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Oyster investigations in Bras d'Or lakes, 1938.

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OYSTER INVESTIGATIONS

IN

BRAS D'OR LAKES

1938

J. C. Medcof.

INTRODUCTION

The writer went to Cape Breton Island on May 9th, 1938, to continue the oyster investigations which were carried on there in 1936 and 1937 by G. F. M. Smith and C. J. Kerswill.

Besides the direct investigational work reported below many time-consuming examinations were made of ground which had been applied for by prospective oyster farmers as leases. These examinations were confined almost entirely to River Denys Basin.

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HANDLING OF THE 1937 CATCH OF SPAT

The separation of 1937 spat from the collectors was begun on May 24th and completed on July 16th.

At Crowdis bridge the spat were larger and present in larger numbers per collector than at Gillis cove. A count of the number of spat on one collector of what seemed to be an average Crowdis bridge bundle gave 1275 spat. A fair average estimate for the number of spat per bundle would therefore be 5,000.

Most of the spat were used at once to set up tray or bottom-rearing experiments but some were "bedded" for two weeks or more at Stoney point awaiting the completion of several trays that were built.

Twelve bundles of spat were sold to local people interested in oyster culture.

REARING EXPERIMENTS

A. Rearing on Trays

Rearing trials were carried out using both wire-bottomed and wood-bottomed trays in Gillis Cove and at Stoney point. The spat used were of the 1937 set and of two sorts. The first was separated from concrete-coated collectors at Crowdis bridge and Gillis cove. The second was "natural" or "eel-grass" spat collectoed along the shore at different places in the basin.

The tray spat were "culled" on July 28th and September 1st. In no case was the growth great enough to be regarded as satisfactory as judged by Prince Edward Island standrads. It was better than that obtained during 1937, however, in which year no "culling" was done.

Crowding of spat in trays reduced the growth of the stock and increased its mortality. In few cases, however, was the mortality as serious as in bottom-rearing where the spat are at the mercy of starfish.

Stock reared in wooden-bottomed trays suffered especially high mortality and showed almost no growth at all possibly because of the poor water circulation through the tray.

At the end of the season the "natural" spat were the best-shaped of all the stock, showed least mortality and considering the late date at which they were collected, showed comparatively good growth.

TABLE I.
(To follow page 2.)

TRAY-REARING EXPERIMENTS WITH 1937 SPAT

Place and Particulars	Equivalent No. in 4' x 12' tray	Source of Spat	Date set up	Date Measured	No. in Meas. Sample	Change in modal pos. for living animals.m.m	% mort-ality	% increase in size
Gillis cove.(Screen bot. on tray).	2,500	"Natural"	July 17	Oct. 28	72	26-46 m.m.	0	77
Stoney point	5,000	"	" "	" "	119	26-40 "	3	54
Gillis cove (deep lidless tray).	10,000	C. Bridge	" "	" 29	122	19-33	13	74
Gillis cove	10,000	G. cove	" "	Nov. 4	178	15-30	17	100
" "	20,000	" "	" "	Oct. 29	84	15027	35	80
Stoney point	5,000	C. Bridge	" "	Nov. 8	171	19-33	3#	74
Stoney point	10,000	C. Bridge	June 8	Nov. 4	121	19-30	30	58
Gillis Cove (Wooden Bottom tray).	10,000	C. Bridge	July 8	Nov. 9	131	19-19	40	0
Stoney Point (Wooden bottom tray).	10,000	C. Bridge	July 8	Nov. 4	152	19-22	20	2
Crowdis Bridge	10.000	C. Bridge	July 8	Nov. 9	191	19-28	14	5
RESULTS OF 1937 TRAY-REARING IN GILLIS COVE OF 1926 SPAT								
Gillis cove A (Screen test tray).	15,000	G. Cove	?	May 16-38	165	16-22#	12	37
					228	16-20	10	25
					211	16-22	21	37
					175	16-19	28	19

3 Not a good sample
16 From Smith's Report for 1937.

TABLE I.
2-Continued
(To follow page 2)

STOCK USED IN SETTING UP REARING EXPERIMENTS

Place and Particulars	Equivalent No. in 4' x 12' tray	Source of spat	Date set up	Date measured	No. in meas. sample	Change in modal pos. for living animals m.m.	% Mortality	% incr. in size.
			1937					
1937 Crowdis B. Spat	---	---	July-Aug.	June 10	311	0-19 m.m.	-	-
1937	---	---	" "	" 8	397	0-15 m.m.	-	-
1937 "Natural" spat	---		" "	July 17	144	0-26 m.m.		
Tray oysters (Spat of 1936).	See column		Results of 1937 tray-rearing of 1936 spat					
Small screened spat			July-Aug.	June 8 & 10	718	0-17av.		
Large " "			" "		45	0-30 av.		

B. Bottom Rearing

In these rearing tests three types of stock were used, namely, 1936 spat reared during 1937 on trays, 1937 spat separated from concrete-coated collectors and 1937 "natural" spa t picked from along shore at various points in the basin. In some cases the tock was separated into "large" and"small" by screening through a wire mesh that retained those spat with an average diameter greater than 2.7 cm.

Table II. gives the results of these tests which were carried out largely in Gillis cove and at Stoney point. It will be noted that on most of the plots there was a heavy mortality especially in the case of "small" stock. While considering the figures in that colum n of Table II headed "% increase in size" it should be borne in mind that the figures are based only on the sizes of living animals found in the samples.

The high mortality is partly attributed to the continued attacks of starfish. A discussion of the starfish problem is to be found in another section of this report.

Judged by Prince Edward Island standards the results of bottom rearing of small oysters are not encouraging from the oyster-culturist's point of view. Conditions in Gillis cove are apparently more favourable than at Stoney point.

A discussion of the basis for the poor growth of oysters in the Bras d'Or lakes is to be found in the section of this report headed "Plankton Studies and the Condition of Oysters".

TABLE II.

BOTTOM REARING EXPERIMENTS

Place and Particulars	Stock and date planted.	Date of plant & of measurement.	No. measured in sample.	Change in modal position ofr living animals	% Mortality	% Increas in size.
Stonny Point on flat in 18" of water	1937 Natural spat where they settled.	July 1937 Oct.11-38	50	0-44 m.m.	---	
Stoney Point on bed in 4' of water	1937 Natural spat	July 17-38 Oct. 11-38	117	26-41 m.m.	55	58
Stoney Point 5-8' deep. Plot II	Large '37 spat from 1st culling.	July 30-38 Oct. 4-38	119	19-34	50	79
Same. Plot III	'37 spat after separation	June 6-38 Oct. 29-38	124	19-41	62	112
Same. Plot VII and VI	'37 spat	July 17-38 Oct. 29-38	99	19-39	90	101
Gillis Cove bed	Large screened '37 spat	June 29-38 Nov. 8-38	61	30-41	15	37
Gillis cove bed	Small screened '37 spat	June 29-38 Nov. 8-38	141	15-35	71	starfish 113

TABLE II.
(Continued)

Place and Particulars	Stock and date planted.	Date of plant & of measurement.	No. measured in sample.	Change in modal position for living animals	% Mortality	% increase in size.
Stoney Point. Plot IV and V	1936 spat from trays.	June 16-38 Nov. 4-38	87	22-45	59	100
Gillis Cove. Bed	1936 spat left on shells during 1937	June /37 to June 13	528	16-33	75	110
Gillis Cove "	'36 spat large screened from trays	From June 16 to Nov. 8-38 June 16 to	69	33-51	10	55
Gillis Cove "	'36 spat: small screened from trays	June 16-38 Nov. 8-38	122	22-39	34	77
North Basin near Robert Gillis' lease	'36 spat: large from trays	June 15-38 Oct. 28-38	116	22-47	59	110
Miscellaneous						
Gillis Cove	'36 spat: left in collector during 1937	July /37 June 8-38		15-51		240
	some left on during '37&38	Jun3 8/38 Oct. 29-38		51-61		20

TABLE II.
(Continued)

Place and Particulars	Stock and date planted	Date of plant and of measurem tnt.	No. measured in sample	Change in modal pos. for living animals.	% mortality	% Increase in size.
Gillis cove	1937 spat left in collectors 2' deep.	June 8-38 Oct. 29-38	48	15-50		230
Gillis cove.	1937 spat left in collectors 7' deep (touched bottom)	June 8-38 Oct. 29-38	59	15-50	32 star-fish attacks	230

SPAT COLLECTION AND SPAT MORTALITY

Collection with concrete-coated egg case fillers.

In all 530 bundles, each of four collectors wrapped in fox wire, were set out. Approximately 300 were placed in the water at Crowdis bridge, July 8-12, and 230 at Gillis cove, July 9-11. The spatfall maximum had been predicted on July 8th as due on July 18th.

At Crowdis bridge about half the collectors were suspended from the iron work on the under side of the larger of the two bridges crossing the river. The rest were hung from poles placed in three banks further down stream on the shoal where the water was about seven feet deep. Some twenty collectors were hung separately on stakes driven into the bottom at "likely" places for a quarter of a mile above and below the bridge in water varying from three to twelve feet deep. All received comparatively good sets of spat and, at the end of the season, showed only slight differences in the numbers caught and in the growth attained. No counts were made to determine the actual diversity of the sets at these different places.

At Gillis cove the collectors were hung from poles in places which during 1936 and 1937 had proven satisfactory. Here the sets were particularly heavy as might be judged from the high counts reported for the experimental collectors (table VI.). At

Gillis cove the catch was approximately twenty times as heavy as At Crowdis bridge.

Spat mortality at Gillis Cove.

It was found within a week after the peak set that most of the spat on the plain surfaces of the collectors in Gillis cove must have died shortly after settlement for their shells were empty and showed, on the average, that the equivalent of only one to two days normal shell growth had taken place after settlement. It was noted, further, that the spat that settled on the wire wrapping of the bundles surfived in much higher proportion than did those on the flat surfaces of the collectors.

A similar observation was made in the case of the brush collectors for while the great majority of spat settling on the flat blades of the green leaves, poplar, birch etc, died, those attached to spruce needles, small twigs and the petioles of the broad leaves, generally survivesand grew normally.

No peculiar hydrographic, meteorological or biological condition was observed that might explain this differential mortality directly. Starvation, related to over-crowding and a low food supply, is suggested as a possible explanation. Nelson (1930) has recorded general mortalities among the spat in Banegat bay but these were apparently more wholesale involving complete sets. This worker is likewise at a loss to explain the phenomena. In addition to those collectors placed at different points in River Denys about Crowdis bridge other "test" bundles were suspended from stakes on July 17th.

in Orangedale bay, in Martin's cove, at Stoney point over the experimental plots and over J. A. MacLean's lease. All of these showed good sets especially those in Orangedale bay and Martin's cove.

On the whole the season's catches on concrete-coated collectors were good and it might be said that spat collection was far from being a crucial problem in any part of River Denys basin where tests were made.

Collection with Brush in Gillis Cove

In order to test the value of brush as a collector of oyster spat small branches, the largest not exceeding the thickness of a man's thumb, were wrapped into bundles about stakes. These bundles, approximately two feet through and five feet long, were then submerged and made to lie horizontally at a depth of two feet below the surface. These were attached to stakes previously driven into the bottom where the water was about seven feet deep in Gillis cove.

At least two bundles of each type of brush were made up and in some cases three. When possible, dead brush cut the previous winter(1936-37) was obtained as well as the "green" which latter was submerged, leaves and all, the same day it was cut. In the experiment the following types of brush were represented: yellow birch, dead and green; white birch, dead and green; wild plum, dead and green; spruce, dead and green; wild cherry, green only; poplar, green only. The bundles were placed in the water on July 15th and 16th. The various sorts were almost uniformly successful and

showed a good catch of spat. The broad leaf blades of the deciduous trees caught particularly heavily but as is pointed out above, most of the spat on these died soon after settlement.

At the end of the season the dead spruce looked the best although the superiority was slight. By September 10th most of the leaves of the deciduous type had fallen off as well as many of the small twigs. The spruce needles were still attached, however, and bore many well-grown spat.

