, 1903)

The members of the order Copepoda form an important section of that great class of animals known as the Crustacea; important, not only from the immensity of their number in individuals, but as regards the variety of species represented. They are, for the most part, very minute in size, and are free-swimming or parasitic on fishes or other marine animals. With many of the parasitic species, the nauplius or larval stage is free-swimming; the species becoming fixed to their respective hosts only during their later or mature state. Other forms may be termed semi-parasitic; in other words, in their mature state they may be able to swim from one host to another, and thus, in some cases at least, may come under the category of commensals rather than parasites.

The order is not only found represented in the sea by an immense number of individuals and a variety of species, but many of its members have an exclusively fresh-water habitat, while others, again, are to be found chiefly in the brackish-waters of the marshes bordering on the sea, in the bays or in the estuaries of tidal rivers.

For the most part they are cosmopolitan as regards their geographical distribution, although it may be noted, that of at least one fresh-water genus—Diaptomus—no species has, as yet, been found common to the waters of this country and the Old World. Wider investigations may prove, howvever, that even in the case of this genus, members may be found which are cosmopolitan in their range.

Minute as these animals are in size, their immense numbers and extraordinary fecundity mark them as perhaps the most important of the whole of the Invertebrates from an economic point of view. To the fish-culturist they are especially important, forming, as they do, the primary food of the majority, if not of the whole of our food-fishes; and, if for no other reason than this, it is a curious commentary on scientific research applied to practical ends that so little has been done on the order by the zoologists of this country. It is true that considerable systematic work has been done as regards the fresh-water forms of the United States, especially by Western investigators, but outside of some minor investigations carried out in Mobile Bay by the late Prof. C. L. Herrick ('84, '87, '95) in the eighties, by Prof. W. H. Wheeler ('00) at Woods Hole in 1899, and some recent work in California waters, the marine Copepod fauna of America is practically unknown, and that of the Gulf perhaps more particularly so. While, as regards the parasitic forms, it is only within the last couple of years (Wilson '02) that the first serious work on one small family—the Argulidae—has been issued under the auspices of the Smithsonian Institution.

Apart from their economic value, the Copepoda offer to the biologist a most fascinating study in their complex developmental histories. In this direction, he will meet with the interesting phases of parthenogenesis, heterogenesis and dimorphism, than which there are no more curious phenomena in the whole book of Nature.

The time may come under the rapid increase of population when the fisheries of our Southern waters will have become so far depleted as to compel artificial cultural operations such as have been so successfully carried out in our Eastern waters under the auspices of the U. S. Fish Commission in the case of the shad, cod, mackerel and lobster fisheries, in the Great Lakes with the white fish and on the Pacific Coast with the salmon. This time may be distant—and it is to be hoped that it be—but no system of artificial fish-culture can be undertaken with any chance of success without a knowledge of the full life-histories and habits of the species being first ascertained, and that without this knowledge, it is safe to say that all attempts will prove failures. It is only quite recently that the question of the artificial propagation of the oyster has been brought prominently before the people of Louisiana, and, as with the oyster, it may be that in the near future some line will have to be taken in regard to some of the most delicate of food-fishes now so abundant in our markets.

Such lines of primary investigation must, of necessity, cover a long period of patient and continued research. The mere patching together of a fact or two, gathered here and there, will not be sufficient, and experience gained elsewhere may be of comparatively little value owing to local conditions. It is therefore not without significance, that should the above contingency arise, the mere fact that the Copepoda form the basis of the food of fish fry, and in many cases of mature fishes, will make any previous knowledge as to the geographical distribution of the Gulf species, of their bathymetrical distribution under varying temperatures and seasons and the relative abundance of any special members of the order of prime importance, and, more especially, any facts gleaned as to whether any special species forms the principal food of any particular fish will be of value. Herring fishers know that their quarry will be found where these little animals are in abundance, while every New Bedford or Dundee whaler has spun yarns of the well-known "whales' pasture," which is nothing more nor less than a reddish patch in the ocean—it may be square miles in extent—composed of countless millions of these little creatures.

In carrying out the investigations of the copepod fauna of the waters in the immediate vicinity of the Gulf Biologic Station, the principal aim was rather to get a line on the different species found therein than with any desire to attempt to settle any knotty points as to their life-histories. For any serious work along the latter line, a long period of sustained investigation is necessary, and the short time which the writer was able to devote was, perforce, in the way of preliminary systematic work.

The work was carried on during the first half of September, 1903, and in its prosecution, collections were made by means of a fine-meshed surface net and modified Birge nets from the plankton, six to eight miles out in the Gulf, in Calcasieu Pass and in St. John's Bayou, connecting Lake Calcasieu with the Pass. These collections were made at the surface, at from three to four feet deep, and at all stations the dredges were sent to the bottom—the maximum depth dredged in the Gulf being about twenty feet. Owing to the continued drought during the whole of July and August, all ponds in the vicinity of the Station were dried up, and thus no work could be done on the fresh-water forms. Beyond a number of species of Cladoceran-*Simocephalus vetulus* and of an Ostracod-*Cypris virens,* found in one of the experiment jars in the station and in the draw-well near the building, nothing in the way of a fresh-water entomostracon was secured, thus narrowing down the list to marine members of the order Copepoda.

The fact that the investigations in the Gulf were limited to a distance of about eight miles from shore, and that at that distance the effect of the fresh water coming from Calcasieu Pass would not be entirely dissipated, would naturally lead to the conclusion that a great similarity would be found between the forms from the plankton and from the two other stations. This was, in a measure, borne out, but it may be mentioned that the Gulf dredgings were made when wind and other conditions had partly overcome the wash from the Pass; in other words, when the water was of that deep blue color noticeable well out at sea. At no period during the writer's stay did the waters of the Pass or of St. John's Bayou present any other appearance than muddy. The result then was that out of a total of 18 species, twelve were from the plankton, of which 9 were not represented in the material from either of the other stations, while one was common to all three, one common to the plankton and to St. John's Bayou, and one to the plankton and to the Pass. Of the 6 forms identified from the Bayou only one was not found represented elsewhere, while of the 7 from Calcasieu Pass 2 were exclusive.

The principal feature of the collections was the overwhelming predominance of a species of Acartia at all the stations and the marked absence of mature forms. The latter is all the more peculiar as at the corresponding period of September, 1902, the writer found at Pass Christian the majority of the species represented in the following list, and the bulk were more or less mature. The lateness of the seasons of 1903 may have been reflected in the development of these minute forms of marine life, and a certain proof of this may be gathered from the fact that the most active reproductive period of fresh-water forms in other sections of the State was towards the end of October. Usually, in the case of these fresh-water forms, the greatest reproductive activity is in the early spring—April and May—and in September and the first half of October.

