THE SIXTH ANNUAL REPORT OF THE BOWDOIN SCIENTIFIC STATION

Bulletin No. 8 Bowdoin College, Brunswick, Maine April 1, 1942

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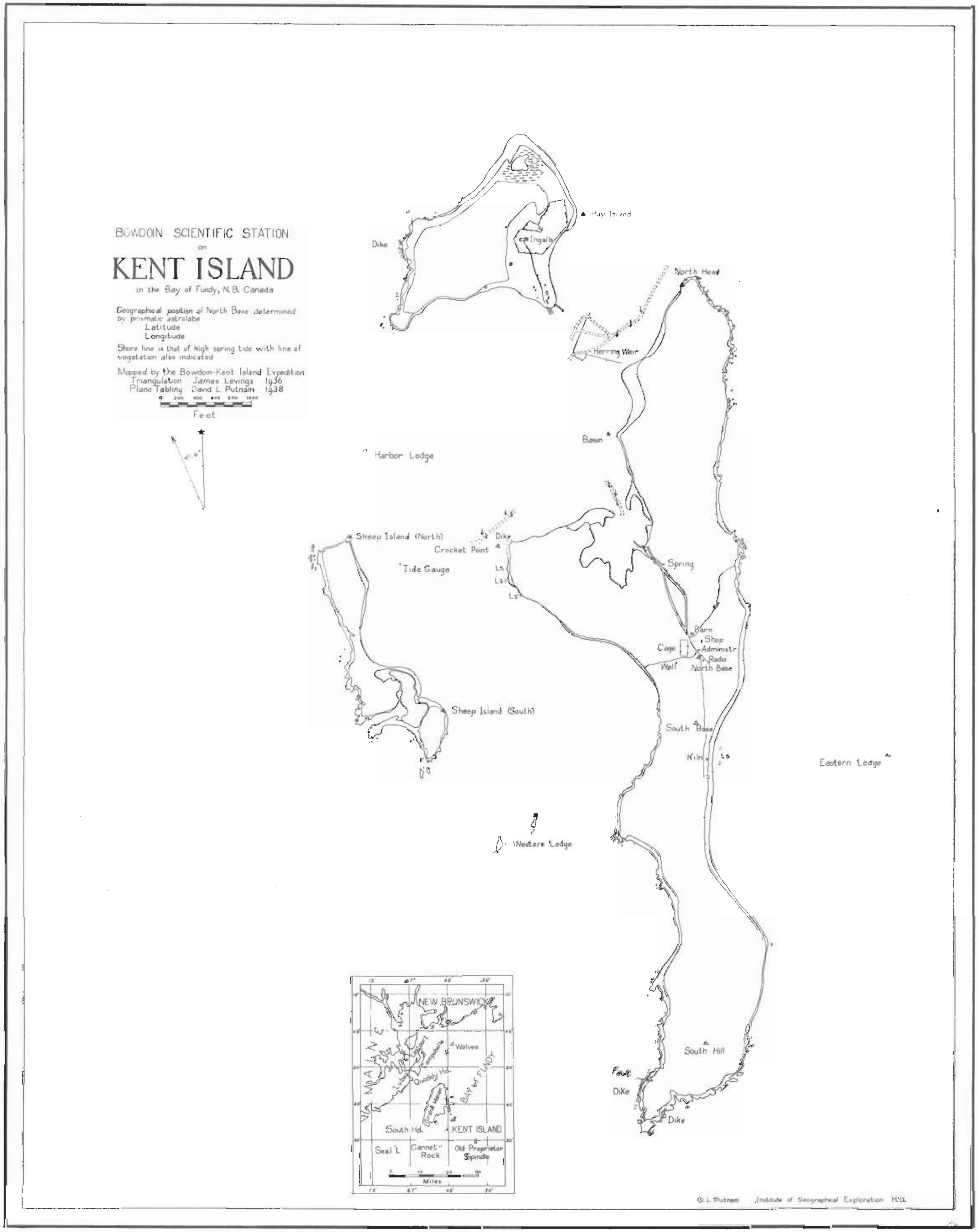
THE BOWDOIN SCIENTIFIC STATION

Kent Island, Bay of Fundy

New Brunswick, Canada



BOWDOIN SCIENTIFIC STATION
on
KENT ISLAND
in the Bay of Fundy, N. B. Canada
Geographical position of North Base determined by prismatic astrolabe
Latitude
Longitude
Shore line is that of high spring tide with line of vegetation also indicated
Mapped by the Bowdoin-Kent Island Expedition
Triangulation James Levings 1936
Plane Tabling David L. Putnam 1938
Feet
21.6°
Dike
Ingalls
North Head
Herring Weir
Basin
Harbor Ledge
Sheep Island (North)
Crocket Point
Dike
Tide Gauge
Spring
Barn
Shop
Administr
Cage
Radio
Well
North Base
Sheep Island (South)
South Base
Kiln
Eastern Ledge
Western Ledge
South Hill
Dike
Dike
NEW BRUNSWICK
MAINE
Wolves
Quoddy Hd.
BAY of FUNDY
Grand Manan
South Hd.
KENT ISLAND
Seal I.
Gannet Rock
Old Proprietor
Spindle
Miles
D. L. Putnam Institute of Geographical Exploration H.U.

THE SIXTH ANNUAL REPORT OF THE BOWDOIN SCIENTIFIC STATION

Bowdoin College
Brunswick, Maine,
April 1, 1942

To the President and
Trustees of Bowdoin College

Sirs:

Following is the sixth annual report of the Bowdoin Scientific Station at Kent Island, Bay of Fundy, New Brunswick, Canada.

The Kent Island Committee recommended the usual appropriation of five hundred dollars ($500.00) and in addition two hundred dollars ($200.00) for the construction of a boat for the use of the station. These recommendations were approved by the Governing Boards of the College.

We are very grateful to Mr. Sumner T. Pike, a member of the Kent Island Committee, for a contribution of two hundred dollars ($200.00) which has made the publication of this report and the the printing of the Kent Island map possible.

The Kent Island map is based on painstaking triangulations made by Mr. James Levings of M.I.T. in 1936-37 and plane tabling by Mr. David L. Putnam in 1938. The latitude and longitude was determined by equal altitude of stars with prismatic astrolable and altitude of Polaris, Ditisheim chronometer and Hamilton Elvinor watch. All coordinates are referred to the northeast base as origin of coordinates, Latitude 44° 35' 18.8" North; Longitude $4^h\ 27^m\ 02.0^s$ West.