In general the brush spat showed good growth, survived better than "collector" spat in Gillis cove and proved to be easily separable from their twigs or needles. The results of the test would suggest that brush bundle collectors might be successfully used regularly as a source for seed oysters in the Bras d'Or districts where production cost must be reduced to a minimum if oyster culture is to justify itself.

SPAWNING AND LARVAL HISTORY IN 1938

As in 1937 (Smith 1937) the oysters were slow to develop sexual products and appeared lank right up to the spawning date. A summary of observations on the gonads and general condition throughout the season appears in Table III. These results indicate that the bulk of the spawning occurred between June 22nd and July 8th.

The sudden rise in water temperatures on June 22nd, 23rd, and 24th seems to have been responsible for the spawning burst which probably took place on the same days. The oysters in most cases seemed to have largely "spawned out" on the three dates for subsequently they were poor and watery until nearly the middle of September. As a result there was only a single but fairly compact age group of larvae observed in plankton catches.

Size-frequency distribution studeis were made on samples of the larvae taken in tows with a #18 bolting-cloth net, on various dates from Gillis cove and River Denys at Crowdis bridge. An ocular micrometer and a 6 b. Reichert objective were used for measurement. Much of this study was carried out while the material was still fresh and unbleached by formalin. It was thus discovered that the colour tints of oyster larvae appear earlier than the seventh of eighth day after spawning as is commonly stated (Nelson 1921). When larvae are in the straight-hinge condition, two to three days old, and measure 70 in average diameter, a definite rose tint appears

TABLE III.

CONDITION OF CAPE BRETON OYSTERS IN 1938.

Date	Source	Number examined ♂	Number examined ♀	Number examined Indeterminate	Condition of Germ Cells	General Condition of oysters
May 9	Gillis cove			6	Undeveloped and therefore undetermined	Lank and watery: fresh.
June 5	Gillis cove from 1'-5' deep	4		2	Active sperm in some: eggs look nearly mature (1 hermaphrodite).	Spawn layer (ventral to heart. 1/16" - 3/16" thick: condition better but still watery.
June 8	Crowdis bridge from 5'-8' deep	4	4	1	Mostly immature: those four from 8' of water are indeterminate.	Generally poorer than Gillis cove oysters. Spawn layer 1/16 -1/8" thick.
June 21	Gillis cove from 2½'	2		4	Some may have spawned lightly: all ripe: spawn "runs" when animal is cut.	Spawn layer 1/8" thick. Oyste are in fair condition.
June 22	Crowdis bridge from 4'-5' deep	7			Five contained active sperm	All look watery.
July 8	Orangedale bay from 3' deep			2	Seem to have spawned considerably but still "run" when cut.	Spawn layer 1/8" thick.
June 22	Stoney Point	2			Spawn runs: but no indication of having spawned.	Spawn laer 1/16 - 3/16" thick.

TABLE III.
(Continued)

Date	Source	No. examined ♂	Indeterminate ♀	♀	Condition of Germ Cells	General Condition of Oysters.
July 26	Gillis cove from 2' deep				Almost empty of spawn.	Very poor; watery and gray-brown coloured.
July 28	St. Ann bay from 7' deep	6		3	Spawn runs: may have spawned a little.	Better than Bras d'Or oysters. Spawn layer 1/16" thick. Condition fair.
Sept. 1	Stoney point		2		Poor watery: gray-brown coloured: no sperm	Very poor.
Sept. 1	South Basin of R. Denys		4		Same as those from Stoney Point	Very poor.
Seot. 6	Malagawatch		6			Fatter than last: creamy over whole body: sweet taste and salter
Sept. 6	Gillis cove		6			Losing gray-grown colour and begin to show creamy: flat taste.
Sept. 26	Gillis cove		6		Local people say, "Oyster have been improving since two weeks": creamy all over now but still lank.	
	Stoney point		6			
Oct. 19	South basin		6		Oysters are in only fair condition: "poor compared with other years": fishermen say.	

about the hinge line. This is of considerable aid in recognition of larvae of oysters when mixed with young of other bivalves, as is ordinarily the case.

The results of the measurement of larvae appear in Table IV.

Larval settlement was carefully followed by counts of spatfall on experimental collectors exposed at Gillis cove and Crowdis bridge. The collectors were in the form of sections of egg-case fillers coated with concrete, each section having a total surface area of approximately 105 centimetres. By arranging 6 brackets in vertical series on an eight foot piece of #9 wire weighted at it slower end, it was possible to mount these sections horizontally. These were firmly clamped but were easily renewed atintervals of from one to three days, after which they were filed in envelopes. The counting of spat was done with a binocular microscope during the winter 1938-39. The results of the counts appear in Tables V and VI where the numbers of spat settling on the lower and upper surfaces of the sections are reported separately.

In order to establish the mean size of the matured oyster larva of the Bras d'Or lakes a series of measurements was made of the prodissoconch's of freshly settled spat. From a sample of 59, 1926 spat the modal size was height 360 μ length 340 μ. The mode for prodissoconch height from measurements of 100 1938 spat was 354 μ.

TABLE IV.
(Height)

SIZE-FREQUENCY DISTRIBUTION OF OYSTER LARVAE BRAS D'OR LAKES 1938.

Size in oc.	1					2									3										4								
Mic. Div.	7.	8.	9.	0.	1	.2	.3	.4	.5	.6	.7	.8	.9	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	.0	11	.2	.3	.4	.5	.6	.7	.8	.9
Date																																	
June 24	6	2																															
June 27			2	8	11	10	2	1	1									1															
		2	6	7	5	8	17	16	14	13		9		6	2	3						1											1
July 4					1		1	1	1	4		4		8	9	9	17	15	14	14	10		9	3	6	5							
July 8									1					2	5	7	7	11	7	9	11		7	10	10	13	12	9	9	8	5	4	2		1
July 11															1						1		1		1	5	2	6	10	6	7	6	11	6	7
July 15																													2	1		1			2
July 17																																	
Gillis cove samples																																	
June 24	1	1		2																													
June 27	1		3	4	4	10	9		1	1		1																					
June 29		1	2	3	4	3	3		7	4	4	7	11	8	4	5	4	5	7	3	5	2	4	5	3	3	1	1		2			1
July 2				2	3		2	1	7	4	11	7	10	11	4	3	1		2	2	4	1	3	6		1	1	4	10	4	11	1	
July 4							1	3	1	9	6	8	5	9	5	9	13	4	7	1	2	2	2			2		3	3				1
July 8									1	1		1		3	3	4		4	11	6	4	6	12	21	4	9	11	6	3	3	1		
July 11													1		1		1	1	1	2	4	2	3	3	7	3	5	4	7	3	10	6	7
July 14															1											1	1		1	3	1	1	4
July 16																									1								
July 18									1	1	2				1									1	1	1					1		
Crowdis bridge samples.																																	

1 oc. Mic. Division = 40μ

TABLE IV. CONTINUED.

(height)

SIZE-FREQUENCY DISTRIBUTION OF OYSTER LARVAE BRAS D'OR LAKES 1938.

.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Totals
																																								8
																																								36
																																								110
					3	2																																	136
2			1				1		1																															156
13	4	17	7	5	8	7	2	2	5	3	1									1																				144
	1	3	5	1	11	1	6	2	2	5	4	6	9	5	10	6	5	6	3	8	2	8	2	6	5	3	4	2	4		1	1		1						142
		2				1	2	3	1	4	2	2	2	1	8	6	6	5	6	5	5	4	8	6	11	8	11	5	4	12	4	9	3	2	4	2	1			155

Gillis cove samples

																																							4
																																							34
																																							117
	1					3																																	120
1	1			1																																			99
		2			2		2	1		2							2	1	2																				130
	3	4	1	1		1	2				1									1																				85
5	2	5	2	4		9	9	7	3	5	5	4	8	5	3		6	5	3		13		3	3	4	1	2	2		1			1			1		2		1	129
1	1	2				3	1	4	2	6	6	6	5	4	7	4		5	3	2		3	4	5	5	4	4	9	4	5	2		2			4	1	1			1	1	117
	2	2	1	2	1	2	1		2	4	2	2	4	6	5	3	5		5		6	3	7	11	11		8	10		5	6	5	3		6		5		4		3	7	4	3	3	2			170

Crowdis Bridge samples

CROWDIS BRIDGE: SPATFALL ON EXPERIMENTAL COLLECTORS 1938

ate	Surface		1' deep		2' deep		3' deep		4½' deep		6½' deep		Set on 630 sq. cm. of collector.	
	Up	down	up	down	up	down	up	down	up	down	up	down		
uly 6	0	0	1	0	0	0	0	0	0	0	0	0	Teredo	1
uly 8	0	0	0	0	0	0	0	0	0	0	0	0	Teredo	0
uly 11	0	0	0	0	0	0	0	0	0	0	0	0	Mussels Teredo	0
uly 13	0	1	1	0	0	0	0	1	0	1	1	0	Teredo	5
uly 15	2	3	2	2	1	1	3	0	2	0	0	1		17
uly 16	1	2	1	1	4	1	0	2	3	1	0	0		16
uly 17	5	5	5	4	4	1	1	0	0	0	0	2		27
uly 18	5	9	1	3	3	3	1	3	1	1	0	0		30
uly 19	13	22	16	25	8	21	8	9	6	7	2	3		140
uly 20	21	10	45	19	21	22	20	10	5	4	2	9		188
uly 22	42	26	17	11	14	17	46	20	7	8	2	7		217
uly 24	0	1	44	7	28	20	27	25	28	13	14	5		212
uly 26	5	0	37	12	20	19	20	18	21	8	5	5		170
uly 28	7	3	14	7	10	14	13	6	6	2	2	0		84
uly 30	3	4	5	0	0	2	2	1	1	0	0	0		18
g. 2	19	5	31	14	22	12	5	28	12	10	3	10		171
g. 5	9	4	15	5	11	9	11	4	4	4	3	3		82
g. 8	2	0	3	1	0	2	2	1	0	1	0	1		13
g. 11	4	0	3	0	0	2	0	2	0	1	2	0		14
g. 14	0	1	2	2	2	0	0	0	0	0	0	2		9
	138		96 243		113	148	146	159	130	96	61	36	48	1,4 14

Down 594 / up 820 Ratio = 0.73

= 1/20 of the set at Gillis cove

TABLE VI.

GILLIS COVE: SPATFALL ON EXPERIMENTAL COLLECTORS 1938

ate	Surface		1' deep		2' deep		3' deep		4½' deep		6½' deep		Set i 630 c
uly	up	down											
12		1		1		1						1	4
14													0
15							1	1	1	7		1	11
16	3	1			3	2		3			1	2	15
17	6	1	9	1	4	2	10	8	10	8	5	4	68
18	3	4	6	13	14	22	20	23	14	71	9	36	232
19	8	21	14	29	58	305	65	311	54	251	13	152	1281
22	730	390	1140	950	2300	2700	3000	2400	1950	2700	1500	2400	22160
25			12	50	380	440	520	380	400	530	280	360	3350
28	5	4	16	20	177	124	124	188	97	106	71	110	1040
31	6	3	26	7	15	16	10	40	12	27	17	18	197
ug. 3	3	1	7	7	5	8	7	22	18	20	15	26	139
6			1		1	4	7	5	4	19	4	24	69
9		1	1	1		3		6	2	6	1	7	28
12	1			1	1	5	1	10	1	5	1	4	30
15	-	-	1	1	1	7		5		4	3	9	31
	430	430	1230	1080	2960	3640	3770	3400	2570	3750	1920	3150	28,700

On this date only a fraction of the spat on each collector was counted and the "total" set" is a calculated figure.

The results of the measurements appear below in tables VII and VIII. The study suggests that the ultimate size of Bras d'Or lake larvae is practically identical with that for Bideford river oysters and that the larval period under the temperature conditions observed is quite comparable (See Medcof 1939).

The study of the Bras d'Or lakes larvae is summarized below in table IX. Since readings were not made every day it was necessary to interpolate from records in calculating the average daily water temperatures.

Table VII: Size frequency distribution of prodissoconch
Measurments of 59 1936 Bras d'Or lakes oyster spat.