The presence of an extra amount of fresh water in Calcasieu Pass and St. John's Bayou, due to protracted high water, might have had some effect on the forms, and in this direction the writer had a kind of demonstration. On September 12 dredgings were made in the Pass between 5 and 6 p. m. The density of the water on this day was 1.0164 (uncorrected for temperature). The forms were exceedingly abundant, although for the most part immature. On the following day, under precisely the same conditions as to temperature and time of day, but with a density of 1.009 (uncorrected), scarcely anything could be got with the dredges, either at the surface, at three feet down or at the bottom. The only forms of crustacea in any numbers were nauplii of a species of Cirripedia—probably the oyster-shell barnacle—and the zoæa stage of crabs and shrimps. The forms had apparently either sought the Gulf or had succumbed to the changed conditions.

NOTES ON SPECIES.

1. *Calanus minor* (Claus). A few forms agreeing well with this species were found in the plankton, the only difference noted being their somewhat smaller size.

2. *Eucalanus* sp. Only a single specimen of this genus has been found in the material from the plankton and the lack of sufficient material has, of necessity, prevented any critical study beyond fixing the genus.

3. *Centropages typicus* Kroyer.

4. *Centropages furcatus* (Dana).

5. *Centropages* sp.

The first two of these forms were present in the material from the plankton. *C. furcatus* was comparatively common, while only one or two specimens of *C. typicus* were noted. *C. furcatus* was also present in material from Calcasieu Pass. A third species of the genus, agreeing in some respects with *C. hamatus* (Lillj.) was given cursory study at the Station, but the preserved material has failed to furnish further specimens. The presence of hooks on the 1st, 2d and 5th joints of the anterior antennæ place it near to *C. furcatus*, but the genital segment is almost symmetrical.

6. *Eurytemora affinis* (Poppe). The presence of one or two individuals of this genus in the material from Calcasieu Pass is of interest, proving, as it does, that its range includes the whole of the Gulf littoral.

Herrick ('84, p. 182) was the first to record and describe the species in America from the "shallow bays and estuaries along the Gulf of Mexico" under the name of *Temora affinis* Poppe, noting its habitat as littoral and range from salt-water bays to the fresh waters of rivers. He later extended his description ('87, pp. 7-10; pl. I, figs. 3-6 and pl. II, figs. 9, 10) under the name of *Temorella affinis* Poppe, and gave the salient characters separating the genus *Temora* of Baird ('50) from *Temorella* of Claus ('81). Giesbrecht ('81) erected the genus *Eurytemora*, the question of priority between him and Claus resting on the fact that whereas Giesbrecht's paper was published on May 16, 1881, Dr. Claus' memoir was only "read" on May 12, 1881, and its publication would necessarily be after that of Giesbrecht's. Zoologists have adopted Giesbrecht's genus and Herrick ('95, pp. 49-53) subsequently noted the form under *Eurytemora*.

De Guerne and Richard ('89, p. 88) note Herrick's record as a definite variety of the type, and for this opinion there may have been justification as the 5th feet of both the female and male as figured by Herrick ('87, pl. 1, fig. 4; pl. 11, fig. 9) show minor differences from the type, while the figure of the animal itself seems to have been drawn from a compressed alcoholic specimen and thus naturally distorted.

The writer has had under observation, forms from Lake Pontchartrain, the artificial ponds (brackish) in Lower City Park, New Orleans, and from the fresh-water ponds in Audubon Park, New Orleans, and a critical examination of the diagnostic points has led him to the conclusion that our form agrees with the type, with the exception that they are somewhat smaller (averaging .69mm for the female and .54mm for the male) and that the furca of both sexes are somewhat longer in proportion to width than in the European specimens. The latter average in length 1.5mm for both sexes. In our form, the small spine (omitted by Herrick) between the two apical spines of the 5th feet of the female, as figured by De Guerne and Richard from European specimens, has been found in specimens from all localities.

The species seems to have a wide range, being very common in North European waters and recorded from the Caspian Sea, but so far as the writer is acquainted with the literature it does not seem to have been recorded south of the Gulf.

From an economic point it seems to be quite important, constituting at some seasons the almost exclusive food of the shad in the Rhine and of the herring in the Baltic. The record from the Audubon Park ponds tends to prove the conclusion arrived at by European investigators, that it is equally at home in absolutely fresh as in brackish waters.

7. *Labidocera* sp. A few female specimens of a fairly large size (2.60mm) were secured from the plankton which seem to break away from the described species of this genus. The species approaches *L. nerii* (Kroyer) in the abdomen being 2-segmented and the genital segment symmetrical. It also comes near to *L. nerii* in the presence of 3 spines to the apical joint of the outer ramus of the 5th foot, but is without the minute spines on the outer margin as in that species, while the inner ramus is prolonged into a symmetrical and rather robust acute tooth instead of into an asymmetrical short and knob-shaped process as in *L. nerii*. The genital opening is central, while in *L. nerii* it lies towards the left side. In the wing-shaped lateral prolongations to the last thoracic segment it is similar to *L. nerii*.

The form also approaches near to *L. aestiva* Wheeler, in the symmetrical genital segment and position of the genital opening and in the 2-segmented abdomen and proportions of the furca, while it differs from that species in the presence of rather long hooks to the rostrum, in the shorter antennæ and in the absence of the plumose setae to the outer margins of the basal segments of the 5th feet. It also differs from *L. aestiva* in the last thoracic segment being not so sharply pointed at the angles and in its greater size (2.60mm as against 1.75mm to 2mm for *L. aestiva.*)

The absence of the male form makes it difficult to settle definitely whether it is distinct from either of the two mentioned species or merely a variety of one of them, and although the above variations would almost warrant the erection of a new species, the writer would prefer to leave that question open until a closer examination of the preserved material is made.

The minor points noticed were the densely hirsute margins of joints 1 to 13 of the anterior antennæ, some of the aesthetasks and all the antennal setae being plumose, while on the proximal setae the plumes were exceptionally well defined. The genital segment has lateral hairs. The thorax of an average specimen measured 2.04mm; abdomen, .56mm. Genital segment as 14:8 in proportion to the follow-segment; 2d segment to furca as 10:7; length of furca to width as 7:3; length of furcal setae, .39mm.

8. *Acartia tonsa* Dana.