This past year the Station has carried on an important project of gull control in cooperation with the United States Department of Fish and Wildlife Service. Mr. Donald Spencer, Regional Director, of the Fish and Wildlife Service visited the Station during May 1941 to outline and to initiate the experiments which were continued by Ivan Spear and H. C. Kendall assisted by Mr. Ernest Joy, warden of the Station. Mr. Spencer was very favorably impressed by the facilities of the Station for ornithological problems of this nature. The island because of its wealth of bird life is pre-eminently suited for ornithological research and this work as in the past will be emphasized in the future.

The session last summer was very successful and excellent work in a diversity of problems was done by the members who attended. The station is measuring up to our expectations as a valuable training school for Bowdoin undergraduates interested in biology. Unfortunately space does not permit the inclusion of all of the papers submitted, but these will be included in the next report.

Mr. Robert M. Cunningham published contribution No. 8 "Chloride Content of Fog Water in Relation to Air Trajectory" in The Bulletin of the American Meteorological Society, vol. 22, number 1. Mr. Cunningham has performed a most important service to the station by making complete meteorological observations during the past five years. In this report he presents a preliminary summary of the Climotology of the Island which is not only important in itself but is also of inestimable value in the consideration of various biological problems.

Mr. Frederick Sargent has prepared a paper on blood pressure adjustments (Contribution number 9) to be published in the Bulletin of the American Meteorological Society. A second paper by Mr. Sargent based on physiological data obtained at the station will be published as contribution number 10.

The station will be operated next season (1942) in spite of the unusual conditions brought on by the war. Naturally not many Bowdoin undergraduates will be able to attend because of the Summer Session of the college at Brunswick and demands made on others by the war.

Alfred O. Gross
for the Committee.

Field-Director's Report for 1941.
(by James Blunt, Bowdoin, '40)

The Bowdoin Scientific Station experienced a good summer. There were ten of us up there this year. Ivan Spear and H. C. Kendall completed a project on Herring Gull Control for the Fish and Wildlife Service. C. H. Bowers devoted his studies to the life cycles of some of the algae. H. B. Taylor spent his time in the study of the Protozoa. Clayton Adams collected plants while David Wells mounted birds for the Kent Island collections and made observations on the local distribution of birds. John Lord and I worked on the endocrine glands and their relation to the impulse of the migratory habit of the Herring Gull. It is not necessary for me to comment further on the results of these various projects because they are written up in the reports that follow. It will suffice to say that the work for the most part was well done; Robert Cunningham continues his interest in meteorology at the station and is doing excellent work in creating that phase of the Station's activities.

On the physical side, no great changes have been made. With the money appropriated by the Boards of the College for the express purpose of building a boat, Lester Tate constructed a large and substantial dory; a second hand outboard motor was purchased to serve as motive power. This brought the total expense for the boat to a little over $100.00. Mr. Tate also made extensive and much needed repairs on the buildings of the Station.

During the summer Dr. and Mrs. Richard Wagner, Prof. and Mrs. Samuel Kammerling plus six weeks old Miss Kamerling and Prof. Philip Wilder and his son made us a visit. The party arrived in Dr. Wagner's sailing yacht, the

"Millicette" out of Boston. The Station was greatly indebted to Dr. Wagner this summer for his advice in planning the Station's diet. Also, while he was at the Island he gave us many suggestions that served as keys to our various problems. The Bowdoin Scientific Station is very grateful to him for his aid. I am also indebted to Prof. and Mrs. Kamerling for their interest in the Station's activities. We also had many groups of visitors who came directly to the Station from Grand Manan.

Each man attending the entire session at the Island was charged seventy-five dollars, fifty dollars of which was used for food. In order to cover adequately, the operating expenses of the Station, a charge of one hundred dollars should be made in the future.

To keep the Station in proper running order, to pay the salary of the warden, taxes, the printing and mailing of the annual report and to provide equipment needed for the various types of work an appropriation of not less than one thousand dollars ($1,000.00) is needed. It is also very desirable that funds be provided for the granting of scholarships to exceptionally good men who cannot afford the expense of a summer at the Station.

In closing this report I would like to say that we all felt it a relief to get away for the summer from the war-torn United States into peaceful Canada, where we could study how things lived while the rest of the world was learning how to kill.

METEOROLOGY

(By Robert M. Cunningham, Massachusetts Institute of Technology)

During the last two years Mr. Joy has continued to take the weather observations twice daily. Mr. David Wells was the observer for part of the summer of 1940, while Mr. James Blunt was the observer during part of last summer. Mr. Benson of Wood Island took the observations during part of the month of October the last two years. The time the observations were taken are as follows:

January through June 15, 1940	9 A.M.	4 P.M.
June 15 through August 31, 1940	8:30 A.M.	8:30 P.M.
September 1940 through June 9, 1941	9 A.M.	4 P.M.
June 9 through September 30, 1941	8:10 A.M.	8:10 P.M.
October 1941	8:10 A.M.	5:10 P.M.
November and December 1941	9 A.M.	4 P.M.

(All times Atlantic Standard, 60th Meridian)

The difference in observation times was due to the attempt to have them coincide with the international observation time and also to have them occur during daylight hours. Besides the observations taken on Kent Island, Mr. Tate took observations of the sea and air temperatures in waters around Grand Manan during part of the lobster season of the past three years.

The weather instruments on the whole worked satisfactorily. The anemometer was overhauled in the spring of 1941 and a half mile contact added so that a continuous reporting of wind velocity could be made. A continuous wind record was made during June and part of December 1941. A longer record was not kept because of a lack of sufficient batteries. A shield of the Mt. Washington type (built by the Stewart Instrument Co.) was placed on the .ain gauge in June, 1941. Although the exposure of the rain gauge is fairly good, its catch of snowfall is quite doubtful, because the snow rarely falls without considerable wind. The shield should give btter results with respect to measurement of snowfall.

None of the Kent Island weather records were used synoptically, of course, because of the shutdown of all radio communications.

The year 1941 makes the fifth year of complete weather records on Kent Island. It is now possible to arrive at some preliminary figures for the mean value of different weather elements. A more complete discussion of the climatology of Kent Island will probably be published later, but a few tables and graphs have been prepared for this report.