Length in μ	290-299	300-309	310-319	320-329	330-339	340-349	350-359	360-369	370-379	380-389	390-399	Totals
270-279			1									1
280-289				1	1							2
290-299												
300-309												
310-319							1	1				2
320-329				1								1
330-339			3	2			2		1			8
340-349			1	1	1							3
350-359		1	3		2	3		2	1			12
360-369			2	3				1				6
370-379				1	1	3		4	2			11
380-389					2	2	1					5
390-399			1					2				3
400-409	1					1			1			3
410-419								1				1
420-429												
430-439											1	1
Totals	1	1	11	9	7	9	4	11	5		1	

Height mode @ 360μ

Length mode @ 340μ

TABLE VIII.

SIZE FREQUENCY DISTRIBUTION OF PRODISSOCONCH MEASUREMENTS OF 100 1938

Bras d'Or Lakes Oyster Spat

Size in ocular micrometer divisions

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
7	Frequencies					1			1	1
8	3	2	6	6	6	4	12	8	8	8
9	5	10	10	5	1	1	2			

Made for height 354μ.

TABLE IX.

SUMMARY OF LARVAL HISTORIES

Locality	Date of Spawning Maximum	Date of Settlement Maximum	Length of Larval Period	Daily Average water temperature during period @ 6' deep.
Crowdis Bridge	June 22-24	July 18-23	28+	19.7
Gillis Cove	June 22-24	July 19-21	28	19.2

THE PHASE AND THE RATE OF SPATFALL

On July 18th the experimental collectors were reversed several times at Crowdis bridge with the hope that some relation might be demonstrated between the stage of the tide and the rate of spat fall. This was the date on which the maximum set had been predicted on July 8th. Unfortunately the maximum was not reached until July 20th. As a result the number of spat caught was rather small and the results, summarized in table X, not very indicative. The figures suggest that when the tide was falling the sets were heavier than when it was rising or slack.

Further observations involving greater numbers of spat would be interesting.

For a record of hydrographic conditions observed during the experiment see Table XIII. in the section headed, "Special hydrographic study at Crowdis bridge".

TABLE X.

COUNTS OF SPAT SETTLING ON EXPERIMENTAL COLLECTORS

AT CROWDIS BRIDGE, JULY 18, 1938.

Depth of Collector, Ft.	Surface up	Surface D	1 up	1 D	2 up	2 D	3 up	3 D	up	D	up	D	Totals	Remarks on tide & current
Times of exposure														
22 hrs. July 17-10:00 a.m. to July 18- 8:30 "	5	9	1	3	3	3	1	3	1	1	0	0	30	
2½ hr. July 18-11:30-2 p.m.	0	0	1	0	0	1	0	1	0	0	1	0	4	Slack slack & rising
3 hr. July 18 8:30-11:30 a.m.	0	1	3	7	2	9	6	2	0	4	0	0	34	Falling slack
3 hr. July 18 2 p.m. to 5 p.m.	0	2	1	4	0	2	0	0	1	0	0	1	11	Rising & slack
3 hr. July 18 5 p.m. to 8 p.m.	5	4	6	3	0	1	1	1	0	0	0	0	21	Falling
	10	16	12	17	5	16	8	7	2	5	1	1	100	

PLANKTON STUDIES AND THE CONDITION OF OYSTERS

A very cursory study was made of the plankton collected by the #18 bolting cloth net used for taking the oyster larvae. A summary of the findings appears in Table XI. In addition to this study, on September 1st several counts were made of the numbers of minute flagellates in samples of water from Gillis cove and Stoney point. These showed average populations of 28 and 30 flagellates per cubic millimetre respectively as compared with 65 cubic millimetre for Bideford river August 30, 1937 (Medcof 1937).

Dinoflagellates were the only phytoplanktonic forms taken in the tows that ever became really numerous. Table XI shows that these were either absent or scarce until the middle of September. Table III, describing the condition of oysters, indicates that "fattening" did not begin until about this time. The hydrographic records show that the water temperatures were falling off rapidly by this date so that even though the quantity of food organisms was increasing its availability was decreasing (Galtsoff 1938).

Several observations other than the actual plankton studies support the conclusion that the Bras d'Or lakes are relatively "poor". The eel grass there seems to remain commonly bright green in appearance and free from encrusting growths of diatoms. So clean is it that the chief source of the natural oyster stock is from ~~xxxxx~~ spat settling on the "green" glades. (The scar of the blade remains visible on the unbone of the oyster shells for several years). To find clean eel grass in Prince Edward Island waters is a rare event. It is a logical assumption that if the water is generally too poor to support a growth of

TABLE XI.

PLANKTON HISTORY FOR GILLIS COVE AND RIVER DENYS AT CROWDIS BRIDGE.

Date	Oyster larvae	Clam larvae Mya	Mussel larvae	Teredo larvae	Gastropod	Copepod	Miscellaneous	Remarks
June 7					000	000		Large green algae cell common: no bivalve.
June 14		0	0			0000		Bivalve mostly in straight-hinge stage.
June 20		0000	00	0	000	0000		
June 24	0000	0000	00	0000	00000	0000		Many straight-hinge bivalves.
June 30	0000	00000	00	0000	00000			Clams and mussels large: Teredo half grown.
July 11	0000							Many straight-hinge bivalves.
July 23	000		000	000	00000		Cyania common	Tows contain almost nothing but molluscan larvae.
Aug. 3	0				00000		Dino fl. 0 Diatom 0	A "water bloom" of gastropod larvae that are over-grown with an unicellular green alga; looked like an Anabaena bloom in fresh water lakes
Aug. 15		00			0000		Dino fl. 0 Diatoms 00	More straight-hinge bivalves: Teredo ready to set
Aug. 29		0	0	0	000	000	Dino fl. 0 Diatoms 00	Scanty tows.
Sept.17					000	000	Dino fl. 000 Tintinainea	Few bivalves.

TABLE XI.
(CONTINUED)

Date	Oyster larvae	Clam larvae Mya.	Mussel larvae	Teredo larvae	Gastro- larvae	Cope- pod	Miscellaneous	Remarks
Sept.21						000	Dino fl. 0000 Diatoms 00	Few Molluscan larvae
Oct. 3					000	000	Dino fl. 000 Diatoms 00	Reduction in numbers of diatoms and dinoflagellates.
Oct. 19						0000	Dino fl. 00 Diatoms 0	Peak of diatom and dinoflag. is past.
Nov. 3						00	Dino fl. 0	Scant tow.
Nov. 28						0	Tenophores common Dino fl. 0	
Oct. 11					000	0000	Dino fl. 000 Diatoms 00	Still quite a few diatoms and dinoflagellates.

encrusting diatoms, it would be likewise incapable of producing any quantity of phytoplankton.

Throughout the entire season the water in the lakes was observed to be remarkably transparent. It was common to see bottom at twelve feet on calm days and on several occasions it was possible to see the bottom at Crowdis bridge, twenty-two feet down. In Bideford river during the summer it is usually impossible to see bottom in seven feet of water. Great clarity of water is usually associated with a low planktonic population.

These considerations support the belief that the prevailingly poor condition of Bras d'Or oysters is to be explained on the basis of inadequate food supply.

STUDIES ON SURVIVAL OF OYSTERS

An investigation of the factors influencing survival of small oysters was begun during the summer. Several plants of small oysters were made at points showing a wide range of differences in depth, bottom character and exposure to wave and ice action. Besides this, a study was begun of the natural survival dealing largely with the 1937 spat which constitute a particularly prominent sector of the natural stock. None of this data is sufficiently complete to present at this time. The writer expects to continue the work during the coming summer and to present a larger body of data in the 1939 report.

ST. ANN BAY OYSTERS

Oysters transplanted from the Bras d'Or lakes to St. Ann bay in 1936 were examined four times during the season but on none of these occasions were they found to be in good condition.

In May they were "fair" to "poor", many thin and watery but on the whole not so poor as those in the Bras d'Or lakes.

July 28 The condition had improved slightly and spawn was developing forming a layer, on the average, about 1/16" thick just ventral to the heart. Some looked as though they might have spawned a little.

August 17 The oysters were in about the same condition as in July. Some of the males contained active sperm that "flowed" when the body was cut. They were better than the Brad d'Or lakes" oysters on the same date.

September 22 The oysters are in slightly better condition than in the Bras d'Or lakes but still only "fair" to "poor".

By mid-October the condition had improved only very slightly over that in September.

Plankton Tows and Temperatures

On the dates listed above tows were made. In no case, howeve were oyster larvae found in them. It is significant that the St. Ann plankton tows always contained a much greater quantity of phytoplankton than those from the Bras d'Or lakes, yet in spite of this there was only a slight difference in the condition of oysters in the two places.

This circumstance is no doubt partly the result of the generally lower temperatures in St. Ann bay. At no time was a temperature as high as the oyster's spawning threshold (20°C) recorded.

The limited set of observations points to the conclusion that food materials were present in fair abundance at St. Ann bay but that low temperatures prevented the oysters from ilizing them to any great extent. Furthermore, temperature conditions while permitting the development of sex products were never favourable to any considerable spawning, if, indeed, they permitted it at all.

Starfish Problem.

In the sections of this headed "Rearing Experiments", it was noted that many lots of small oysters planted on the bottom suffered heavy mortality. Staffish are largely responsible for this loss.

During the summer a record was kept of the starfish removed from a Gillis cove experimental plot 30 feet square stocked with young oysters of the 1936 and 1937 sets. On the three dates, July 7, 23 and August 20, 70, 400 and 100 starfish, were removed respectively from this area. The animals were mostly small, averaging from 2 to 3 inches in diameter. The water over the plot was 2½' deep at the shoreward side and 4½' on the seaward side.

Starfish were common on the beds at Stoney point throughout the summer.

The 1938 season mu t have been favourable to the starfish for in the fall of the year the eel grass throughout the whole basin of River Denys was heavily populated with the small white young, measuring approximately 1.5 cm. in diameter.

Protection against shipworm

Parts of two trays which had been painted with the standard tar-copper mixture in use in Prince Edward Island suffered from the attacks of shipworm. The destruction in one case was not attributed to the failure of the coating for the section attacked had a "wind" edge and the painting had been done over the bark which subsequently came loose leaving an area of free entry for the settling shipworm larvae.

In the second case the wood attacked was planed lumber which was covered with less of the preservative than the rest of the tray which was made of unplaned wood.

In 1937 copper paint was used successfully as a protection so that 1938 was the first time that the tar-copper mixture had been tested in the Bras d'Or lakes. The sets of shipworm in 1938 was very heavy and, judging from the plankton catches, probably came in two waves - one early and one late in the season. The results of the season's trial would suggest that adequate protection of wood against shipworm in the Bras d'Or lakes is afforded by the mixture in its present form.

THE AUSTRALIA MUD WORM

Approximately 75% of the soft bottom oysters fished at Crowdis bridge in a sample in early September showed "mud blisters" on the inner surfaces of the shells. None of the "hard bottom" Bras d'Or stock encountered throughout the season showed this infection. Mrs. C. J. Berkeley of the Pacific Biological Station, Nanaimo, B. C., had examined a collection of worm removed from the blisters and identified them as Polydora Ciliata (Johnston). Taken from blisters were also two small specimens of Nereis succinea (Leuckhart) whose occurrence there, Mrs. Berkeley regards as adventitious.

P. ciliata is apparently a very widely distributed animal. An account of the trouble it has caused in Australia is given by Whitelegge (1890). It seems unlikely that it would ever create a serious problem in this country where only hard bottoms are used to any extent for the rearing of oysters.

A NATIVE OYSTER DRILL

When fishing up samples of 1937 spat which had been reared on the bottom at Stoney point twelve small drilled oysters were found whose mean diameters ranged from 2.4 to 3.6 cm. and averaged 2.9 cm. All were "natural" eel-grass spat apparently of the 1937 set and the twelve constituted about 1% of the total sample. These shells were kept and taken to Ellerslie. According to Dr. A. W. H. Needler, the drillings resemble those of Polynices heros, a common gastropod at Stoney point.