9. *Acartia gracilis* Herrick

Herrick ('84, p. 181) noted with doubt a form from the Gulf under the name of *Dias longiremis* Lilljeborg. His material was insufficient to establish his diagnosis definitely, and while he subsequently ('87, p. 7; pl. 1, figs 1, 1a and 2) recorded and figured the same species under *Acartia gracilis,* and at the same time gave a short desription and comparison with other species of the genus, his diagnosis is so incomplete as to be relatively of very little value to the student of the Copepoda. Moreover, his figure of the female animal itself gives 20 joints to the anterior antennæ, whereas only 17 are present in Acartia. For this error he may be excused through the paucity of material and the fact that the joints are extremely difficult to differentiate both in the live animal and in preserved specimens.

Giesbrecht and Schmeil ('98, p. 156) record merely the name and place it among their uncertain species.

The overwhelming predominence of this form at all stations, and the fact that it is quite the commonest species in the Gulf, off Pass Christian and in Lake Pontchartrain lead the writer to believe that the species has once more come under observation.

In general outline and in the rounded lateral corners to the last thoracic segment in both sexes, the form approaches near to that of *A. tonsa* Dana and to *A. giesbrechti* (Dahl), while in size (1.01mm to 1.12mm for the mature female; 92mm to 1.00mm for the male) it approximates closely to measurements given for both the above forms. In the presence of rostral filaments (rather in the shape of attenuated hooks than filaments) it also approaches the two mentioned species.

In *A. tonsa,* the anterior antennæ of the female reach not quite to the posterior margin of the genital segment, while in mature forms of *A. gracilis* these organs reach well over the margin, but in immature specimens only to the end of the last thoracic segment.

As in *A. tonsa,* the abdomen is relatively short, being a little less than one-fourth the length of the thorax, while there are no thorns on the genital segment. The female of *A. gracilis* differs from that of *A. tonsa* in the absence of hairs to the abdominal segments; the only hairs present on the numerous specimens examined from all localities mentioned being confined to the inner and outer margins of the furca, although the anal segment of the male is rather densely haired on the margins, while the fine spines present on the second abdominal segment of the male of *A. tonsa* are absent in *A. gracilis*

In *A. gracilis,* the genital segment of the female is equal to the two following; the 2d and 3d about equal, and the furca equal to the 3d, with the proportion of length to width as 8:6. In the male, these characters approach very near to *A. tonsa.*

The fifth feet of the female are practically the same as figured for *A. tonsa,* having the curious barbed-like projections to the middle of the attenuated apical claw, while the lateral setae are plumose as in the latter species.

From 7 to 8 very minute points are present at the rounded corners of the last thoracic segment of the male.

A. giesbrechti differs from *A. tonsa* mainly in having only the anal segment very sparsely haired and in the somewhat greater length of the anterior antennae. In these respects, *A. gracilis* approaches nearer *A. giesbrechti* than *A. tonsa,* and these differences are of so minor character as to lead to the belief that *A. gracilis* and *A. giesbrechti* are one and the same species, but without a comparison with Dahl's types the question could hardly be settled. If they be identical, Dahl's specific name will have to give way to that of Herrick, the latter having published *A. gracilis* seven years previous to the description of *A. giesbrechti,* from material gathered in the estuary of the Brazilian river Tocantins.

A few typical forms of *A. tonsa* were found in the plankton along with *A. gracilis.*

The predominance of *A. gracilis* over all other species would seem to give it special economic value, and it would be interesting to note whether any of our Gulf fishes make an exclusive diet off the animal, either at certain seasons of the year or at some certain stages of their life histories.

10. *Tortanus* sp. A single specimen of this curious genus was noted at the Station in material from the plankton, but was not given critical study at the time, and the preserved material has failed to furnish other specimens.

11. *Oithona similis* Claus. A few specimens of what fitted in very well with the descriptions of Claus' form were secured from Calcasieu Pass and St. John's Bayou. The form was the only species found with the egg-sacs attached during the whole period of the writer's stay at the Station. Some of the other species had spermataphores attached, and thus ensured maturity and a safe basis for diagnosis, but the general absence of eggs was a marked feature in all the gatherings.

12. *Miracia efferata* Dana. This well differentiated Harpacticid was found in sparse numbers in collections from St. John's Bayou only.

13. *Amcira* sp. One or two specimens fitting in with this genus were found in St. John's Bayou and Calcasieu Pass. The species has not yet been sufficiently studied so as to place it definitely.

14. *Laophonte mississippiensis* Herrick (?). A few specimens of what seemed to be Herrick's species were found in Calcasieu Pass gatherings. More material will be required before the form can be placed definitely.

15. *Oncaea venusti* Philippi. A few specimens of this rather handsome form were secured in the plankton and were given cursory examination at the Station from fresh material brought in, but which afterwards gave out before it could be gone over thoroughly.

16. *Corycaeus elongatus* Claus.

17. *Corycaeus carinatus* Giesbrecht.

18. *Corycaeus* sp.

The first named species of Corycaeus was rather common in the plankton collections, and was also noticed in material from St. John's Bayou. A few specimens agreeing well with the description of *C. carinatus* were found with the former in St. John's Bayou, although in less numbers. A third species from the plankton, with extremely attenuated abdomen,differs materially from any descriptions of species with which the writer is acquainted. The genus is rather well provided with species, and until all descriptions are available, so that full comparisons can be made, the form has been retained for further study.

SUMMARY OF THE FOREGOING SPECIES.

	Plankton	St. John's Bayou	Calcasieu Pass
Calanus minor	X		
Eucalanus sp.	X		
Centropages typicus	X		
Centropages furcatus	X		X
Centropages sp.	X		
Eurytemora affinis			X
Labidocera sp.	X		
Acartia gracilis	X	X	X
Acartia tonsa	X		
Tortanus sp.	X		
Oithona similis		X	X
Miracia efferata		X	
Ameira sp.		X	X
Laophonte mississippiensis (?)			X
Oncaea venusta	X		
Corycaeus elongatus	X	X	
Corycaeus carinatus		X	X
Corycaeus sp.	X		
Species	12	6	7

The writer begs to offer his best thanks to Prof. H. A. Morgan for many courtesies extended him during his stay at the Station.

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REPORT ON THE CONDITIONS OF BIRD-LIFE AS NOTED AT THE GULF BIOLOGIC STATION.