Perhaps the most important item to investigate is the prevalence of fog on the Island. The average number of days of dense fog (observed on one or more of the two observations a day) is shown in table 5 and figure 2. The summer maximum is paramount, of course, but a midwinter secondary maximum is also apparant because of the production of Arctic steam fog (locally called "vapor") whenever there is strong outbreak of cold air. The Bay of Fundy region is favorable for this type of fog by reason of the great difference in temperature of sea and air. For example, December 4, 1940, had dense steam fog with an air temperature of 6 degrees and a sea temperature of 42 degrees.

The following tables have been prepared to show the total number of observations (two a day) during the five year period - observations of fog with different wind directions and velocities (data on steam fog in January, February, and March, 1937 is not included).

Table 1

Wind direction	0	N	NE	E	SE	S	SW	W	NW	Total
Light and dense fog not including steam fog.	1	4	33	37	42	150	200	82	15	564
Light and dense steam fog.	0	40	4	2	0	0	0	0	15	61
Total.	1	44	47	39	42	150	200	82	30	625

(Note: Dense fog, visibility less than 5/8 mile.)

Table 2

Wind velocity in the Beaufort scale.	0	1	2	3	4	5	6	7	8	Total
Dense fog Nov-Apr.	0	5	6	16	8	11	9	9	2	66
Dense fog May-Oct.	1	51	145	120	51	19	9	2	0	398
Total	1	56	151	136	59	30	18	11	2	464
(Above does not include steam fog.)										
Dense steam fog.	0	0	0	1	2	1	6	4	0	14
Light and dense steam fog.	0	0	1	6	18	14	16	5	2	62

In connection withbthe steam fog it is interesting to note the range of temperature under which it occurs. Table 3 shows the total number of observations of dense and light steam fog at different temperatures.

Table 3

Temperature	Steam fog Light	Dense	Total
24-25	1	1*	2
20-23	2	0	2
16-19	6	0	6
12-15	16	1	17
8-11	16	3	19
4-7	3	4	7
0-3	3	5	8

(*Snow was falling at the same time.)

In comparison with the above table 4 shows the mean temperature of the dry bulb in each month with observations of light and dense fog (not indluding steam fog) for the years 1937 and 1938.

Table 4

	J	F	M	A	M	J	J	A	S	O	N	D
Temperature	43	40	40	41	46	53	55	57	57	53	51	49

(Note: The mean temperatures during the winter months are based on only a few observations.)

In table 6 the mean maximum and minimum temperatures for each month are shown. However, the mean temperature of a station does not give one much information about the climate of the station. What is more enlightening is the frequency of various temperatures. In the case of Kent Island this is particularly significant. Table 7 gives the frequency of maximum and minimum temperatures for each month over the five year period. What is most striking about these figures is the very small range of minimum temperatures in spring and the few times temperature goes above 70 in the summer. It is interesting to compare the spring minimum temperature and the sea temperature. The mean minimum temperature for May, 1940, was 39.7, while the mean sea temperature for the same month was 39.8. The marine character of the climate is clearly most pronounced in spring, when there are neither cold nor warm outbreaks of air from the nearby continent.

The fact that there are only a few "hot" days in summer is another notable aspect of Kent Island weather. The temperature usually rises above 70 only when there are currents of very light northerly winds during a period of very hot weather inland. The maximum temperature is reached in the calm period just before the wind shifts to the southerly quadrant. What happens apparently is that the light northerly winds bring the hot air out over the cold ocean above a very intense inversion. When the wind dies out, the solar heating over the Island destroys the inversion locally, allowing the temperature to rise above the 70 degree mark. A thermograph record will show this up well. Frequently the temperature will rise rapidly just after sunrise on clear calm mornings to above 70 degrees. Then even before 8 A.M. the wind will blow occasionally from the south or southeast and the temperature will drop in less than a minute ten degrees or so. The temperature may fluctuate five to ten degrees for an hour or so, going up or down with every puff of wind, before a steadily southerly wind is set up. The temperature then usually drops to the lower fifties, or if a fog comes in, into the forties.

Sea temperatures were not frequently taken on Kent Island because of the unrepresentativeness of readings along the beaches exposed to solar heating and large tidal fluctuations. However, Mr. Tate has taken quite a few observations with a Frieze sea thermometer from his lobster boat and from the breakwater at Ingalls Head. Table 5 gives his results. Most of the inshore readings are from Ingalls Head, and most of the offshore ones were taken near the Murr Ledges seven miles southwest of Kent Island.

Table 5

Date		Sea Temperatures Inshore	Offshore
1940			
April	1-3	31	36
	4-7	34	--
	8-12	34.5	--
	13	35	--
	14-28	36	36
	29-30	37	37
May	1	--	38
	2-	39	--
	3-7	40	39
	9-14	42	40
	16-22	43	40
Nov.	10-20	43	43
	21-27	43	44
	28	39	--
	30-Dec. 2	43	43
Dec.	3-4	35	42
	5	40	--
1941			
June	19	--	43
	27	45	--
Dec.	29	38	--
	30	40	40

(Note: Readings are not necessarily taken every day in each period, but all readings in each period are the same.)

Included in this report are also the annual summaries of the years 1940 and 1941 - Tables 8 and 9. In 1940 the maximum temperature reached 70 degrees or above on ten days while in 1941 there were eight such days. In 1940 there were four days with thunderstorms (July and August data incomplete). In 1941 there were 11 such days. Two hurricanes came close to Kent Island in September 1940, resulting in most of the 12.3 inches of rain for the month. There were 2.53 inches of rain on the second, and 5.37 inches on the fifteenth.

It is to be hoped that the weather observations will be continued on Kent Island. Five years allow one to make some conclusions about the climatology of this island, but a longer period better lends itself to statistical analysis. These records, I believe, are also useful to the biologist and scientists in related fields. Weather reports from the island have, moreover, been found useful synoptically by the Yankee Network in forecasting summer fog conditions along the Maine and Nova Scotia coasts.