No drilled shells were found in Gillis cove where Polynices is seldom seen. No "collector spat" were ever found to have suffered from these attacks. It seems hardly likely that this native oyster drill will ever present a serious problem in these waters.

SPECIAL HYDROGRAPHIC STUDIES AT CROWDIS BRIDGE--JULY 2nd and 18th, 1938.

The accompanying data were collected at the time of a series of observations on spatfall described elsewhere in this report. Although the records are scanty in number they illustrate several interesting points.

Apparently there is a slight tide in the Bras d'Or lakes whose regular cycles can be traced in spite of more conspicuous day-to-day changes in water level which are regarded as seiches.

The total fluctuation in water level at Crowdis bridge on the two dates July 2nd and July 18th was 4½ and 5 inches respectively. (The moon was at its first quarter on July 4th and in its last on July 20th).

The layer of fresh surface water at Crowdis bridge has a varying thickness dependent on the stage of the tides and the amount of recent precipitation. On July 2nd it varied from three feet at high tide to one foot at low. On July 18th it varied from one to two feet at corresponding tidal phases. There had been considerable rain just previous to July 2nd but little just before July 18th.

A thermocline corresponding in position to the halicline, which latter is usually conspicuous, may or may not be present at Crowdis bridge.

The current speeds were measured by timing the movement of a free-floating buoy to the lower side of which was attached, by a lead of variable length, a set of sheet zinc "wings".

SPECIAL HYDROGRAPHIC STUDY AT CROWDIS BRIDGE--JULY 2nd.

Time	Tide and direction	Water level	Current speed ft/sc.	Dp. in ft.	Water temp.	Sal.	Sp. Gravity.	(T)	Remarks: (Weather etc.)
10.15 a.m. under bridge	going out	4' 5"	0.1	Sur.	16.0	1.8	1.0013	18.0	Cloudy: fresh SE
				1	16.7	6.4	1.0048	18.2	Thr fresh layer of
				2	18.0	16.1	1.0120	18.9	surface water is
				3	18.0	19.2	1.0144	19.0	brown due to recen
				6	18.0	19.2	1.0144	19.2	rains: below 2' is clear.
10.45 a.m. over shaal				Sur.	16.2	2.4	1.0018	17.8	
				3'	17.5	3.9	1.0031	17.1	
12.30 p.m. under bridge	coming in	4' 4"	0.6	Sur.	16.7	2.8	1.0021	18.4	Cloudy: fresh SE
				1'	16.8	2.8	1.0020	18.6	
			0.6	2'	16.7	4.6	1.0109	19.2	
			0.5	3	17.7	17.9	1.0133	19.3	
				6	17.8	19.1	1.0142	19.5	
12.45 p.m. over shoal				Sur.	17.0	2.0	1.0013	19.0	
				1					
				2	16.8	2.6	1.0017	19.0	
				3	17.0	7.0	1.0051	19.2	
				5	17.8	17.4	1.0130	18.9	
2.10 p.m. under bridge	coming in	4'1"	0.52	Sur.	17.5	3.6	1.0027	19.0	
				1	17.4	5.7	1.0042	18.7	Cloudy: light E
				2	17.6	9.1	1.0067	19.0	
			0.50	3	17.8	17.4	1.0130	19.0	
				6	18.0	19.1	1.0143	19.2	
Over shoal				Sur.	17.5	3.7	1.0028	18.0	
				1'	17.3	3.9	1.0029	18.2	
				2	17.4	5.3	1.0040	18.3	
				3	17.5	8.6	1.0065	18.3	
				5	17.5	18.4	1.0140	17.9	

TABLE XII. CONTINUED

Time	Tide and Direction	Water level	Cureent speed ft/sc.	Dp. in ft.	Water Temp.	Sal.	Sp. Gravity	(T)	Remarks: (weather etc.)
4.45 p.m. under bridge	going out	4' ½"	0.62	Sur.	17.2	2.4	1.0021	16.0	
				2'	17.6	6.5	1.0052	16.0	Cloudy: light SE
			0.32	3	17.6	1.26	1.0101	16.0	
				6	17.6	18.8	1.0147	16.0	
OVER SHOAL				Sur.	17.2	2.6	1.0022	16.0	
				2'	17.3	4.4	1.0036	16.0	
				3	17.3	7.7	1.0061	16.0	
				5	17.6	15.3	1.0120	16.2	
			0.80	Sur.					
6.30 p.m.	going out	4' 1"		2	17.2	4.1	1.0034	16.0	Cloudy: fresh east
			0.37	3	17.0	8.6	1.0069	16.0	
				5	18.0	19.1	1.0149	16.0	

TABLE XIII.

SPECIAL HYDROGRAPHIC STUDY AT CROWDIS BRIDGE--JULY18th.

(moon almost at 3rd quarter).

Time	Tide and direction	Water Level	Current speed at dp.	Dp. in ft.	Water Temp.	Sal.	Sp. Gravity	(T)	Remarks: (weather etc.)
8.30 a.m.	going out falling	4' 5"	0.26 ft/sc.	1	22.1	16.6	1.0107	26.3	Fair; fresh west 2ind.
				2	22.1	18.6	1.0122	26.0	
				3	22.0	18.6	1.0127	26.0	
				4	21.7	19.7	1.0131	26.2	
9.15 a.m.	See remarks falling	4' 6"							Tide slack at 6' depth but still going out at sur.
11.30 a.m.	going out falling	4' 6¼"	0.15	1	23.2	12.0	1.0072	26.6	
				2	22.2	19.6	1.0130	26.1	Fair: fresh SW
				3	22.0	19.9	1.0130	26.7	
				4	21.9	20.0	1.0133	26.1	
1.30 p.m.	rising coming in	4' 4"	0.20	1	23.4	19.1	1.0125	26.3	
				2	22.8	19.5	1.0129	26.0	
				3	22.8	19.7	1.0133	25.3	
				4	22.4	19.7	1.0133	25.3	
2.30 p.m.	rising coming in	4' 2"	0.31						
3.00 p.m.	rising coming in	4' 1"	0.35						Wind is now due S.
3.30 p.m.	coming in	4' 1"	0.33	1	24.1	18.7	1.0127	24.6	
				2	23.7	17.0	1.0115	24.3	
				3	22.8	19.5	1.0133	24.7	

TABLE XIII. CONTINUED

Time	Tide and direction	Water level	Current speed at dp. 1'-2' ft/sec.	Depth in ft.	Water Temp.	Sal.	Sp. Gravity	(T)	Remarks: (weather etc.)
5.00 p.m.	going out	4' 1"	0.16	1	24.1	12.6	1.0082	24.4	At 5.00 p.m.
				2	23.7	16.9	1.0114	24.3	thunder shower
				3	23.1	19.7	1.0135	24.6	fresh to strong W.
6.00 p.m.	going out falling	4' 2"	0.7						
7.00 p.m.	going out	4' 3"	0.4	1		13.6	1.0088	24.7	Light south west.
	falling			2		13.8	1.0091	24.6	
				3	1	17.8	1.0120	24.8	

HYDROGRAPHIC OBSERVATIONS IN CAPE BRETON--1938

Records were kept of temperature and salinities at Gillis cove and Crowdis bridge as in 1937 and in addition at Stoney point over the experimental plots.

Readings of surface temperatures were made from a common mercury thermometer graduated in °C and of depth temperatures from a reversing thermometer. Water samples from depths were taken with a citrate bottle that could be opened below the water at any desired level.

Salinities were calculated from hydrometer readings made with a Knudsens hydrometer No. 5020.

The season's observations are summarized below in tabular form.

HYDROGRAPHIC OBSERVATIONS IN CAPE BRETON--1938

Records were kept of temperatures and salinities at Gillis cove and Crowdis bridge as in 1937 and in addition at Stoney point over the experimental plots.

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Salinities were calculated from hydrometer readings made with a knudsens hydrometer No. 5020.

The season's observations are summarized below in tabular form.

GILLIS COVE

Date	Time	Depth	Tide	Weather	Temp.	Sp.Gr.	(T)	Sal.	Remarks
June 20	11.00 a.m.	Sur.		Cloudy: light	18.2				
		1		south west	18.0				
		3			17.8				
		6			17.7				
		10			17.7				
June 22	3.30 p.m.	Sur.		Bright: fresh	22.7	1.0129	27.4	20.0	
		1		south west	21.2				
		8			20.8	1.0128	27.4	19.9	At other stake
		3			20.6				
		6			20.2	1.0130	28.0	20.3	
		9			21.0				At another spo
June 23	5.00 p.m.	Sur.	L	Bright;light	24.8				
		3		west	24.0				
		6			21.1				
		9			18.7				
June 27	3.00 p.m.	Sur.	H	Light:south	19.7				
		3		west, cloudy	20.0				
		6		rainy	19.2				
		9			18.5				
June 30	11.45 a.m.	Sur.	H.	Bright;fresh west	19.2	1.0130	22.0	18.3	Water very cloudy with
		3			18.8	1.0140	21.8	19.5	recent rains:
		6			18.2	1.0146	22.0	20.4	the clay makes
		9			17.3	1.0146	22.1	20.4	it red.
July 4	12.00 noon	Sur.	H.	Cloudy, rainy	18.0				Water is clear
		3'		light north	18.1				again.
		6		east	18.0				
July 8	9.45 a.m.	Sur.	H.	Light South	18.2	1.0139	16.2	17.9	At stake.
		2'		east, bright		1.0145	16.4	18.7	
		3			18.0				
		6			18.3	1.0154	16.5	19.9	
		11			18.4	1.0158	17.0	20.5	
July 9	4.20 p.m.	Sur.	L.	Light, fresh	22.5				At stake
		3'		south	22.1				
		6			21.8				

GILLIS COVE

Date	Time	Depth	Tide	Weather	Temp.	Sp.Gr.	(T)	Sal.	Remarks
July 11	10.15 a.m.	Sur.		Bright fresh	20.3				
		3'		southwest	20.3				
		6'			18.0				
July 13	11.00 a.m.	Sur.		Raining	17.7				
		6'		coll	17.8				
July 15	5.00 p.m.	Sur.	L.	Bright:fresh	21.3	1.0140	23.1	19.9	
		3'		south	21.3	1.0142	22.8	20.1	
		6'			21.0	1.0142	22.9	20.1	
		9'			20.7	1.0142	23.3	20.3	
July 16	5.30 p.m.	Sur.		Fair	23.5				A rise yesterday.
		3'			23.3				
		6'			20.7				
July 17	3.45 p.m.	Sur.	H.	Fresh SE	24.2				
		3'			24.1				
		6'			23.0				
July 21	11.00 a.m.	Sur.	H.	Cloudy light	22.4	1.0142	20.2	19.4	
		3'		west	22.5	1.0151	20.2	20.5	
		6'			21.3	1.0154	20.8	21.1	
July 25	2.00 p.m.	Sur.	H.	Light SW	25.8				
		3'		bright	23.7				
		6'			22.9				
July 27	12.00 noon	Sur.	H.		24.7	1.0117	19.8	15.9	
		3'			24.1	1.0154	19.8	20.8	
		6'			23.6	1.0155	19.8	20.9	
Aug. 3	3.00 p.m.	Sur.	½R	Bright,fresh	25.3	1.0152	22.0		
		3'		west by north	25.1	1.0151	21.9		
		6'			24.8	1.0153	21.8		
Aug. 6	3.00 p.m.	Sur.	H.	Bright.	27.2				
		3'			26.5				
		6'			24.4				
Aug. 13	3.30 p.m.	Sur.			21.3	1.0152	20.4	20.7	
		3'			21.3	1.0152	20.6	20.8	
		6'			21.0	1.0154	20.8	21.1	
		12'			21.0	1.0154	21.0	21.1	
Aug. 22	5.15 p.m.	Sur.	L		23.2	1.0149	24.8	21.7	
		3&			23.1	1.0148	25.1	21.7	
		6'			23.0	1.0146	25.4	21.5	