The exceedingly limited nature of my observations made it impossible to do more than estimate the value of the vicinity of Cameron as a field for the ornithologist. The striking element of bird-life even at the season of my visit was the abundance of the Limicolae. As shown by the accompanying list, all but two of the Limicolae known to breed in Louisiana were found at Cameron during my brief stay. The species I failed to observe were the Oyster-catcher (Hæmatopus palliatus Temm.) and the Turnstone (Arenaria interpres—Linn). In addition, the Sanderling (Calidris arenaria—Linn) was found, and I saw at least two other species that are merely transients in Louisiana, but I had not at hand the means of determining their identification. That the limicoline fauna of the neighborhood of Cameron must be exceedingly rich during the height of the migrations, therefore, seems certain. Other water-birds, as well, find the section in question very attractive. Except during the migrations, when many species of land birds would doubtless be found resting among the thickets on the prairie, the land birds are limited chiefly to species that love the open, the meadow-lark, kingbird, nighthawk, mourning dove, bob-white, painted bunting, etc., etc. A characteristic feature of the terrestrial bird-life of the place is the fondness shown by nearly all the small species for the thickets of the small tree Bumelia lanuginosa Pers.

SPECIES OF BIRDS OBSERVED AT THE GULF BIOLOGIC STATION.

1. *Larus articilla* (Linn).—Laughing Gull.

2. *Anhinga anhinga* (Linn).—Water-turkey, or snake-bird.

3. *Tantalus loculator* (Linn).—Wood Ibis. One small flock seen.

4. *Arda herodias* (Linn).—Great Blue Heron. . . . .

5. *Florida coerulea* (Linn).—Little Blue Heron.

6. *Butorides virescens* (Linn).—Little Green Heron. Very common.

7. *Nyctinassa violacea* (Linn). — Yellow-crowned Night Heron.

10. *Rallus sp.*—Clapper? Rail.

11. *Himantopus mexicanus* (Mull).—Black-necked Stilt. One seen July 2.

12. *Calidris arenaria* (Linn).—Sanderling. About 5 were seen on the beach June 30.

13. *Symphemia semipalmata inornata* (Brewst).—Western Willet. The characteristic wader in the marsh prairies.

14. *Actitis macularia* (Linn).—Spotted Sandpiper.

15. *Numenius longirostris* (Wils).—Long-billed Curlew. Saw one July 2.

16. *Aegialitis vocifera* ALinnQ.—Kildeer.

17. *Ochthodromus wilsonius* (Ord).—Wilson's Plover. Common on the beach.

18. *Colinus virginianus* (Linn).—Bob-white.

19. *Zenaidura macroura* (Linn).—Mourning Dove. Common.

20. *Cathartes aura* (Linn).—Turkey Vulture.

21. *Catharista uruba* (Vieill).—Black Vulture.

22. *Chordeiles virginianus* (Gmel).—Nighthawk. Abundant, and to a large extent diurnal.

23. *Tyrannus tyrannus* (Linn).—Kingbird. The multitude of bushes and thickets at Cameron proves very attractive to the Kingbird.

24. *Corvus ossifragus* (Wils).—Fish Crow.

25. *Agelaius phoeniceus* (Linn).—Red-winged Blackbird.

26. *Sturnella magna argutula* (Bangs).—Southern Meadowlark. Abundant on the prairie.

27. *Icterus spurius* (Linn).—Orchard Oriole. Found about the few groves in the neighborhood.

28. *Megaquiscalus major* (Vieill).—Boat-tailed Grackle.

29. *Cardinalis cardinalis* .(Linn).—Rather common about the thickets.

30. *Cyanospiza ciris* (Linn).—Painted Bunting. Common about the thickets.

31. *Spiza americana* (Gmel).—Black-throated Bunting. Saw one female in weeds not far from beach.

32. *Telmatodytes palustris* (Wils).—Long-billed Marsh Wren. Not noted in the immediate neighborhood of the Station, but a few miles up the Calcasieu River.

33. *Mimus polyglottos* (Linn).—Mockingbird.

INSECTS INJURIOUS TO STOCK IN THE VICINITY OF THE GULF BIOLOGIC STATION.*

BY JAMES S. HINE.

The Gulf Biologic Station is located at Cameron, La., near the mouth of the Calcasieu River, which empties into the Gulf of Mexico a few miles from the Texas boundary. The writer arrived there August 14, 1903, with directions from the United States Department of Agriculture to investigate the stock insects of the region. A report on a subject like the present one, observed for a short time, must necessarily be incomplete, and some suggestions are omitted which if developed might lead to important results.

Mosquitoes are very abundant and are serious pests to both man and beast. The director of the station, Prof. H. A. Morgan, is actively engaged in studying them.

Several of the Muscids, such as the stable fly, hornfly, screw-worm fly, and Hippelates flies, are also plentiful.

Although directed to investigate stock insects, the writer understood that horseflies of the family Tabanidæ were to be his special subject, consequently most of his time during a two weeks' stay was devoted to these forms.

The whole country is only a few feet above sea level and is favorable for the development of the Tabanidæ on account of the large acreage of wet and marshy land. Running nearly parallel to the shore of the Gulf is a series of alternating ridges and depressions. The depressions form extensive fresh-water marshes, over a part of which the water stands the year round. Such species as oviposit over mud or stagnant water find ideal conditions in this region, and consequently some of them are abundant.

SPECIES OF TABANIDAE OBSERVED.

A large number of species have a range such as would safely include them within the fauna of Louisiana; and besides the writer has seen nearly a dozen species from that State, but during his stay there only five were collected or observed, but at least three of these are among the worst stock pests of the family, and taking into consideration their abundance in the region, they are certainly a serious drawback to stock raising.

*Reprinted from "Some Miscellaneous Results of the Work of the Division of Entomology, VII."—U. S. Dept. Agr. Division of Entomology, Bull. No. 44. Washington, 1903, pp. 57-60.

Chrysops flavidus Wied. was the only one of its genus observed, and owing to the lateness of the season only now and then a specimen was seen. It is said to have been an abundant and troublesome pest earlier.

Tabanus atratus Fab. was occasionally seen. As in other localities, it is present through nearly the entire summer, but usually not abundant enough to be considered a serious pest. Only a few specimens were observed molesting horses and cattle.

Tabanus lineola Fab. is a widely distributed species and everywhere is of especial economic importance. It was common at Cameron, and is one of the three species referred to above as being especially injurious.

Tabanus costalis Wied., the common greenhead, was abundant and appeared to be more persistent in its attacks than any of the others. When sucking blood it is usually located on the under parts or on the fore legs, where an animal has most difficulty in reaching it, and once it alights it is pretty sure to satisfy its appetite before leaving.

Tabanus quinquemaculatus Wied. has not been reported from the United States heretofore, but the commonest species observed at Cameron agrees very closely with Wiedemann's description. Besides, it is reported from Mexico by both Wiedemann and Bellardi, so it would not be strange to find it in Louisiana. This species appears much like *costalis,* but is larger, has two purple bands on the eye instead of one, and the costal cell is hyaline. It is also close to *lineola* in appearance, but the color of the vestiture of the body is decidedly more yellowish, and the upper purple band of the eye is noticeably narrower than in that species. Besides, it averages larger than either *costalis* or *lineola*, but undersized specimens are often met with.