Table 6

METEOROLOGICAL SUMMARY FOR KENT ISLAND, N.B., CANADA
FOR THE FIVE YEARS, 1937 THROUGH 1941

	Jan	Feb	Mar	Apr	May	June	July
Mean Temp.	25.4	27.6	30.0	39.2	46.0	51.5	55.7
Mean Max. Temp.	31.7	33.9	36.0	45.1	52.6	58.6	63.0
Mean Min. Temp.	19.1	21.4	24.2	33.5	39.4	44.5	48.4
Highest Temp.	49	50	58	65	71	79	79
Lowest Temp.	0	2	2	17	33	39	41
Prevailing Wind	N	N	N	NE	SW	SW	SW
Avr. Vel. (mph)	19	18	18	16	13	10	8
Highest Vel.	9B	10B	10B	10B	7B	6B	6B
Avr. no. Days* with:							
Fog (all types)	6.6	3.0	2.8	4.0	7.4	13.8	18.2
"Vapor" Fog	6.5	1.5	0.5	0	0	0	0
Dense Fog	2.6	1.8	1.8	3.2	6.0	10.8	17.0
Dense "Vapor"	1.6	0.4	0	0	0	0	0
Max. no. Days of Dense fog	5	4	5	6	9	12	21
Min. no. days of Dense fog	0	0	0	0	3	8	9

	Aug	Sept	Oct	Nov	Dec	Annual
Mean Temp.	58.1	54.5	48.1	40.2	31.3	42.3
Mean Max. Temp.	65.3	60.5	53.1	45.4	37.1	48.5
Mean Min. Temp.	51.0	48.5	43.0	34.9	25.5	36.1
Highest Temp.	77	72	68	59	54	79
Lowest Temp.	42	38	28	13	0	0
Prevailing Wind	W	SW	N	N	N	N
Avr. Vel. (mph)	8	11	16	19	19	15
Highest Vel.	6B	8B	8B	9B	10B	10B
Avr. no. days* with:						
Fog (all types)	16.0	8.0	4.6	2.4	5.8	92.8
"Vapor" Fog	0	0	0	0	4.0	12.5
Dense Fog	14.8	6.6	2.4	1.8	1.8	71.6
Dense "Vapor"	0	0	0	0	0.4	2.4
Max. no. days of dense fog	20	10	7	6	5	21
Min. no. days of dense fog	9	5	1	0	0	0

*Fog that occurred on one or more of the two observations a day.

Annual precipitation: 1937, 42.12"   1938, 50.40"   1939, 39.51"
1940, 49.50"   1941, 32.76"

Greatest rainfall in one month 12.30" in September 1940.
Greatest rainfall in one day 5.37" on September 16th, 1940.
Least rainfall in one month 0.57" in June 1941.

Fig. 1 The temperature regime of Kent Island.
(1) Highest temperature observed in five years.
(2) Mean max. temperature
(3) Mean temperature
(4) Mean min. temperature
(5) Lowest temperature observed in five years.

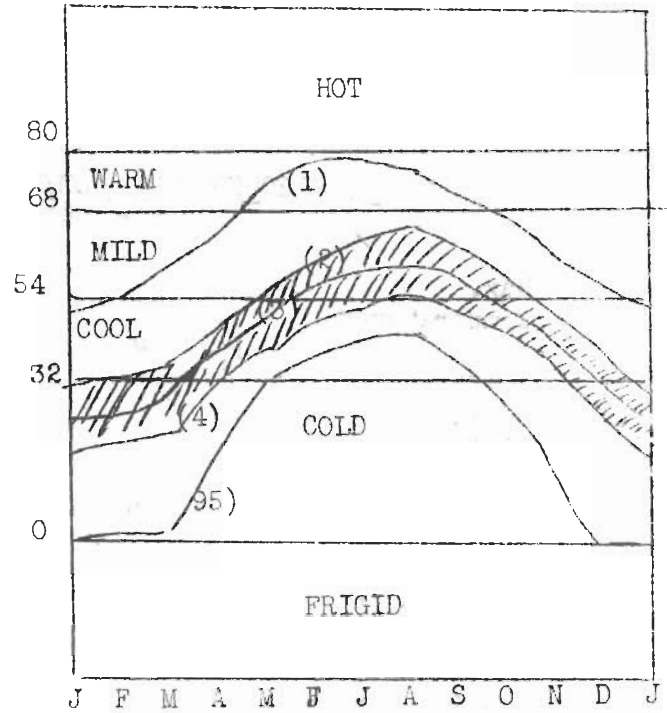


Fig 2 The fog regime of Kent Island. Days of dense fog on one or more of the two observations a day lies along the ordinate.
(1) Greatest number of days in any one month.
(2) Average number of days in any one month.
(3) Least number of days in any one month.

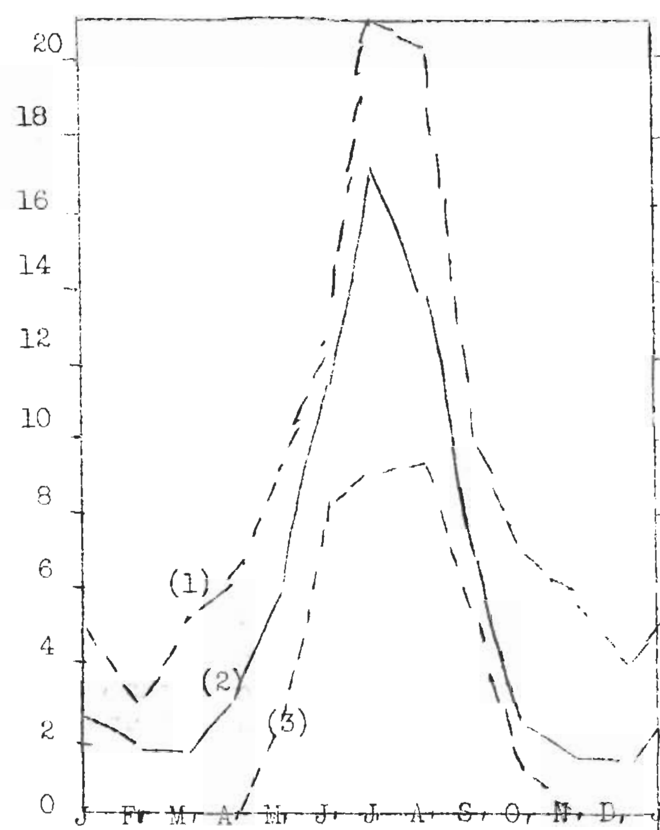


Table 7

AVERAGE FREQUENCY OF MAXIMUM AND MINIMUM TEMPERATURES ON KENT ISLAND FOR THE FIVE YEARS 1937-1941

Max. Temperatures	Months												
	J	F	M	A	M	J	J	A	S	O	N	D	Total
75-79						a	2	1					3
70-74					a	d	2	5	b				8
65-69				a	b	4	6	10	5	b			26
60-64				a	3	6	14	12	12	2			49
55-59			b	1	7	13	6	2	10	11	1		51
50-54		a	1	4	12	6	2		1	10	8	1	45
45-49	2	d	1	11	7	c				5	10	6	43
40-44	5	4	6	10	1					2	4	7	39
35-39	5	9	12	3						b	4	6	39
30-34	4	7	5	a							2	6	24
25-29	8	5	3								b	2	18
20-24	5	d	1								a	2	9
15-19	1	d	b									d	3
10-14	c	a	a									a	1
5-9	a											a	b