GILLIS COVE

Date	Time	Depth	Tide	Weather	Temp.	Sp.Gr.	(T)	Sal.	Remarks
Sept. 7	5.30 p.m.	Sur.	½		18.3	1.0177	15.3	22.6	
		3'			18.6	1.0178	15.2	22.8	
		6'			18.2	1.0178	15.3	22.8	
Sept.16	10.00 a.m.	Sur.	H	Light west,	17.8	1.0167	20.3	22.6	
		3'		cloudy	17.7	1.0167	20.0	22.5	
		6'			17.0	1.0165	20.3	22.5	
Sept.27	2.30 p.m.	Sur.	H.	Fresh south-	16.7	1.0185	8.0	22.3	
		3'		west	16.5	1.0187	8.0	22.6	
		6'			16.4	1.0186	8.5	22.5	
Oct. 3	3.45 p.m.	Sur.	H.	Light east	14.6	1.0169	8.2	20.3	
		3'				1.0177	7.9	21.3	
		6'			14.6	1.0179	8.0	21.6	
Oct. 11	10.00 a.m.	Sur.	H.	Light north	12.2	15.6	15.6		
		3'			12.7	16.0	16.0		
		6'			13.0	15.7	15.7		
Oct. 19	11.00 a.m.	Sur.	H.	Fresh south-	11.6	173	15.4		
		6'		west	11.8	173	15.3		

HYDROGRAPHY AT CROWDIS BRIDGE

Date	Time	Depth	Tide	Weather	Temp.	Sp.Gr.	(T)	Sal.	Remarks
May 14	3.00 p.m.	Sur.	Out	Cloudy but	10.8	1.0021	12.0	2.7	
		2'		clearing		1.0024	11.1	3.1	
		3'		fresh west	10.2	1.0022	12.0	2.8	
		4'				1.0085	10.8	9.9	
		5'			10.1	1.0130	10.0	15.5	
		6'			8.8	1.0128	11.2	15.4	
		12'			8.0	1.0160	10.4	1915	
May 19	3.00 p.m.	Sur.	Go-	Bright:	12.6	1.0011	20.0	1.9	
		1'	ing	light west	12.0	1.0010	17.8	1.0	
		2'	out	breeze	11.2	1.0012	19.1	1.9	
		3'			9.2	1.0120	18.2	15.8	
		6'			9.0	1.0126	13.7	15.7	
		9'			8.8				
		12'			8.9	1.0121	20.2	16.5	
May 25	3.45 p.m.	Sur.	"		16.4	1.0012	19.0	1.8	
		1'			15.2	1.0023	18.2	3.1	
		2'	almost		13.5	1.0035	17.0	4.4	
		3'	slack		11.3	1.0102	16.8	13.2	
		6'			11.7	1.0138	13.0	17.1	
		9'			9.3	1.0145	14.8	18.3	
May 26	3.00 p.m.	Sur.	"	Bright	17.1				
		2'		fresh wind	15.0				
		3'	low	west	13.8				
		6'			12.3				
		11'			9.0				
May 28	3.00 p.m.	Sur.	go-	Bright:	16.7	1.0076	19.4	10.4	
		2'	out	fresh east	14.4	1.0194	17.0	13.4	
		3'			14.1	1.0109	18.0	14.4	
		6'			13.4	1.0124	15.4	15.7	
		12'			10.3	1.0138	15.6	17.2	6
May 31	2.40 p.m.	Sur.	high	Bright:	18.7	1.0022	22.3	4.0	
		1'	going	light no-	17.7	1.0023	21.6	4.0	
		3'	ou5	rthwest	15.5	1.0114	20.8	15.8	
		6'			15.1	1.0127	18.3	16.9	
		9'			14.2	1.0126	20.6	17.3	
June 4	6.00 p.m.	Sur.	High	Bright:	20.1	1.0082	14.7	11.5	
		2'	going	light west	18.7	1.0087	15.0	10.8	
		3'	out		16.3	1.0147	16.0	18.8	
		6'			13.9	1.0155	16.0	19.9	
		11'			11.3	1.0159	14.9	20.4	

HYDROGRAPHY AT CROWDIS BRIDGE

Date	Time	Depth	Tide	Weather	Temp.	Sp.Gr.	(T)	Sal.	Remarks
June 7	11.30 a.m.	Sur.	High	Bright:	18.1				
		1'	almost	light W.	18.3				
		2'	slack		17.4				
		6'			16.7				
		12'			14.3				
June 11	5.00 p.m.	Sur.	Low	Bright	23.8	1.0059	18.4	7.9	
		1'	going	fresh W.	21.7	1.0063	18.2	8.3	
		2'	out		18.6	1.0065	18.1	8.6	
		3'			18.3	1.0141	18.3	18.7	
		6'			17.5	1.0145	19.1	19.4	
		11'			15.9	1.0149	18.9	19.1	
June 21	11.30 a.m.	Sur.	High	Bright	20.0	1.0029	27.4	6.5	
		2'	com-	light east	19.6	1.0093	26.9	15.0	
		3'	ing		19.4	1.0112	27.2	17.6	
		6'	in6		19.1	1.0121	28.0	19.1	
		9'			18.7	1.0128	28.0	20.0	
June 14	10.00 a.m.	Sur.	High	Fair:	20.4				
		2'	coming	fresh W	18.9				
		3'	in		18.8				
		6'			18.4				
		11'			15.3				
June 22	12.30 a.m.	Sur.	High	Bright	24.0				
		1'		light NS	23.8				
		2'			23.6				
		3'			23.3				
		4'			21.8				
		5'	(bottom)		21.7				
June 23	3.00 p.m.	Sur.	Low		24.7				over oyster bed
		1'	going		24.6				
		3'	out		24.3				
		4'			23.9				
		Sur.			22.4				Under bridg
		1'			22.4				
		2'			22.4				
		3'			22.3				
		4'			18.1				
		6'			16.7				
		12'			16.7				

HYDROGRAPHY AT CROWDIS BRIDGE

Date	Time	Depth	Tide	Weather	Temp.	Sp.Gr.	(T)	Sal.	Remarks
June 24	4.30 p.m.	Sur.	Low		25.0				Over oyste
		2'	slack		24.7				beds
		4'			24.0				
		6'			19.8				Under
		9'			18.7				bridge
June 27	4.00 p.m.	Sur.	Low	Rainy	19.2				Over oyste
		3'	going		18.3				beds
		6'	out		19.0				
June 29	4.00 p.m.	Sur.	High	Raining	17.6	1.0091	15.0	11.3	Over oyste
		3'	going		18.6	1.0148	15.1	17.8	bed
		5'	ou5		18.6	1.0143	14.8	18.0	
		9'			18.7	1.0148	15.1	17.9	Under bridge
July 2	2.15 p.m.	Sur.	High	Cloudy	17.5	1.0028	18.0	3.7	
		1'	coming	light	17.3	1.0029	18.2	3.9	Over oyster
		2'	in	east	17.4	1.0040	18.3	5.3	beds. Water
		3'			17.5	1.0065	18.3	8.6	level 4' 1"
		5'			17.5	1.0140	17.9	18.4	
July 4	2.00 p.m.	Sur.	High	Cloudy	17.0				Over oyste
		3'	coming	raining	17.3				bed
		5'	in	light E.	17.7				
July 8	12.00 noon	Sur.	Low	Bright	18.7	1.0142	#15.8	18.2	All but #
		2'	going	light	18.4	1.0143	16.0	18.3	below bridge
		3'	out	south	18.3	1.01461	#16.1	18.7	at the bar
		5'		east 18.3	xxxx	1.0148	16.1	19.0	where colle
		12'			17.5	1.0150	16.4	19.4	tors are hu
July 9	5.00 p.m.	Sur.	Low	Fresh to	22.5				Over oyster
		3'	going	strong	22.0				bed
		6'	out	southwest	20.8#				
July 11	12.00 noon	Sur.	Tide	Bright	19.7				
		3'	low		18.9				
		6'	slack - 4' 1½"		18.5				
July 13	11.30 a.m.	Sur.	Low		17.7				Over oyster
		3'	coming		19.0				bed
		5'	in		1911				
July 14	10.00 a.m.	Sur.	Low	Bright		1.0078	23.3	11.7	
		2'	almost	light	19.7	1.0123	24.0	17.9	
		3'	slack	south	19.0	1.0132	24.0	19.1	
		5'	coming	east	19.1	1.0128	24.1	18.8	
		9'	in		19.0	1.0134	23.7	19.4	

HYDROGRAPHY AT CROWDIS BRIDGE

Date	Time	Depth	Tide	Weather	Temp.	Sp. Gr. (T)	Sal.	Remarks
July 16	10.00 a.m.	Sur.	LF	21.2	21.2			Over oyster bed
		3'			20.8			
		5'	out		1915			A rise yesterday
July 18	11.00	1'	LF	Fresh SW	23.2	1.0072	26.6 1.2.0	
		2'			22.2	1.0130	26.1 19.6	
		3'			22.0	1.0130	26.7 19.9	
		4'			21.9	1.0133	26.1 20.0	
July 21	12.00 noon	Sur.	L 4'4½"		22.9			Over oyster bed
		3'			23.3			
		6'			22.9			
July 23	11.00 a.m.	Sur.	2'4"	Fresh W.	19.6			
		3'	LF		19.3			
		6'			20.3			
July 25	3.00 p.m.	Sur.	LF	Bright:	24.8			
		3'	2'9"	fresh W.	23.9			
		6'			21.2			
July 29	2.00 p.m.	Sur.	H	Light east	23.7	1.0109	19.8 14.9	
		3'			23.3	1.0144	19.7 19.4	
		6'			23.2	1.0150	19.6 20.1	
Aug. 3	2.00 p.m.	Sur.	LR	Bright	25.0	1.0090	22.0 12.9	
		3'		light W.	24.7	1.0094	22.2 13.6	
		6'			22.4	1.0153	22.3 21.3	
		15'			19.8	1.0159	22.1 22.1	
Aug. 6	12.00 noon	Sur.			28.2			
		3'			24.9			
		6'			23.4			
		12'			21.7			
Aug. 15	9.00 a.m.	Sur.	L	Bright	21.0	1.0027	23.2 4.9	
		3'		light W.	23.4	1.0130	24.3 19.0	
		6'			22.0	1.0145-->	24.0 20.9	
Aug. 22	3.30 p.m.	Sur.		Cloudy	24.3	1.0102	22.8 14.7	
		3'		fresh SW	24.0	1.0112	23.3 16.2	
		6'			22.4	1.0147	23.3 20.9	
Sept. 6	4.00 p.m.	Sur.	LF	Bright	20.2	1.0098	15.5 12.4	
		3'		fresh W.	20.2	1.0137	15.7 17.5	
		6'			20.0	1.0168	15.5 21.5	

HYDROGRAPHY AT CROWDIS BRIDGE

Date	Time	Depth	Tide	Weather	Temp.	Sp.Gr.	(T)	Sal.	Remarks
Sept. 13	4.00 p.m.	Sur.	H	Cloudy	17.3	1.0027	20.3	4.1	
		3'		raining	18.2	1.0156	20.4	21.2	
		6'			17.9	1.0163	20.4	22.1	
Sept. 24	12.00 noon	Sur.	HR	Bright:	18.0	1.0092	13.0	11.1	
		3'		fresh W.	18.3	1.0152	13.0	18.8	
		6'			18.3	1.0169	13.0	21.1	
Oct. 4	9.50 a.m.	Sur.	HF	Light W.	10.6	1.0021	11.5	1.8	
		3'			11.9	1.0132	13.0	16.3	
		6'			12.0	1.0159	13.8	19.9	
Oct. 11	2.30 p.m.	Sur.	H	Fresh NW	10.9	1.0046	15.7		
		3'			11.0	1.0117	15.8		
		6'			12.7	1.0158	15.7		
		20'			13.0	1.0163	15.8		
Oct. 19	5.00 p.m.	Sur.	HF	Light W.	11.0	1.0082	15.3		
		3'			13.3	1.0130	15.0		
		6'			14.0	1.0152	15.3		