Since no systematic experiments were carried on at the Gulf Biologic Station, what the writer has to say regarding remedies may be considered as suggestions, derived partly from observations on the conditions existing in that section, and partly from work and experience in Ohio.

NATURAL ENEMIES.

The natural enemies of the Tabanidæ is an interesting subject for investigation at the Gulf Biologic Station. The writer is under obligations to Messrs. Ashmead and Coquillett for the names of most of the species mentioned below.

Monedula carolina Fab., a large and attractive species of the family Bembecidæ, is common, and its habit of flying around horses and cattle for the purpose of catching Tabanids and other stock pests is so noticeable that it has received the common name of horse-guard.*

One commonly sees from one to three or four of these at work around a single animal.

Bembex belfragei Cr. belongs to the same family as the last and like it is an important enemy of horseflies. It has different habits, however, for instead of capturing prey around animals, it flies about the fields in the vicinity of marshes and captures males and females at their breeding grounds. It is a common occurrence to see a specimen carrying an adult Tabanid.

Both the above species deposit their eggs in burrows which they make in the sand, and they store the burrows with insects for the young to feed upon when they hatch. It is not uncommon to find from half a dozen to a dozen specimens of Tabanus in a single burrow, besides other insects. Professor Morgan says that he has taken seventeen horseflies, one Syrphid, one Tachinid and one Stratiomyiid from a single burrow.

Crabro 10-maculatus Say, another wasp, is an expert at catching Tabanids, and the writer often saw them capture the flies and carry them away. None of their nests were found, but it would appear that they have about the same habit in this regard as the Bembecids.

Erax maculatus Macq. and species of Deromyia were rather common and were often observed feeding upon different species of Tabanidæ.

That chickens may become a factor in destroying stock pests was proved by the fact that they were often observed following cattle in the pasture, picking off such Tabanids as alighted on the lower extremities of the animals for the purpose of sucking blood.

I wish to express my appreciation for many kindnesses shown me during my stay at the Gulf Biologic Station. Professor Morgan and his co-workers have a rare opportunity for investigating the economic and other biologic problems of interest to the people of that section of the country.

METHODS OF CONTROL.

In my "Tabanidæ of Ohio" I suggested the use of kerosene on the surface of the water for killing larvæ hatched from eggs deposited over water. Of course this method could not be used in

*A name which it shares with the great digger wasp (Sphecius [Stizus] speciosus Dru.)

cases where deposition took place over damp ground, as was observed at Cameron. One finds eggs of *costalis* and a number of other species in such places quite frequently.

With so much standing water to be considered, it would be an immense undertaking to use kerosene for killing adult flies, as suggested by Porchinski in Russia, and commented on by Doctor Howard in Bulletin No. 20 (n. s.), Division of Entomology (p. 24). It appears that both of the above suggestions, as well as others that might be mentioned, are of most value in special cases; in fact there is seldom a single remedy in use in economic treatment of insects that is appropriate at all times with reference to a particular species or group of nearly related species.

It is my belief that species of the genus Tabanus have a habit which if better understood might be utilized in trapping them in numbers sufficient to materially lessen their ravages. I refer to their habit of collecting in certain places, as on buildings, fences, and the like. The habit has been observed at different times and in different places but I saw it more forcibly at the Gulf Biologic Station than at any other place I have observed. The sexes of the last three species of Tabanus mentioned above flew around the station building in numbers, often resting on the siding and windows or striking against the glass and screens; then flew away so rapidly that the eye could not follow them. August 23, I obtained permission to open the screens from one of the doors to see what the result would be. The screens from a doorway (7 by 5½ feet) were left open from 10 in the morning to 3 in the afternoon, after which between a pint and a quart of flies of the size of the common *costalis* were procured from the windows upon the inside of the building. All but about a dozen of these were females, which, as was proved by dissection, had not yet laid their eggs. I believe that a trap might be manufactured that would attract Tabanids in the same way that they are attracted to the building in question.

It is worth mentioning that a few females of *atratus* were taken with the above, so it is probable that if this species had been as numerous as the others just as striking results could have been obtained with regard to it.

SOME ECONOMIC CONSIDERATIONS WITH REFERENCE TO THE TABANIDAE.*

BY JAMES S. HINE.

An interesting entomological study is that which has for its object the separation of beneficial and injurious species, but it is safe to say that one is almost sure to meet with perplexing questions when he undertakes a study of the kind. Some statements bearing on the matter regarding the Tabanidæ have appeared from time to time in the literature of economic entomology. If I understand the situation, some hold that it is not advisable to attack these insects in the immature stages on account of the predaceous habits of the larvæ. So far as the study of this latter stage has advanced, all that bears on feeding habits indicates that they are as apt to feed on beneficial as injurious forms; and since the remedies for horseflies in any stage are, to a degree, unsatisfactory, it seems best to pursue any mode of attack that offers results without reference to the stage in which the attack is made.

By studying the egg-laying habits of different species, it is revealed that there is a certain uniformity in regard to the matter. *Tabanus stygius* Say, in the locality where I have studied it, places its masses of eggs on the leaves of Sagittaria almost altogether, and since these plants have a tendency to grow in patches, one often finds a small area where these eggs are very abundant, while but a short distance away where the plants may not be growing scarcely any are to be found. A few counts of the number of eggs composing a mass are of interest. Twenty masses of *Tabanus trimaculatus* averaged over 500 eggs each, and several masses of *T. stygius* averaged almost as many. From a desire to know how many eggs could be collected in a given time, I have found that it is easily possible to find places where as many as 60,000 may be taken in a single hour. Therefore it looks reasonable that some method of gathering the eggs might produce good results, especially when we consider the large size of the masses and the fact that these masses usually contrast very strongly in color with the objects to which they are attached. And again, the fact that a small area of marshy ground or stagnant water in some regions may be the only location in a large scope of country that offers favorable conditions for the oviposition of the Tabanidæ.

It is not to be supposed that an account of the habits and life

*Reprinted from "Proceedings of the Sixteenth Annual Meeting of the Association of Economic Entomologists."—U. S. Dept. Agr., Division of Entomology, Bull. No. 46, Washington, 1904, pp. 23-25.

history of one species will furnish facts which may be applied in all particulars to the other members of the family. A careful study of each species is almost sure to bring out striking differences, and it is this fact that makes their study interesting and instructive. Eggs may be placed in different situations, for example, over water or over mud, usually according to the species; but at other times it seems according to circumstances. Some species are known to habitually attach their eggs to projecting stones in ripples, others to foliage or any projecting object over stagnant water. It appears that the commonest species and at the same time the worst stock pests oviposit over stagnant water or over wet ground. Larvæ hatched from eggs placed over water must drop into the water, and therefore a measure of success may be had by using contact insecticides on its surface at hatching time.