Min. Temperatures	Months												
	J	F	M	A	M	J	J	A	S	O	N	D	Total
55-59							a	2	1				3
50-54						c	10	20	11	3	b		45
45-49					d	13	19	8	13	11	2	a	67
40-44	a			b	16	16	2	b	4	8	7	1	55
35-39	2	d	1	11	11	a			c	4	5	5	41
30-34	4	4	10	14	2					3	7	6	50
25-29	4	6	5	3						d	4	6	29
20-24	5	6	7	b							3	4	25
15-19	8	6	4	a							a	5	23
10-14	4	3	2								a	2	11
5-9	3	2	1									1	7
0-4	1	b	b									c	2

a = occurred on one day in the five years.
b = occurred on two days in the five years.
c = occurred on three days in the five years.
d = occurred on four days in the iife years.

Table 8

METEOROLOGICAL SUMMARY FOR KENT ISLAND N.B., CANADA. YEAR 1940.

	Jan	Feb	Mar	Apr	May	June	July
Mean Temp.	21.0	27.6	30.0	37.4	45.8	49.8	55.1
Mean Max. Temp.	25.6	32.2	34.6	43.1	52.0	56.5	62.
Mean Min. Temp.	16.3	23.1	25.3	31.8	39.7	43.2	47.7
Highest Temp.	40	45	43	54	60	67	78
Lowest Temp.	1	9	12	23	33	40	41
Prevailing Wind	N	N	NE	N	NE	SW	SW
Highest wind	50	61	52	55	24	24	20
Avr. Vel (M.P.H.)	15.7	16.5	16.4	15.4	11.7	10.0	5.8
Precipitation in.	1.16	2.84	4.63	6.08	3.19	2.68	2.84
Snowfall in.	4.9	6.1	4.4	1.7?	0	0	0
Days with:							
.01 or more	6	10	13	11	11	16	13
.25 or more	1	4	5	8	5	3	3
Snow	8	9	5	6	0	0	0
Fog (all types)*	5	0	3	2	9	14	20
"Vapor" fog*	5	0	0	0	0	0	0
Dense Fog*	1	0	2	2	9	12	18
Dense "Vapor"*	1	0	0	0	0	0	0
Dense Fog**	1	0	4	3	9	14	18

	Aug+	Sept	Oct	Nov	Dec	Annual
Mean Temp.	58.1	53.4	46.0	40.1	32.2	41.4
Mean Max. Temp.	65.6	59.2	50.9	44.6	38.3	47.1
Mean Min. Temp.	50.6	47.4	41.1	35.5	26.2	35.7
Highest Temp.	77	67	62	54	48	78
Lowest Temp.	45	39	29	13	4	1
Prevailing Wind	NE	SW	v	N	N	N
Highest wind	6B	7B	6B	8B	7B	61mph
Avr. vel. (mph)	9	13	16	18	20	14 mph
Precipitation in.	0.99	12.30	1.37	7.43	3.99	49.50
Snowfall in.	0	0	0.9	1.8	2.6	22.4
Day with:						
.01 in. or more	(4)	15	12	18	12	141
.25 in. or more	(3)	7	1	9	5	54
Snow	0	0	3	3	5	39
Fog (all types)*	(13)	6	2	1	5	80
"Vapor" fog*	0	0	0	0	4	9
Dense fog*	(13)	6	1	1	2	67
Dense "Vapor"*	0	0	0	0	1	2
Dense fog**	(13)	7	1	1	2	73

*Fog on one or more of the observations (two a day)
**Dense fog any time during the day.
+Ten days missing, scattered through month.
v An equal number of observations from several directions.
( ) corrected to 31 days
Highest velocities in miles per hour (one minute velocities) except when B follows figure, then in Beaufort scale.

Table 9

METEOROLOGICAL SUMMARY FOR KENT ISLAND N.B., CANADA. YEAR 1941

	Jan	Feb	Mar	Apr	May	June	July
Mean Temp.***	22	27	29	40	46	51.3	54.3
Mean Max. Temp.	27.8	33.6	34.6	46.0	51.8	58.2	61.4
Mean Min. Temp. ***	16	21	24	35	40	44.4	47.1
Highest Temp.	41	43	52	60	61	79	74
Lowest Temp.	0?	14?	8?	24?	37?	42	42
Prevailing wind	N	N	N	NE	v	SW	SW
Avr. vel. (mph)	22	20	20	13	16	9.7	8.1
Highest vel.	7B	9B	8B	7B	6B	6B	26
Precipitation in.	2.20	1.02	3.55	0.64	4.25	0.57	2.67
Snowfall in.	7.7	2.7	13.7	0	0	0	0
Days with:							
.01 in. or more	15	6	13	6	13	7	11
.25 in. or more	4	1	3	1	7	0	4
Snow	10	6	9	0	0	0	0
Fog (all types)*	8	2	2	4	5	13	19
"Vapor" Fog*	7	1	1	0	0	0	0
Dense Fog*	3	1	1	3	3	11	17
Dense "Vapor"*	3	0	0	0	0	0	0
Dense Fog**	4	1	2	5	8	11	17