HYDROGRAPHY AT ORANGEDALE WHARF

Date	Time	Depth	Tide	Weather	Temp.	Sp. Gr. (T)	Sal.	Remarks
May 18	4.30 p.m.	Sur.	H	Clearing:N	9.7	1.0072	10.7 8.2	
		1'		E fresh		1.0074	10.8 8.4	
		2'		breeze		1.0112	11.2 13.4	
		3'			9.8	1.0119	10.6 14.2	
		6'			8.2	1.0149	9.2 17.9	
		8'	(bottom)		7.6	1.0160	8.3 19.2	
May 21	4.00 p.m.	Surr	L.	Drizzle light				
					11.4	1.0079	13.0 9.3	
		2'		NW	11.4	1.0105	12.6 12.6	
		3'			11.4	1.0109	13.0 13.3	
		7'			11.0			

OVER STONEY POINT BEDS

Date	Time	Depth	Tide	Weather	Temp.	Sp. Gr.	(T)	Sal.	Remarks
May 18	3.30 p.m.	Sur.		Clearing:	10.2	1.0057	12.1	6.5	
		3'		fresh NE	9.7	1.0113	11.0	13.4	
		6'			8.6	1.0122	11.3	14.7	
		12'			6.1	1.0158	9.9	19.2	
May 21	3.30 p.m.	Sur.	L	Drizzle NW	11.5	1.0096	13.5	11.6	
		1'		breeze light	11.7	1.0107	13.3	13.2	
		3'			11.4	1.0120	13.8	14.9	
		6'			10.2	1.0137	13.5	17.0	
		9'			9.7	1.0149	12.3	18.4	
		21'			5.8	1.0172	10.0	20.9	
May 26	4.00 p.m.	Sur.	L	Fresh NW	16#	1.0119	19.9	16.2	# Records
		3'			15#	1.0119	19.7	16.1	observed.
		6'			14.2	1.0122	19.8	17.5	
		9'			14.4	1.0123	20.0	16.7	
		15'			10.0				
May 31	10.00 a.m.	Sur.	L.	Bright:lt.	14.3	1.0129	18.3	17.1	
		1'		west	14.2	1.0130	18.8	17.4	
		3'			14.1	1.0130	16.7	16.9	
		9'			12.8	1.0140	18.2	18.4	
June 4	3.30 p.m.	Sur.		Bright,	17.0	1.0137	19.2	18.3	
		3'		fresh NE	13.7	1.0150	17.2	19.5	
		9'			11.8	1.0162	15.0	20.7	
June 10	7.55 p.m.	Sur.		Light SW	16.5	1.0159	12.0	19.6	
		1'		fair	16.2	1.0153	12.0	19.0	
		3'			15.4	1.0156	11.6	19.1	
		6'			15.0	1.0158	12.3	19.5	
		12'			13.6	1.0167	11.8	20.5	
June 22	9.45 a.m.	Sur.	H.	Bright:	18.4	1.0120	30.0		
		1')		light NE	19.0			no figures to	
		2')	at stake		18.3	1.0125	29.1	translate from	
		3')			18.0	1.0123	30.0	in tables	
		6( )			18.4	1.0127	30.0		
		9))	Off shore		16.8	1.0132	29.9		
June 23	7.30 p.m.	Sur.	H.	No breeze	21.1				
		2'		clouding	20.7				
		6'			19.3				
		9'			17.4				
June 24	3.30 p.m.	Sur.		Bright:	22.8				
		2'		fresh NW	21.2				
		4'			18.0				

OVER STONEY POINT BEDS

Date	Time	Depth	Tide	Weather	Temp.	Sp. Gr. (T)		Sal.	Remarks
June 30	3.15 p.m.	Sur.		Bright,	1912	1.0138	21.3	19.1	
		3'		fresh W.	18.7	1.0140	21.3	19.4	
		6'		tide high	17.2	1.0153	21.1	21.1	
		9'			15.9	1.0158	21.3	21.7	
July 9	6.00 p.m.	Sur.	L	Fresh SW	20.6				
		3'		today	19.6				
		6'			19.0				
July 11	9.00 a.m.	Sur.		Dull	19.3	1.0146	18.7	19.4	
		2'		raining	19.6	1.0147	18.6	19.5	
		5'			19.5	1.0149	18.7	19.7	
		9'			16.7				
July 16	3.00 p.m.	Sur.		Bright:	20.3				
		3'		light NE	20.8				
		6'			18.1				
July 17	13.00 p.m.	Sur.		Bright	21.3				
		3'			21.0				
		6'			20.5				
July 21	10.00 a.m.	Sur.	H	Cloudy:	20.2	1.0149	20.8	20.4	
		3'		light W.	21.7	1.0149	21.0	20.4	
		6'			19.9	1.0160	20.8	21.8	
		9'			18.2	1.0162	20.8	22.1	
July 27	10.00 a.m.	Sur.	H	Bright	23.0	1.0152	19.8	20.5	
		3'		light W.	23.0	1.0153	19.6	20.5	
		6'			22.7	1.0152	19.4	20.4	
		9'			19.7	1.0163	19.6	21.8	
Aug. 3	8.30 a.m.	Sur.		Bright	22.7	1.0149	21.3	20.5	
		3'		light W.	22.6	1.0148	21.9	20.5	
		6'			22.4	1.0153	21.7	21.2	
Aug. 6	8.30 a.m.	Sur.	H	Bright	23.9				
		3'		light NW	23.7				
		6'			23.8				
Aug. 13	4.00 pmm.	Sur.	H		21.0	1.0148	23.0	2019	What look4d
		3'			20.8	1.0151	21.5	20.9	like water
		6'			20.7	1.0151	21.6	20.9	bloom proved to be a bunch of verliger
Aug. 22	7.00 p.m.	Sur.	L	Light W.	21.9	1.0152	24.6	22.0	
		3'			22.0	1.0151	25.0	22.0	
		6'			22.8	1.0153	24.8	22.2	
Sept. 6	10.00 a.m.	Sur.	L.	Fresh W.	19.7	1.0173	15.4	22.1	
		3'		bright	19.7				
		6'			19.7	1.0175	15.6	22.3	

OVER STONEY POINT BEDS

Date	Time	Depth	Tide	Weather	Temp.	Sp. Gr. (T)	Sal.	Remarks.
Sept. 16	9.00 a.m.	Sur.	H.	Cloudy	17.4	1.0167	19.8	
		3'		light W.	17.3	1.0167	20.0	
		6'			17.2	1.0167	20.0	
Sept. 24	9.00 a.m.	Sur.	H.	Bright:	18.5	1.0176	13.0 22.0	
		3'		light W.	18.5	1.0178	13.2 22.2	
		6'			18.4	1.0179	13.0 22.3	
Oct. 3	4.30 p.m.	Sur.	H.		14.3	1.0178	8.0 21.5	
		6'			14.2	1.0181	8.2 21.8	
Oct. 11	11.45 a.m.	Sur.	H.	Fresh N.	13.3	1.0179	15.6	
		3'			13.2	1.0180	15.4	
		6'			13.2	1.0179	15.9	
Oct. 19	3.00 p.m.		H	Fresh N.	12.3	1.0180	15.3	
					12.3	1.0180	15.1	

MISCELLANEOUS OBSERVATIONS

Date	Time	Depth Tide	Weather	Temp.	Sp. Gr. (T)	Sal.	Remarks
July 1	4.00 p.m.	Sur. HR	Bright	19.0	1.0007	21.3 1.8	Orangedale B
		2'	light SE	19.0	1.0089	21.5 11.9	above the
		6'		18.5	1.0135	21.7 18.8	tracks.
July 1	11.00 a.m.	Sur.		19.2	1.0080	25.4 12.6	At Andrew
		5'		18.0	1.0133	25.4 19.7	Williamson's
		9'		18.0	1.0137	24.8 20.1	lease off De
July 7	3.15 p.m.	Sur. ½	Bright	20.7	1.0153	16.2 19.7	Martin's Cov
		3'		20.2	1.0151	16.2 19.5	over M.A. Ma
		6'		19.7	1.0152	16.6 19.6	Lean's lease
		9'		19.3	1.0153	16.5 19.7	
July 7	4.30 p.m.	Sur.		20.3	1.0143	16.8 18.6	Orangedale B
		2'		20.2	1.0146	16.6 18.8	opposite
		3'	20	20.1	1.0150	16.8 1915	wharf over
		6'		19.0	1.0151	16.9 19.6	M.A. MacLean
		9'		19.0	1.0152	16.8 19.7	lease
July 12	3.30 p.m.	Sur. HF	Dull	18.6	1.0151	18.2 19.9	Over MacLeod
		3'	fresh SE	17.9?	1.0152	17.8 20.0	lease outsid
		6'		18.6	1.0152	18.1 20.0	Martins cove.
July 15	6.00 p.m.	Sur. L		22.8	1.0139	22.9 19.7	At boat moor
		4'		21.6	1.0141	22.9 19.9	ing in Gilli
							cove where tray is to be
July 15	4.30 p.m.	Sur.	Fresh S.	20.5	1.0141	22.3 19.7	Over Fraser
		3'		20.6	1.0142	22.4 20.0	Gillis' leas
		6'		20.3	1.0142	23.0 20.1	in N Basin
July 20	4.00 p.m.	Sur. LF	No breeze	22.4	1.0147	20.7 20.1	Area just at
		3'		21.8	1.0148	20.4 20.1	at mouth of
		6'		21.6	1.0148	20.6 20.3	Gillis' cove
							Neil D. Gillis leas
July 20	3.30 p.m.	Sur. L.	Calm	22.0	1.0145	20.6 19.9	2nd area SW
		3'		21.8	1.0146	20.4 19.9	of the Cove'.
		6'		21.4	1.0145	20.6 19.9	mouth ¼ mile
July 21	4.15 p.m.	Sur. L.	Light E.	23.0	1.0149	20.5 20.3	Over T.A.Mac-
		3'		2216	1.0149	20.7 20.4	Neil's lease
		6'		20.3	1.0156	20.5 21.2	in Martinis
							cove.

MISCELLANEOUS OBSERVATIONS

Date	Time	Depth	Tide	Weather	Temp.	Sp. Gr. (T)	Sal.	Remarks
July 26		Sur.	L.	Cloudy	23.3	1.0157	20.5 21.2	Over John Y.
		3'		light E.	23.4	1.0159	20.1 21.5	MacLean's
		6'			23.0	1.0159	20.1 21.5	lease
July 28	2.00 p.m.	Sur.	L.	Bright	19.0	1.0220	19.7 29.5	S. gut over
		6'		fresh E.	19.0	1.0221	19.5 29.5	oyst.
						transplanted		
Aug. 17	1.00 p.m.	Sur.	LR	Bright	17.2	1.0213	24.9 25.5	South Gut
		6'		light E.	16.9	1.0213	25.2 25.4	
Aug. 19	6.00 p.m.	Sur.		Bright		1.0149	24.0 21.5	Over Neil
		6'		light W.		1.0143	24.0 20.7	Murdock
							MacLean's lease.	
Aug. 18	12.00 noon	Sur.	H.	Bright	25.0	1.0146	24.0 21.1	Over Mrs.
		5'		light W.	24.0	1.0148	24.2 21.3	John E.
							MacLean's lease.	
Aug. 18	12.00 noon	Sur.			17.2	1.0213	24.9 25.5	
		6'			16.9	1.0213	25.2 25.4	
								S.S.R.Denys
Aug. 20	1.00 p.m.	Sur.	L.	Light W.	21.9	1.0147	23.7 21.1	Over Malcol
		6'			20.3	1.0158	24.0 22.6	MacLean's
							lease.	
Sept. 17	4.00 p.m.	Sur.	½			1.0146	20.0 19.7	In Flat in
		Indian Reserve at extrememend near previous canal.						
Sept. 6	4.00 p.m.	Sur.	½	Fresh W.	18.0	1.0182	15.3 23.3	Over John
		5'			18.0	1.0182	15.4 23.3	Murdock Mac-
						Kenzie's lease, Malagawatch.		
Sept. 13	5.00 p.m.	Sur.				1.0033	20.6 5.1	Cove at
						MacAulay's above bridge.		
Sept. 9	4.00 p.m.	Sur.	½R	Bright	15.3	1.0172	20.8 23.4	Grand Etang
		5'			15.3	1.0204	20.6 27.6	high up the
		10'			15.0	1.0208	20.4 28.0	inlet.
		Sur.				1.0210	20.4 28.3	Under bridge
Sept. 16		Sur.				1.0163	20.2 22.1	Over Chas.
						H. MacDonald lease. S.S. R. D.		
Sept. 17	12.00 noon	Sur.	H.	Bright		1.0161	20.4 21.8	Over lease
		6'		light W.		1.0162	20.3 22.0	Chas B. Mac-
							Lean. old of S.S.R. Denys.	