The method so long used of applying some oily or ill-smelling substance to stock for the purpose of repelling the flies has certain virtues that should not be lost sight of, but a single application is of such short duration and the objection to making such applications to animals so common that if any other equally effective measures could be brought out the former would become unpopular.

Since the injury caused by horseflies is produced only by the adults, a remedy for this stage is most desirable, and it is to be hoped that a careful study of the habits of this stage may reveal points where successful attacks may be made. Porchinski, of Russia, and Howard, of this country, have already made a notable contribution along this line; and besides, the habit which the adults of some species, at least, have of collecting in certain situations seems to offer promise of good results. In the few experiments I have made in this connection it has been demonstrated to my satisfaction that it is possible to get good results by systematically trapping the adults.

TREASURER'S REPORT.

TREASURER'S OFFICE OF THE GULF BIOLOGIC STATION,
LAKE CHARLES, LA., April 18, 1904.

H. A. Morgan, Director Gulf Biologic Station, Baton Rouge, La.

SIR—In accordance with your request, I beg leave to submit the following report of receipts and disbursements for account of Gulf Biologic Station from the beginning of its operations in 1900 to the present date, April 18, 1904.

Frank Roberts, Treasurer Gulf Biologic Station, in account with Gulf Biologic Station—

RECEIPTS.

Jan. 9, 1900—Cameron Parish	$ 500.00
Jan. 9, 1900—Calcasieu Parish	100.00
June 10, 1901—Perkins & Miller L. Co	50.00
June 13, 1901—State of Louisiana	5,000.00
Aug. 21, 1901—H. C. Drew	100.00
Aug. 23, 1901—North American L. & T. Co	250.00
July 18, 1902—State of Louisiana	1,250.00
Oct. 10, 1902—State of Louisiana	1,250.00
Jan. 7, 1903—State of Louisiana	1,250.00
April 4, 1903—State of Louisiana	1,250.00
July 7, 1903—State of Louisiana	1,250.00
July 22, 1903—Board of Health	225.00
Sept. 4, 1903—Board of Health	75.00
Sept. 9, 1903—Board of Health	75.00
Oct. 3, 1903—State of Louisiana	1,250.00
Oct. 16, 1903—Board of Health	75.00
Nov. 13, 1903—Board of Health	75.00
Jan. 12, 1904—State of Louisiana	1,250.00
April 9, 1904—State of Louisiana	1,250.00
	$16,525.00

DISBURSEMENTS.

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
November, 1900—					
7. N. Y. draft, H. A. Morgan	....	....	....	....	$ 31.00
7. N. Y. draft, H. A. Morgan	....	....	....	....	88.70
7. W. C. Robinson	$ 45.10	....	....	....	....
May, 1901—					
28. H. & G. W. Lord	22.40	....	....	....	....
28. R. P. Charles	6.10	....	....	....	....
28. Jno. J. Kane	16.00	....	....	....	....
31. Jno. Raum	8.63	....	....	....	....
June, 1901—					
10. Monongalia Co.	2.75	....	....	....	....
10. Fuqua Hardware Co	....	40.51	....	....	....
10. Schering & Glatz	13.50	....	....	....	....
10. Somerville & Sons	4.63	....	....	....	....
13. Baker Bros. & Co	44.00	....	....	....	....
17. Frt. pkg. drugs	1.25	....	....	....	....
21. Express Washington	1.65	....	....	....	....
22. Express Queen & Co	1.15	....	....	....	....
24. Frt. two crates bottles	4.75	....	....	....	....
July, 1901—					
1. Frt. Washington	2.74	....	....	....	....
12. Queen & Co	11.34	....	....	....	....
13. Hemenway F. Co	14.00	....	....	....	....
	$ 199.99	$40.51	....	....	$119.70

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$ 199.99	$40.51	....	....	$119.70
August, 1901—					
14. H. A. Morgan	....	....	....	....	53.29
17. S. P. Henry	....	412.05	....	....	....
22. S. P. Henry	....	94.45	....	....	....
22. S. P. Henry	....	50.14	....	....	....
23. H. A. Morgan	....	....	....	....	300.00
23. H. G. Rheimes	....	166.45	....	....	....
23. S. P. Henry	....	60.72	....	....	....
September, 1901—					
3. Murray-Brooks H. Co.	....	13.43	....	....	....
3. Von Phul & Gordon	4.85	....	....	....	....
3. S. P. Henry	....	34.57	....	....	....
3. S. P. Henry	....	139.92	....	....	....
3. S. P. Henry	....	71.64	....	....	....
3. Hemenway F. Co.	18.50	....	....	....	....
7. H. E. Buck	....	34.00	....	....	....
27. Jno. H. Poe	....	211.25	....	....	....
25. Calcasieu Iron Works	....	.90	....	....	....
28. Lock-Moore Co.	....	82.33	....	....	....
October, 1901—					
2. Murray, Brooks H. Co.	....	5.75	....	....	....
8. S. P. Henry	....	49.86	....	....	....
11. S. P. Henry	....	175.97	....	....	....
	$223.34	$1,643.94	....	....	$472.99

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$223.34	$1,643.94	....	....	$472.99
October, 1901—					
30. Jno. H. Poe	....	32.50	....	....	....
November, 1901—					
27. S. P. Henry	....	211.04	....	....	....
27. S. P. Henry	....	67.20	....	....	....
December, 1901—					
2. Perkins & Miller L. Co	....	235.10	....	....	....
9. Murray-Brooks H. Co	....	146.55	....	....	....
11. H. C. Drew	....	526.00	....	....	....
20. S. P. Henry	....	54.07	....	....	....
20. S. P. Henry	....	327.57	....	....	....
January, 1902—					
3. A. Bruckert	....	412.50	....	....	....
4. Perkins & Miller L. Co	....	36.00	....	....	....
6. A. Bruckert	....	7.50	....	....	....
7. Murray-Brooks H. Co	....	145.50	....	....	....
9. S. P. Henry	....	37.54	....	....	....
9. S. P. Henry	....	259.84	....	....	....
18. H. A. Morgan	....	23.05	....	....	....
February, 1902—					
3. Murray-Brooks H. Co	....	17.50	....	....	....
15. S. P. Henry	....	77.27	....	....	....
15. S. P. Henry	....	47.60	....	....	....
	$223.34	$4,308.27	....	....	$472.99