	Aug	Sept	Oct	Nov	Dec	Annual
Mean Temp.	55.5	53.1	46.4	40.8	31.4	41.4
Mean Max. Temp.	62.0	58.9	51.2	46.5	37.9	47.5
Mean Min. Temp.	49.0	47.4	41.5	35.2	25.0	35.5
Highest Temp.	74	72	68	52	48	79
Lowest Temp.	42	39	23	21	0	0
Prevailing wind	v	N	v	SW	N	N
Avr. vel. (mph)	8.2	10	15	17	18	15
Highest vel.	21	7B	7B	7B	10B	10B
Precipitation in.	5.62	2.79	4.01	3.88	1.56	32.76
Snowfall in.	0	0	0	0	5.1	29.2
Days with:						
.01 in or more	16	10	12	9	13	131
.25 in or more	6	4	3	5	2	40
Snow	0	0	0	0	7	32
Fog (all types)*	10	6	6	6	10	91
"Vapor fog"*	0	0	0	0	5	14
Dense Fog*	9	5	5	6	5	69
Dense "Vapor"*	0	0	0	0	1	4
Dense Fog**	14	6	7	6	5	86

*Fog that occurred on one or more of the two observations a day.
**Dense fog that occurred any time during the day
***Minimum thermometer read incorrectly Jan. through May.
Values arrived at for these months by applying mean deviations of the morning dry bulb temperature from the minimu temperatures of the four previous years to the morning dry bulb temperatures of this year.
? Lowest dry bulb temperatr--e. (Rest of the notes in table 8.)

HAEMATOXYLIN AND IODINE AS A CHROMATIN STAIN
(by James Blunt, Bowdoin '40)

There is no doubt but that a Haematoxylin stain with a counterstain of Iodine is such a simple technique that it is generally used in many places. But so far as I have been unable to find any written record of it, so I am giving it in this report as a stain which I worked on this summer and proved very successful.

Tissues are fixed in either Gildon's Fluid or Worchester's Fluid. Sections were made at seven microns, mounted, and stained in full strength Delafield's Haematoxylin for twenty minutes by the usual process. After washing thoroughly in running water, the slides were put in 70% alcohol that had enough Iodine crystals added to it to turn it a deep brown; overconcentration should be avoided. They remain here for a minimum of 10 minutes but there is no danger in leaving them up to one hour in this solution. The 95%, 100%, and the Zylol are also made a deep brown by the addition of Iodine crystals, and the slides are left in each for 5 minutes in the dehydration and clearing process. The sections are made permanent by Canada Balsam and a cover glass.

The advantages of this stain are excellent chromosome figures, a faint counterstain of light tan, good differentiation of unicellular glands in the intestinal mucosa, and no danger of overdifferentiation. It presents all the advantages of an iron-haematoxylin stain with none of the chances of mishap and is considerably quicker. The one drawback is that the counterstain tends to fade in lengthy exposure to sunlight.

PRELIMINARY EXPERIMENTS ON THE RELATIONSHIP OF THE SUPRARENAL CORTEX TO THE MIGRATORY INSTINCT IN BIRDS.
(by J.W. Blunt Jr, Bowdoin '40 and J. Thord, Bowdoin '44)

It has long been proven that the gonads of a bird are influential in the migratory process to which birds subject themselves twice each year. But it seemed strange that the gonads, so far removed from any influence by the forces of the outside world could be the only facotr in initiating this remarkable process. So, during the summer of 1940 I made observations on the various endocrine glands of the Herring Gull to see if there were any fluctuations in their sizes that would indicate increased activity as the migratory period approached. These observations showed a few changes that took place, but they were not definite enough to permit conclusions to be drawn. However, I did notice that the suprarenal gland showed signs of activity toward the end of the summer. I compared sections made from the suprarenals of birds taken in the middle of July with those of birds taken at the end of August and with those taken from birds-of-the-year. I noted that in July the nuclei of the cortical cells were removed to the basal half of the cells, but they did not touch the base itself. On the other hand, in adult birds taken late in August the cortical cells had their nuclei flattened against the bases of their respective cells. This indicated a definite increase in activity over the July sections. In the case of the birds-of-the-year, which had never flown, the cortical cells were small with the nuclei centrally placed, indicating inactivity. At the time this didn't particularly interest me, but when I made some sections of the suprarenal of a pigeon the following spring and found the same condition as that occurring in the bird-of-the-year, the whole thing began to take shape. Here in the pigeon at the hight of the breeding season, when the gonads were as large as walnuts, and migrations should have taken place the cortical cells showed no signs of activity whatsoever. It became very obvious then, the birds that didn't migrate had inactive cortical cells and the birds that did migrate showed increased activity in the cortical cells as the migratory period approached.

Through the courtesy of the Parke, Davis Co. who kindly sent us twenty ounces of their "Eschatin", John Lord and I were able to make some preliminary experiments on the effect of the cortical extract in the migratory instinct of the Herring Gull. "Eschatin" is a pure extract from the beef suprarenal cortex.

First we administered the "Eschatin" in increasing dosages to a series of birds to determine its toxicity. It was discovered that a dose of more than six tenth of a cc. was fatal; the bird would lie on its back and expire from conditions that closely resembled asthma. We set out dose at five tenths of a cc. as a result to these experiments, and administered that amount to three birds that we kept in captivity for seventy two hours to make sure that no fatal complications set in.. Nothing happened.

With this as a basis we attempted to determine how long it would take the "Eschatin" to stimulate the bird to migrate. For this experiment we jacked fifteen birds from their nests, and injected each with five tenths of a cc. These birds were released at six hour intervals and their nests watched. None of the birds ever returned to the nest, so we set an arbitrary time of six hours for the birds to be kept in captivity.

In our next experiment we jacked nineteen birds, injected fourteen of them with five tenths of a cc. of "eschatin", and kept five for controls. The injected birds were marked with Spirits Blue and the controls with Eosin. Twenty-four hours after release two of the injected birds were observed in the region of their nests and three of the controls; at forty-eight hours no injected birds were seen and two of the controls were noted. Fog prevented further observations. Two weeks later one of the controls was found dead near the place of captivity, indicating that it never flew after its release; that accounts for four out of the five of the controls and only two out of the fourteen of the injected birds.

From this it can be concluded that the extract from the suprarenal cortex causes the Herring Gull to leave it nesting site.

Another summer we propose to inject a large number of birds and attempt to determine what happens to them after they leave Kent Island. We will also attempt to remove the suprarenals from a series of birds and see if they will stay behind when the other birds migrate.

The work is far from complete as yet, but at least we've made what seems to be a step in the right direction.