MISCELLANEOUS OBSERVATIONS

Date	Time	Depth	Tide	Weather	Temp.	Sp. Gr. (T)	Sal.	Remarks
Sept. 22	2.00 p.m.	Sur.	LR	Brigh6	15.3	1.0237	13.4 29.5	South Gut
		5'		fresh W.	14.6	1.0239	13.2 30.3	
Sept. 23	5.00 p.m.	Sur.	LF	Bright		1.0168	13.5 21.1	In cove at
		4'		light W.		1.0172	13.2 21.5	John Alex. Gillis' place.
Sept. 23	5.30 p.m.	Sur.		Bright		1.0177	13.2 22.1	Boom at
		4'		light W.		1.0182	13.1 22.8	Kennedy Bros
Sept. 29	5.00 p.m.	Sur.				1.0175	8.1 21.1	Cove at
		3'				1.0187	8.2 22.6	MacAulay's Bridge S. S. River Denys.
Sept. 29	12.00 noon	Sur.				(1.0190	8.2 23.0	Malagawatch
		6'			Area a	(1.0193	8.2 23.4	Harbour over
		18" (bottom 3'			Area b	(1.0189	8.6 22.9	MacDonald's
						area (a)	area(b)	in cove.
Sept. 29	12.00 noon	Sur.	H.			1.0179	8.6 21.7	S.S.R.Denys
						1.0185	8.4 22.3	over lease o John Neil MaCDonald
Sept. 30	12.00 noon	Sur.	H.			1.0185	8.3 22.3	Over John A.
						1.0192	8.2 23.3	MacPhail's lease, Malagawatch harbour.

METEOROLOGICAL RECORDS FOR ORANGEDALE, NOVA SCOTIA.

May to December, 1938

Air temperature readings were made from a standard maximum-minimum thermometer graduated in degrees Fahrenheit. The instrument was placed within a shelter five feet above the ground in the middle of a lawn so that the thermometer was continually in the shade and yet well exposed to air currents.

The season's records are summarized below.

TEMPERATURE AND WEATHER RECORDS--ORANGEDALE--1938

Date	Time	Max. °F.	Min. °F.	At time °F.	Weather
May 13					
May 14					Some rain: cloudy most of day
May 15	11.00 a.m.	52	31	40	Cloudy and rainly all day
May 16	7.00 p.m.	62	32	48	Cloudy and rain most of day.
17	1.00 p.m.	57	41	51	
18					rained all moring, cleared in afternoon: moderate west breeze
	Reading				
19	8.00 a.m.	no good	24	51	Bright all day light west.
	6.30 p.m.	67	58	58	Bright light west wind.
20	8.30 a.m.	58	31	58	Bright, light NE
	7.00 p.m.	73	55	57	Bright, light NE
21	9.00 a.m.	48	43	48	Heavy rain fresh NW breeze
	7.00 p.m.	55	44	45	Clearing, light NW
22	10.00 a.m.	55	42	53	Bright fresh NE all day
23					Bright mod.
24	10.00 a.m.	75	50	28	Raining.
	7.00 p.m.	55	51	53	Clearing; slight SE
25	9.00 a.m.	61	50	60	Cloudy; westerly breeze light
	7.00 p.m.	72	55	55	Fair light SW breeze.
26	9.00 a.m.	55	31	55	Clouding overl light E. breeze.
	10.00 p.m.	65	49	49	Cloudy; no breeze.
27	9.00 a.m.	60	47	60	Cloudy; slight SW
	7.30 p.m.	70	57	57	Fair; slight NW
28	8.00 a.m.	64	39	64	Bright; slight E wind (fresh at noon)
	7.00 p.m.	69	51	51	Fair, slight NW
29	10.00 a.m.	55	36	54	Bright; fresh E.
	6.45 a.m.	51	48	48	
30	6.30 a.m.	47	26	45	Bright; light SW
	7.30 p.m.	66	47	47	Fair; light SW.
31	8.30 a.m.	63	28	63	Fair; light SW
	9.00 p.m.	74	49	49	Fair; light SW
June 1	9.00 a.m.	72	38	72	Fair.
	9.00 p.m.	83	59	59	Fair.
2	7.30 p.m.	80	52	67	Fair.
3	9.00 a.m.	71	46	71	Bright; fresh SW
	7.00 p.m.	79	52	61	Bright; fresh SW
4	9.00 a.m.	61	47	57	Cloudy; light SW, shower during night
	8.40 p.m.	71	59	59	Clear; light NW (bright all day).
5	8.30 a.m.	65	41	65	Bright; light E.
	6.30 p.m.	75	41	60	Cloudy rainy; light NE
6	9.00 a.m.	60	52	53	Cloudy; light E.
	8.00 p.m.	58	52	52	Cloudy: clearing.
7	7.30 a.m.	64	46	64	Bright; light SW
	630 p.m.	79	64	64	Fair fresh, SE

TEMPERATURE AND WEATHER RECORDS--ORANGEDALE--1938.

Date	Time	Max. °F	Min. °F	At time °F	Weather
June 8	9.00 a.m.	67	45	63	Bright, light SE
9	9.00 a.m.	83	56	62	Cloudy; rained during night; light W.
10	8.30 a.m.	75	46	66	Bright; fresh NE
	7.30 p.m.	71	59	59	Fair all day, light W.
11	7.00 a.m.	72	40	70	Light E; birght
12	10.00 a.m.	80	37	56	Raining heavily; no breeze.
13	8.00 a.m.	76	53	62	Cloudy; light E.
	7.30 p.m.	63	52	52	Cloudy; still
14	8.45 a.m.	66	44	66	Bright; light SE
	7.40 p.m.	68	57	57	Fair; light E
15	9.30 a.m.	68	44	70	Fair; light W.
	7.30 p.m.	70	52	50	Fair; light W.
16	9.00 a.m.	67	31	68	Fair; light SW
	6.30 p.m.	70	60	58	Cloudy; raining; SE breeze.
17	9.00 a.m.	62	54	58	Cloudy; raining, E wind.
	6.00 p.m.	64	62	62	Cloudy; showers during day; W. wind
18	11.00 a.m.	64	58	60	Cloudy; SW wind.
	9.00 p.m.	64	54	54	Fair.
19	8.00 p.m.	68	50	58	Cloudy fresh E.
20	8.30 a.m.	59	53	57	Cloudy; light E.
	7.00 p.m.	63	52	61	Bright; light W.
21	8.00 a.m.	71	47	71	Bright; light W.
	8.30 p.m.	79	55	55	Bright; light W.
22	8.30 a.m.	66	36	65	Bright; light NE
	7.30 p.m.	91	67	78	Bright; light W.
23	8.00 a.m.	78	62	74	Bright; fresh W.
	7.00 p.m.	88	74	77	Fair but clouding; light W.
24	8.00 a.m.	77	63	71	Cloudy; light SW
	6.00 p.m.	83	72	74	Clouding and fresh West.
25	9.00 a.m.	74	54	71	Cloudy; light W.
	7.30 p.m.	75	63	63	Cloudy; fresh E. (looks like rain)
26	10.00 a.m.	75	52	73	Cloudy; strong SW
	6.30 p.m.	74	57	57	Cloudy; fresh SW rained this p.m.
27	8.15 a.m.	56	53	56	Cloudy and raining; no wind
	6.30 p.m.	60	52	58	Cloudy; rained most of day; no wind.
28	8.40 a.m.	59	51	57	Light SE, raining.
	6130 p.m.	66	55	58	Rained all day; no wind.
29	8.00 a.m.	56	52	52	Cloudy; light E. heavily raining.
	6.00 p.m.	63	53	59	Cloudy; light E. heavy rain all day.
30	9.00 a.m.	59	53	58	Light W. clouding raining.
	6.30 p.m.	73	59	64	Bright; fresh SW; fair since 10 a.m.
July 1	9.00 a.m.	65	40	61	Fair; clearing; light W.
	7.00 p.m.	75	60	60	Clear bright; light W.
2	7.15 a.m.	63	56	60	Light west; cloudy.
	8.30 p.m.	63	54	54	Strong to fresh E., cloudy; rain today
3	10.30 a.m.	59	53	59	Cloudy; strong E.
	9.30 p.m.	64	57	57	Fresh E; cloudy; raining.
4	7.45 a.m.	57	56	57	Cloudy; raining; light E.
	7.15 p.m.	63	57	57	Cloudy; raining; light E.
5	9.30 a.m.	57	50	53	Cloudy; fresh SW
	7.00 p.m.	60	55	55	Cloudy; raining; fresh E.

TEMPERATURE AND WEATHER RECORDS--ORANGEDALE--1938

Date	Time	Max. °F	Min. °F	At time °F	Weather
July 5	7.00 p.m.	60	55	55	Cloudy; raining; fresh E.
6	9.00 a.m.	69	49	67	Bright; light SW, shower in afternoon
7	8.00 p.m.	73	49	56	Clear; cloudy during day with a shower
8	8.30 a.m.	71	39	71	Bright warm; light E.
	6.30 p.m.	79	40	67	Bright; light W.
9	9.00 a.m.	71	45	71	Bright; fresh SW
	6.00 p.m.	85	72	75	Bright; light SW
10	9.15 a.m.	76	61	75	Bright; fresh SW
	6.30 p.m.	82	68	67	Cloudy; light SW
11	8.30 a.m.	68	57	61	Cloudy; fresh W.
	7.30 p.m.	69	56	56	Clear; fresh W.
12	7.30 a.m.	56	37	53	Cloudy; fresh E.
	7.00 p.m.	59	53	54	Cloudy; fresh E.
13	9.00 a.m.	54	51	53	Cloudy; raining; light E.
	8.00 p.m.	61	54	59	Cloudy, no breeze.
14	9.00 a.m.	68	57	67	Bright; light SE
	7.00 p.m.	79	67	67	Bright; light W.
15	8.00 a.m.	69	53	69	Cloudy; lgiht W.
	7.30 p.m.	79	68	68	Bright; fresh W.
16	8.00 a.m.	73	58	73	Clear; light SW
	6.00 p.m.	85	74	76	Fair; light W.
17	9.00 a.m.	82	53	81	Bright; light E.
19	9.00 a.m.	87	50	68	Raining no breeze.
20	9.00 a.m.	80	61	61	Raining light W.
	7.00 p.m.	73	62	71	Cloudy clearing, Rained all morning.
21	9.30 a.m.	72	66	71	Cloudy; fresh W.
	8.00 p.m.	83	66	66	Clouding over.
22	9.30 a.m.	67	61	62	Heavy rain; light E.
	6.00 p.j.	74	62	69	Rained all day; light W.
23	9.00 a.m.	72	63	72	Cloudy clearing; light W.
25	11.15 a.m.	87	66	79	Bright; fresh W.
	6.30 p.m.	84	77	76	Bright; light W.
26	8.00 a.m.	77	63	77	Bright; fresh SW
	8.00 p.m.	84	73	72	Cloudy.
27	9.30 a.m.	78	66	74	Cloudy; light W.
	5.45 p.m.	82	73	75	Cloudying over; light W.
28	9.00 a.m.	74	60	74.	Bright; light NE.
	6.00 p.m.	78	68	68	Bright; light E.
29	8.00 a.m.	69	56	60	Cloudy; light E.
	6.00 p.m.	71	59	60	Cloudy; light W.
30	9.00 a.m.	66	59	66	Cloudy; rained last night, light W.
	5.30 p.m.	73	67	71	Showers to day; light W.
31	9.00 a.m.	80	61	79	Light SW; bright.
	10.30 a.m.	87	59	59	Bright, no breeze.
Aug. 1	9.00 a.m.	84	53	84	Bright; light SW
	7.30 p.m.	92	72	72	Clouding over now; light W.