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$223.34	$4,308.27			$472.99
March, 1902—					
3. H. A. Morgan		11.90			
5. A. Bruckert		77.50			
22. S. De Borge		58.97			
22. S. De Borge		60.00			
April, 1902—					
3. Perkins & Miller L. Co.		7.04			
11. H. E. Buck		15.00			
4. Murray-Brooks H. Co.		21.90			
21. B. F. Avery & Son	27.00				
May, 1902—					
6. C. F. Henry		22.38			
6. C. F. Henry		3.00			
6. C. F. Henry		21.26			
13. A. Bruckert		1.10			
13. A. Bruckert		53.55			
13. A. Bruckert		177.10			
13. A. Bruckert		1.00			
16. Hemenway F. Co.	37.00				
13. S. De Borgue		6.75			
23. S. P. Henry		239.26			
June, 1902—					
7. Barnett Bros.		31.00			
	$287.34	$5,116.98			$472.99

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$287.34	$5,116.98	....	....	$472.99
June, 1902—					
11. Frt. pkg. to Rochester	....	1.91	....	....	....
30. S. De Borgue	....	18.00	....	....	....
July, 1902—					
1. B. & L. Optical Co	32.08	....	....	....	....
3. Perkins & Miller L. Co	....	3.42	....	....	....
3. Murray-Brooks H. Co	....	76.75	....	....	....
5. A. Bruckert	....	88.65	....	....	....
5. A. Bruckert	....	4.50	....	....	....
5. A. Bruckert	....	.50	....	....	....
18. Von Phul & Gordon	6.93	....	....	....	....
21. H. A. Morgan	....	....	....	....	326.60
September, 1902—					
8. C. F. Henry	....	28.00	....	....	....
5. C. F. Henry	....	18.70	....	....	....
10. C. F. Henry	....	88.92	....	....	....
10. L. C. Planing Mill	....	21.55	....	....	....
10. Perkins & Miller L. Co	....	84.09	....	....	....
11. Murray-Brooks H. Co	....	14.30	....	....	....
26. H. C. Drew	....	111.50	....	....	....
October, 1902—					
1. H. A. Morgan	....	12.10	....	....	....
1. H. A. Morgan	....	5.00	....	....	....
	$326.35	$5,694.87	....	....	$799.59

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$326.35	$5,694.87	....	....	$799.59
October, 1902—					
2. C. F. Henry	....	6.90	....	....	....
10. A. Bruckert	....	145.00	....	....	....
31. S. De Borgue	....	51.75	....	....	....
November, 1902—					
10. A. Bruckert	....	55.00	....	....	....
10. H. A. Morgan	....	....	....	....	100.00
11. L. C. Planing Mill	....	9.05	....	....	....
11. Murray-Brooks H. Co	....	5.25	....	....	....
December, 1902—					
5. A. Bruckert	....	55.00	....	....	....
January, 1903—					
5. Perkins & Miller L. Co	....	62.34	....	....	....
5. A. Bruckert	....	55.00	....	....	....
8. C. F. Henry	....	23.50	....	....	....
February, 1903—					
2. L. C. Planing Mill	....	2.15	....	....	....
2. Murray-Brooks H. Co	....	12.50	....	....	....
2. Perkins & Miller L. Co	....	30.36	....	....	....
4. W. M. McCall	....	....	25.00	....	....
9. A. Bruckert	....	55.00	....	....	....
17. L. C. Planing Mill	....	4.75	....	....	....
	$326.35	$6,268.42	$25.00	....	$899.59

DISBURSEMENTS—*Continued.*

		Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward		$326.35	$6,268.42	$25.00	....	$899.59
March, 1903—						
4.	M. W. McCall	....	....	25.00	....	....
6.	B. F. Avery & Sons	6.59	....	....	....	....
6.	H. A. Morgan	....	....	....	....	114.95
9.	Murray-Brooks H. Co	....	16.12	....	....	....
10.	A. Bruckert	....	55.00	....	....	....
12.	N. Y. Exch	....	....	30.00	....	....
April, 1903—						
6.	M. W. McCall	....	....	25.00	....	....
7.	O. C. Glaser	....	....	58.33	....	....
9.	C. F. Henry	....	....	24.00	....	....
9.	C. F. Henry	....	....	7.60	....	....
9.	C. F. Henry	....	13.90	....	....	....
11.	A. Bruckert	....	55.00	....	....	....
15.	W. M. McCall	....	....	10.00	....	....
15.	W. M. McCall	....	....	30.00	....	....
17.	O. C. Glaser	....	....	48.25	....	....
May, 1903—						
4.	Murray-Brooks H. Co	3.60	....	....	....	....
4.	C. F. Henry	....	....	....	$8.00	....
4.	M. W. McCall	....	....	25.00	....	....
8.	Clark & Courts	31.00	....	....	....	....
11.	C. F. Henry	....	27.76	....	....	....
		$367.54	$6,436.20	$308.18	$8.00	$1,014.54

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$367.54	$6,436.20	$308.18	$8.00	$1,014.54
May, 1903—					
15. N. O. Exch., B. M. Munroe	1,242.50	....	....	....	....
15. B. F. Avery & Sons	54.93	....	....	....	....
15. H. A. Morgan	....	....	16.45	....	....
27. S. De Borgue	....	45.00	....	....	....
29. O. C. Glaser, N. O. Exch	....	....	75.00	....	....
June, 1903—					
4. A. Bruckert	....	55.00	....	....	....
4. M. W. McCall	....	....	25.00	....	....
4. C. F. Henry	....	....	....	8.00	....
4. C. F. Henry	....	18.50	....	....	....
8. L. C. Planing Mill	....	15.25	....	....	....
8. Murray-Brooks H. Co	....	8.40	....	....	....
11. C. F. Henry—Thos. Bonsall	20.00	....	....	....	....
13. A. P. Sale, Agt	62.48	....	....	....	....
23. A. Bruckert	....	38.00	....	....	....
24. Pacific Express Co	1.50	....	....	....	....
10. R. M. Munroe	1,383.90	....	....	....	....
29. H. A. Morgan	....	....	110.90	....	....
July, 1903—					
3. M. W. McCall	....	....	25.00	....	....
6. O. C. Glaser	....	....	25.00	....	....
6. C. F. Henry	....	29.10	....	....	....
	$3,132.85	$6,645.45	$585.53	$16.00	$1,014.54