HERRING GULL CONTROL EXPERIMENTS
(by Ivan M. Spear, Bowdoin '44)

The problem of Herring Gull control has for some time been interesting the Fish and Wildlife Service. This useful gull must be protected from wanton slaying, and yet not be allowed to become so plentiful as to be an economic hazard. Where its numbers have become overplentiful, it has caused considerable local damage to blueberry and cranberry crops, seed clams exposed by diggers, and fish impounded in weirs. The bird has been known to drive away many of the birds which favor similar nesting sites such as petrels, terns, and other species of birds. But let us not lose light of the merits of the herring gull. As a scavenger it has no equal along our shores, and it is a welcome addition to our beaches. The bird is among the best known of our coastal birds, and its graceful flight is a source of pleasure to all. Hence we must not permit the destruction of the adults, but we must find a method of exerting a controlling and stabilizing influence over its numbers. To obtain this desirable constant population several methods have been used. Destruction of the eggs themselves at one time during incubation was found useless, for other clutches were soon laid. For several years the gulls' eggs have been punctured by drilling with 3/16" diameter needles so that the eggs will decay. However, this method is also impractical. Hydrogen sulfide formed by the decomposition escapes through the aperture and the gull, finding that the eggs have become rotten will crush or roll them from the nest and lay another clutch. Recent experiments have shown that oil, sprayed upon the surface of an egg, will penetrate the porous shell and form a coating over the egg membrane, preventing oxygen from reaching the embryo and thus prohibiting its development, and eventually resulting in the decay of the egg. This oil spray needs further perfecting, for while it does prevent the egg from rotting for about two weeks, a more lengthened period of decomposition would be most desirable and efficient.

Working in cooperation with the Fish and Wildlife Service, Mr. H. C. Kendall and myself undertook the interesting experiment of spraying the gull eggs with an oil containing various preservatives of hardening agents in solution, the purpose of which was to aid in delaying the decomposition of the eggs. With the assistance of Mr. D. A. Spencer of the Fish and Wildlife Service and Prof. A. O. Gross of Bowdoin College the experiment was set up on the thirtieth and the thirty-first of May on Kent Island, one of the islands of the Grand Manan Archipelago where Bowdoin College operates a scientific station. During the three week period elapsing between our return to the island after the close of the college year, Mr. E. Joy, the warden of the island, conducted our observations for us.

The reactions of the gulls to the treatment of the eggs with the oil spray may well be of interest to many. In the majority of cases where the clutch was complete the gulls seemed to pay little heed to the spray. However, our observations would indicate that where the clutch was not completed gulls would often destroy the eggs, possibly to lay again. Nineteen nests in quadrangles 1 to 5 inclusive were destroyed within approximately ten days. Thirteen of these nests contained one egg, five two eggs, and but one contained three eggs. Also of interest is that in only four of the thirteen one egg nests were eggs again laid. In the late incubation plots 7 to 10 inclusive, such observations were impossible. The advanced stages of incubation made it impossible for us to ascertain with any degree of accuracy such destruction of eggs. Many cases pointing toward this possibility may well have been natural desertion of the nest because of already delayed hatching, the natural decay of infertile eggs and hatching of some.

On the thirtieth and thirty-first of May five quadrangles or plots about seventy feet square were staked off with colored stakes. Each quadrangle contained fifty nests at the time of spraying. These nests and subsequent nests were marked with labeled wooden stakes. Birds laying in the quadrangle after spraying furnished interesting data as controls. The condition of each nest was checked every two days, weather permitting.

The eggs of the first plot were sprayed on May thirtieth with an oil containing elgitol, a yellow dye, for identification. Within the first five days four nests were destroyed by the gulls. One of these cases may have been the work of a marauding crow. The fifty nests in which the eggs were sprayed contained 123 eggs or 2.46 eggs per nest. The complete set of Herring Gull eggs varies from 1 to 4 eggs. Mr. F. H. Crystal found in his partial census of Herring Gull nests on Kent Island that 34.1% contained one egg, 38.6% two eggs, 27.3% contained three eggs and two nests held four eggs; 11.672 nests were considered. (See 5th Annual Report, Feb. 1, 1941). Twenty or 16.26% of these treaty eggs hatched. It should be remembered that variation in operator's technique, poor emulsions, and inefficient nozzles on the spray guns may have resulted in poor coverage of the eggs and thus the effectiveness of the sprays cannot entirely, though in part, be judged by such percentages of hatchings. Fourteen new nests were established in the quadrangle after the spraying. Twenty-eight eggs were contained in these new nests and twenty or 71.43% of these eggs hatched. By the third of August only three nests contained eggs. All of these had decayed and only the shell was left, incubation had ceased by the twenty-first of July. It was found that by shaking the egg an approximation of the degree of decomposition could be ascertained. On the twenty-seventh of June the first entirely decayed eggs were found. Usually the gulls rolled these light egg shells from the nest and in many instances punctured them with their bills. Some of the gulls in this plot incubated eggs partially decayed in most cases until July 18 or for a period of 49 days. After this date the gonads cease functioning and laying stops.

Studies of the gonads of the Herring Gull on Kent Island conducted by Mr. J. Blunt have shown that the gonads of the male cease to function about the eighteenth of July and those of the female about the first of August. Thus the sudden discontinuation of nesting activities may be explained.

The eggs of fifty nests of the second quadrangle were sprayed with oil containing a 5% solution of sodium borate. Each egg was marked with eosin. The original fifty nests contained 112 eggs or 2.24 eggs per nest. Five of these nests were deserted in the first eight days after spraying. Sixty eggs of the 112 treated eggs hatched or approximately 53%. This high percentage of hatching, however, is not directly caused by the inefficiency of the sodium borate. It may well be explained by the fact that the sodium borate would not form a permanent solution with the oil, but would separate from it and the operator of the spray gun was forced to shake the container frequently. After spraying on May 30-31 twenty-three new nests were built. These nests contained 48 eggs or 2.01 eggs per nest. Only 27 or 56% of these eggs hatched. On July 18 I observed a bird in this plot carrying nesting material and after that day many new and unused nests were found.