TEMPERATURE AND WEATHER RECORDS--ORANGEDALE--1938

Date	Time	Max. °F	Min °F	At. time °F	Weather
Aug. 2	8.30 a.m.	73	63	73	Fresh to strong W; cloudy;
	7.30 p.m.	78	69	69	Bright; light W.
3	7.30 a.m.	73	59	73	Br ght, light W.
	8.30 p.m.	83	65	65	Bright; no breeze
4	8.00 a.m.	76	57	75	Bright; light E.
	8.15 p.m.	83	70	70	Bright; light W.
5	8.00 a.m.	74	57	74	Bright, light E.
	8.00 p.m.	87	74	74	Bright all day; clouding now.
6	8.00 a.m.	78	67	78	Bright; light NW
	10.30 p.m.	93	57	57	Clear; light W.
7	9.00 a.m.	67	53	67	Cloudy; no breeze.
12	10.00 p.m.	71	54	59	Cloudy; light E. raining.
13	8.00 a.m.	61	56	61	Cloudy; light E.
	8.00 p.m.	74	61	68	Bright; light W.
14	9.30 a.m.	77	41	77	Bright; light E.
15	7.30 a.m.	71	49	71	Bright; light W.
	5.30 p.m.	81	50	70	
16	8.30 a.m.	72	68	72	
	5.45 p.m.	82	72	75	Bright; light W.
17	8.50 a.m.	75	61	75	Bright; light W.
	7.30 p.m.	87	72	72	Bright; light W.
18	8.00 a.m.	71	59	68	Cloudy with fog; light E.
	8.15 p.m.	81	69	76	Cloudy; light W.
19	8.15 a.m.	81	76	81	Bright; light W.
	8.00 pmm.	87	69	69	Fair; light W.
20	8.00 a.m.	71	69	71	Bright; light W.
	8.00 p.m.	79	53	79	Bright; light W.
21	8.30 a.m.	71	41	71	Bright; light W.
	6.30 p.m.	79	62	62	Bright; light W.
22	7.45 a.m.	68	54	68	Bright; light W.
	8.10 p.m.	81	65	65	Clear; light W.
23	8.30 a.m.	74	62	74	Bright; light W.
	8.00 p.m.	84	62	62	Bright; light W.
24	8.00 a.m.	64	53	60	Cloudy; light W.
	7.00 p.m.	81	61	67	Cloudying over: light E.
25	7.30 a.m.	67	58	59	Cloudy; light rain; light E.
	9.00 p.m.	73	60	60	Cloudy; light W.
26	8.00 a.m.	68	48	68	Bright; light W.
	9.30 p.m.	81	61	61	Cloudy light W.
27	7.45 a.m.	62	54	62	Bright; light W.
	7.00 p.m.	76	63	63	Bright; light W.
28	9.00 a.m.	67	52	67	Cloudy; light W.
29	9.00 a.m.	73	39	66	Bright; light W.
	7.15 p.m.	74	57	57	Bright; light W.

TEMPERATURE AND WEATHER RECORDS--ORANGEDALE--1938

Date	Time	Max. °F	Min. °F	At time °F	Weather
Aug. 30	8.00 a.m.	63	32	63	Bright; light W.
31	8.00 a.m.	75	61	62	Cloudy;
	6.30 p.m.	79	63	63	Bright; light E.
Sept. 1	8.00 a.m.	63	47	63	Bright; light E.
	8.00 p.m.	73	65	65	Raining; light E.
2	7.30 a.m.	64	59	59	Cloudy; light E.
3	9.30 a.m.	68	39	65	Bright; light W.
5	8.00 a.m.	71	31	61	Clear; fresh W.
	9.00 p.m.	69	47	47	Bright; still
6	8.00 a.m.	55	45	55	Bright; fresh E.
	7115 p.m.	63	43	43	Clear; light W.
7	9.00 a.m.	62	31	62	
	7.00 p.m.	71	54	54	Cloudy; light W.
8	8.15 a.m.	55	51	52	Cloudy; and raining; light E.
	8.00 p.m.	55	48	48	Cloudy; rained all day; lightE.
9	8.15 a.m.	56	49	56	Cloudy; fresh E.
	9.00 p.m.	63	48	48	Cloudy; still.
10	7.30 a.m.	55	44	55	Bright; still.
12	9.30 a.m.	71	31	67	Bright; light W.
	7.00 p.m.	72	53	53	Bright; light W.
13	8.20 a.m.	53	40	53	Foggy; light Wind.
	6.00 p.m.	67	58	59	Cloudy and raining; light W.
14	8.00 a.m.	61	57	59	Cloudy, rained all last night, light
	10.30 p.m.	65	54	54	Cloudy; light W.
15	8.30 a.m.	63	54	63	Clear; light W.
	7.00 p.m.	68	61	61	Cloudy; light E, drizzle.
16	7.30 a.m.	70	61	70	Bright; light W.
	6.00 p.m.	77	68	68	Cloudy; light W.
17	8.00 a.m.	68	55	63	Bright; light E.
	7.45 p.m.	75	49	49	Clear; no breeze.
18	9.00 a.m.	57	39	57	Cloudy; light E.
	7.00 p.m.	61	55	55	Raining; light E.
19	8.00 a.m.	58	55	58	Cloudy and raining; light E.
20	8.00 a.m.	69	58	69	Part cloudy; light W.
	6.15 p.m.	83	69	69	Clear; light W.
21	8.00 a.m.	73	65	73	Bright; light W.
	7.30 p.m.	77	64	64	Cloudy; light E.
22	8.00 a.m.	70	65	70	Rain; fresh W.
	7.30 p.m.	72	65	65	Cloudy; light W.
23	8.00 a.m.	63	56	59	
	6.30 p.m.	75	59	59	Part cloudy; light W.
24	8.00 a.m.	59	47	59	Part cloudy; light W.
	8.00 p.m.	72	54	54	Clear; light W.
25	9.30 a.m.	63	45	56	Part cloudy; light W.
	6.00 p.m.	66	49	49	Clear; light W.

TEMPERATURE AND WEATHER RECORDS--ORANGEDALE--1938

Date	Time	Max. °F	Min. °F	At time °F	Weather
Sept. 26	8.00 a.m.	53	37	53	Clear; light W.
	6.00 p.m.	65	51	51	Clear; still.
27	8.30 a.m.	57	31	57	Clear; fresh W.
	7.30 p.m.	68	54	54	Part cloudy; light W.
28	8.30 a.m.	60	55	57	Raining; light W.
	7.00 p.m.	68	48	48	Clear; light W.
29	7.30 a.m.	49	30	40	Part Cloudy.
	8.30 p.m.	41	45	63	Clear; light W.
30	8.00 a.m.	55	38	55	Bright.
	Evening	-	-	-	--
Oct. 1	8.00 a.m.	65	51	65	Light W; raining; rained all night.
	6.00 p.m.	66	48	48	Clearing; fresh W.
2	9100 a.m.	56	42	54	Bright; fresh W.
3	8.00 a.m.	59	28	39	Clear; light W.
	5.00 p.m.	59	39	50	Clear; fresh W.
4	8.00 a.m.	51	37	39	Heavy fog; no breeze.
5	8.15 a.m.	61	39	61	Part cloudy; light W.
	7.00 p.m.	69	47	47	Clear; light W.
6	8.30 a.m.	49	39	49	Cloudy; light E.
	7.00 p.m.	63	41	41	Part cloudy; light E.
7	8.30 a.m.	46	33	46	Bright; fresh NE
	6.30 p.m.	59	34	34	Clear;
8	9.00 a.m.	39	25	39	Heavy fog; ~~xigixi~~lifting; slight E.
10	---				Heavy NE all day.
11	8.15 a.m.	57	35	49	Part cloudy: light W.
	8.45 p.m.	56	40	40	Part cloudy: still
12	9.00 a.m.	53	29	53	Bright; light E.
	5.15 p.m.	72	54	60	Clear; faint E.
13	9.00 a.m.	68	42	68	Bright; light W.
	6.00 p.m.	81	65	65	Clear; light W.
14	8.00 a.m.	65	40	52	Bright; light W.
	8.00 p.m.	82	53	59	Clear; light W.
15	8.00 a.m.	60	43	53	Fair and light W.
	9.00 p.m.	77	53	59	Part cloudy; light W. (fair all day)
16	9.30 a.m.	67	52	65	
	6.00 p.m.	77	54	54	Part cloudy; light E.
17	8.00 a.m.	55	37	47	Cloudy; light W; rained in night.
	5.30 p.m.	57	46	47	Cloudy and raining; light to fresh W.
18	7.15 a.m.	47	42	42	Part cloudy; light W.
	8.00 p.m.	55	34	34	Clear; light W.
19	8.30 a.m.	40	28	40	
	7.00 p.m.	57	41	50	Cloudy; fresh W; rained in p.m.
20	8.00 a.m.	56	49	52	Cloudy; still
21	8.30 a.m.	60	51	51	Heavy rain; light W.
	6.00 p.m.	67	51	51	Cloudy; light W.
24	5.30 p.m.	60	23	49	Part cloudy; light to fresh W.

TEMPERATURE AND WEATHER RECORDS--ORANGEDALE--1938

Date	Time	Max. °F	Min. °F	At time °F	Weather
Oct. 25	9.00 a.m.	60	50	60	Heavy rain; strong SW
	5.00 p.m.	61	46	46	Raining
26	8.00 a.m.	47	28	36	Bright; light W.
	5.30 p.m.	55	36	44	Clear; light W.
27	8.00 a.m.	45	26	31	Clear; light W.
	9.00 p.m.	60	32	32	Clear; light W.
29	8.00 a.m.	39	32	39	Heavy fog; light W.
	5.30 p.m.	68	39	46	Part cloudy; light E.
30	9.30 a.m.	47	39	47	
	5.00 p.m.	53	47	47	Fresh SE cloudy;
31	8.30 a.m.	46	37	40	Raining; light E.
	8.00 p.m.	41	38	41	Rainy
Nov. 1	9.00 a.m.	43	40	41	Raining (rained all night).
	7.00 p.m.	43	40	40	Clear; light E.
2	8.00 a.m.	41	30	41	Fine rain; light W.
	6.00 p.m.	47	42	42	Raining.
3	8.30 a.m.	34	29	33	Part cloudy; first snow last night.
	5.30 p.m.	43	33	33	Part cloudy; light W.
4	9.00 a.m.	40	34	40	
5	8.00 a.m.	40	49	59	Bright; light W.
	6.00 p.m.	72	41	41	Clear; west all day.
6	9.00 a.m.	58	32	58	Part cloudy; light W.
7	8.30 a.m.	68	38	51	Part cloudy; light W.
	6.00 p.m.	66	43	43	Light W; part cloudy.
8	7.30 a.m.	47	37	47	Bright; still.
	6.00 p.m.	70	47	56	Part cloudy; light W.
9	9.00 a.m.	59	39	59	Part cloudy; light W.
	7.00 p.m.	61	43	43	Cloudy; fresh NW
10	9.00 a.m.	43	39	43	Bright; fresh W.
	7.00 p.m.	51	41	41	Part cloudy; light NW
11	12.00 noon	42	35	39	Bright; light NE
15	5.00 p.m.	58	31	31	Cloudy; light W.
16	8.30 a.m.	58	23	52	Part cloudy; light W.
	5.00 p.m.	41	19	31	Clear; light W.
18	10.00 a.m.	47	10	47	Cloudy; light W.
20	5.00 p.m.	65	36	36	Heavy rain all yesterday and this am.
21	10.30 p.m.	43	26	29	Clear; still.
22	1.00 p.m.	43	21	43	Bright; light W.
26	9.00 a.m.	51	21	23	Heavy snow; rained heavily all yesterday

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