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$3,132.85	$6,645.45	$585.53	$16.00	$1,014.54
July, 1903—					
6. C. F. Henry	....	....	....	8.00	....
7. Busch & Lomb O. Co	33.50	....	....	....	....
13. Rock Hardware Co	19.00	....	....	....	....
17. C. H. Kretz	....	....	35.30	....	....
21. M. W. McCall	....	....	6.20	....	....
22. E. T. Burrows & Co	....	213.14	....	....	....
29. N. Y. Exch	6.10	....	....	....	....
August, 1903—					
10. E. Anderson	....	....	75.00	....	....
10. O. C. Glaser	....	....	50.00	....	....
11. Bryan Imp. Co	....	....	5.00	....	....
11. Murray-Brooks H. Co	1.75	....	....	....	....
11. M. W. McCall	....	....	54.00	....	....
11. Interstate Electric Co	22.33	....	....	....	....
29. Capt. F. Ford	....	....	24.00	....	....
29. Capt. J. Picinich	....	....	2.25	....	....
29. O. C. Glaser	....	....	25.00	....	....
September, 1903—					
1. C. F. Henry	....	....	34.00	....	....
1. E. Anderson	....	....	82.50	....	....
2. B. F. Moss	....	....	.80	....	....
2. Kaufman Merc. Co	18.50	....	....	....	....
	$3,234.03	$6,858.59	$979.58	$24.00	$1,014.54

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$3,234.03	$6,858.59	$979.58	$24.00	$1,014.54
September, 1903—					
2. C. F. Henry	....	....	....	8.00	....
2. C. F. Henry	....	....	18.70	....	....
2. Perkins & Miller L. Co	....	7.61	....	....	....
3. Murray-Brooks H. Co	24.75	....	....	....	....
4. M. W. McCall	....	....	25.00	....	....
4. M. W. McCall	....	....	25.00	....	....
8. Prof. Morgan	....	....	51.87	....	....
9. Murray-Brooks H. Co	4.75	....	....	....	....
9. I. Vaughn	....	....	17.00	....	....
9. I. Vaughn	....	....	5.00	....	....
9. M. W. McCall	....	....	33.00	....	....
9. A. H. Thomas Co	10.00	....	....	....	....
9. Elstner Gro. Co	....	....	118.10	....	....
9. C. F. Henry	....	....	....	8.00	....
9. C. F. Henry	....	....	4.90	....	....
9. W. A. Bailie Co	2.40	....	....	....	....
25. Von Phul & Gordon	2.10	....	....	....	....
25. Von Phul & Gordon	....	....	7.00	....	....
25. Elstner Gro. Co	....	....	1.00	....	....
19. O. C. Glaser	....	....	50.00	....	....
30. O. C. Glaser	....	....	150.00	....	....
30. O. C. Glaser	....	....	10.50	....	....
	$3,278.03	$6,866.20	$1,496.65	$40.00	$1,014.54

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$3,278.03	$6,866.20	$1,496.65	$40.00	$1,014.54
September, 1903—					
30. C. J. Crossman	....	....	6.00	....	....
October, 1903—					
1. Murray-Brooks H. Co.	1.55	....	....	....	....
1. Wells-Fargo Express	....	....	5.10	....	....
3. Rock Hardware Co.	3.95	....	....	....	....
3. C. F. Henry	....	....	....	8.00	....
3. M. W. McCall	....	....	25.00	....	....
3. C. F. Henry	....	....	3.60	....	....
8. Capt. Moss	....	....	.60	....	....
9. C. J. Crossman	....	....	24.40	....	....
15. M. W. McCall	....	....	1.50	....	....
23. H. A. Morgan	....	....	100.00	....	....
24. Dr. Glaser	....	....	3.40	....	....
November, 1903—					
3. M. W. McCall	....	....	25.00	....	....
12. C. F. Henry	....	....	3.95	....	....
12. C. F. Henry	....	....	....	8.00	....
December, 1903—					
3. M. W. McCall	....	....	25.00	....	....
5. Bryan Imp. Co.	....	....	5.00	....	....
17. C. F. Henry	....	....	8.65	....	....
17. C. F. Henry	....	....	....	8.00	....
Forward	$3,283.53	$6,866.20	$1,733.85	$64.00	$1,014.54

DISBURSEMENTS—*Continued.*

	Equipment.	Construction.	Operating Expense.	Rent.	Preliminary Expense.
Forward	$3,283.53	$6,866.20	$1,733.85	$64.00	$1,014.54
January, 1904—					
7. C. F. Henry	....	....	5.85	....	....
7. M. W. McCall	....	....	25.00	....	....
7. C. F. Henry	....	....	....	12.00	....
14. Bell Lumber Co	....	37.80	....	....	....
15. D. Goodman	....	5.50	....	....	....
19. Murray-Brooks H. Co	11.70	....	....	....	....
February, 1904—					
4. M. W. McCall	....	....	25.00	....	....
5. Jas. Clooney	....	....	69.50	....	....
March, 1904—					
1. M. W. McCall	....	....	25.00	....	....
4. C. F. Henry	....	....	....	16.00	....
4. C. F. Henry	....	....	17.15	....	....
4. H. A. Morgan	....	....	100.00	....	....
4. O. C. Glaser	....	....	10.00	....	....
15. Von Phul & Gordon	....	....	7.00	....	....
April, 1904—					
6. M. W. McCall	....	....	25.00	....	....
Totals	$3,295.23	$6,909.50	$2,043.35	$92.00	$1,014.54

SUMMARY.

Receipts forward..................		$16,525.00
Disbursements—		
Preliminary Expense acct...........	$1,014.54	
Construction acct....................	6,909.50	
Operating Expense acct.............	2,043.35	
Equipment acct.....................	3,295.23	
Rent acct..........................	92.00	13,354.62
Cash balance................		$3,170.38

FRANK ROBERTS, Treasurer.

STATEMENT.

The investigations of the Station on account of the nature of the work must of necessity be conducted during the spring and summer months. The funds now in the hands of the Treasurer have been appropriated, and contracts have been made, which will entirely consume, the balance on hand, and the future of the Station is dependent upon appropriations to be made by this Legislature.

The following is the estimate of requirements for the next two years:

Salary of Oyster Expert per year $1800.00..........	$3600.00
Salary of Engineer and Boatman per year $900......	1800.00
For Boat fuel and repairs, $500.00 per year..........	1000.00
Equipment and repairs of Laboratory, per year $1000.	2000.00
Care taker, per year $300.00.....................	600.00
Rent of quarters, per year $96.00..................	192.00
Conducting Oyster and other Experiments, per year $1000.00................................	2000.00
Total..............................	$11,192.00