Quadrangle number threevwas treated with clear oil containing a small amount of picric acid. This quadrangle contained fifty-one nests havin g a total of 111 eggs or 2.17 eggs per nest. Six of these nests were destroyed in the first week after spraying. One of these nests was used again. Ten of these nests hatched a total of fourteen eggs or 13% of the sprayed eggs hatched. Thirty new nests containing 57 eggs or 1.9 eggs per nest were established after May 31. Sixteen of these eggs or 28% of the unsprayed eggs hatched.

The fifty nests in the fourth quadrangle were sprayed with oil containing a 5% solution of cresylic acid. There were 119 eggs in these nests or 2.38 eggs per nest. Five of these nests were deserted within the first week and 5 eggs of three of the nests, or approximately 4.2% of the sprayed eggs hatched. Twelve nests were added after spraying and these contained 24 eggs or 2 eggs per nest. Sixteen of these eggs or 66.6% of the unsprayed eggs hatched. The gull incubating the eggs of nest 17 in this plot showed a determination to incubate which we found unequalled elsewhere. On July 7 she evidently decided that her eggs were not going to hatch and rolled them from the nest. On the tenth of July she was proudly incubating one of her forsaken eggs in a new nest less than a foot from the old.

The eggs of the fifth quadrangle were treated with oil containing 5% formalin and marked with methylene blue. The fifty nests contained 127 eggs or 2.54 eggs per nest. Ten of these eggs hatched or approximately 8%. Ten nests added after spraying contained 19 eggs or 1.9 eggs per nest. Thirteen or 68% of these unsprayed eggs hatched.

Because the eggs are laid later on Kent Island than along most of the New England coast, we established four additional quadrangles on June 27 to test the effects of the sprays on eggs containing embryos that were well developed. However that incubation was so far advanced that the possibility of a large number of sterile eggs having been laid by late nesting birds may well obscure and minimize the apparent effectiveness of this late spraying. Yet it should be borne in mind that many of these nests contained incomplete clutches because many of the eggs had hatched by the time of spraying. Nevertheless, spraying after the incubation period is well advanced cannot fail to be superior to early spraying, for there is then a greater possibility that the decaying of the eggs will be retarded long enough to prevent the gull from laying another clutch because of inactive gonads, and because most of the clutches will then be complete.

Quadrangle number seven, set up and sprayed on the twenty-seventh of June, contained fifty nests at the time of spraying. The oil spray used here contained elgitol. The nests contained 92 eggs (1.84 eggs per nest) and some young. Five of the 92 eggs or 5.5% hatched. Four more nests containing six eggs or 1.5 eggs per nest were added. None of these eggs hatched, probably because they were infertile as the season was so far advanced. Here we found that many well advanced embryos were killed by the oil spray. Those which survived were stained by the dye.

Quadrangle eight, second of the advanced stage group was treated with formalin. The fifty nests held 104 eggs or 2.08 per nest. Fifteen or 14% of the eggs which were sprayed hatched. Two nests containg 3 eggs (1.5 per nest) all of which hatched were added after spraying.

The oil used on Quadrangle nine contained picric acid. The fifty nests held 102 eggs (2.04 per nest) and of them seventeen or 16.7% hatched. Three nests with five eggs (1.6 eggs per nest) were added and none of them hatched.

Quadrangle ten was treated with sodium borate. 109 eggs (2.18 eggs per nest) were sprayed and thirty or 26.6% of these hatched. Only one nest containing one egg was added and that egg hatched.

In order that we might visualize the result of egging as is permitted in the Grand Manan region Quadrangle six was devoted to a thorough process of egging. In the period from the 31st of May to July 17, when the last egg was taken, the original fifty nests swelled to 133. Three hundred and eighty-six eggs were taken, an average of 2.9 eggs per nest. The greatest number of eggs laid in any one nest was twelve. The remendous increase in the number of nests within this plot may lead us to assume that many of the birds made and laid eggs in more than one nest. The fact that the nests were often very close together would also bear out this assumption. It is of interest to note that after the seventeenth of July no more eggs were laid, This would seem to support Mr. J. Blunt's findings that after or possibly a few days before that date the gonads of the male Herring Gulls of Kent Island become dormant. That the female gonads cease to function later than the male would explain the number of unused nests which we saw after the seventeenth of July. Nests were abondoned in the treated quadrangles at about the same date, regardless of whether they were treated early or late. Hence it might prove of great assistance to the gull control project to adapt the time of spraying eggs to the cessation of the activity of the gonads. The data resulting from our experimental control of eggs in the late stage of incubation and the very few additional nests built in these plots, the possible high rate of infertility among gulls laying second or third clutches and immature birds being considered, would emphasize the importance of spraying the eggs at a late date to offset relaying.

A graph was made of the number of eggs in the first five quadrangles and it enabled us to visualize the approximate time of completion of the clutches and decay of the eggs. Most of the clutches were completed by June 11 and decay of the eggs had begun by June 21 in all of these quadrants.

Summary and conclusions.

Formalin was the best control over the early incubation hatching only 8% of the eggs. It was the second best in the late incubation, hatching 14% there.

Cresylic acid was the second best among the early control sprays hatching 9%. It was not used on a late incubation plot.

Picric acid was the third best in both early and late incubation plots allowing 13% and 16% of the eggs to hatch, respectively.

Elgitol allowed 16% of the eggs in the early incubation plot to hatch and 5% in the late incubation plot.

Sodium borate was found unsatisfactory allowing 53% and 27.5% of the eggs to hatch in the early and late incubation plots, respectively. Probably this is because the sodium borate would not mix well with the oil.

According to these experiments, formalin would be the best emulsion to use on eggs in the early stages of development and elgitol on the eggs in the last stages of incubation.

The spraying method is far superior to egging or drilling for the gulls will lay additional eggs where the latter methods are employed. Mr. H. C. Kendall and I removed eleven eggs from one nest during our egg investigations. Spraying with oil results in the decay of the eggs in about two weeks and is 60 to 70% effective control.

Late spraying is advisable. On Kent Island about June 21 would be best for after that date a constant and rapid decline of the number of sprayed eggs in the early incubation plots was noted.

The number of nests appearing after spraying in the early and late incubation plots were in a ratio of 91 to 10 or about 9 to 1. Therefore fewer nests will escape control if they are sprayed fairly late.

The activity of the male gonads should be considered and the eggs sprayed about three weeks before they cease to function. On Kent Island they cease functioning about July 18.

Corresponding data as to the cessation of the activity of the male gonads should be made along the coast where the greatest gull control is desired.

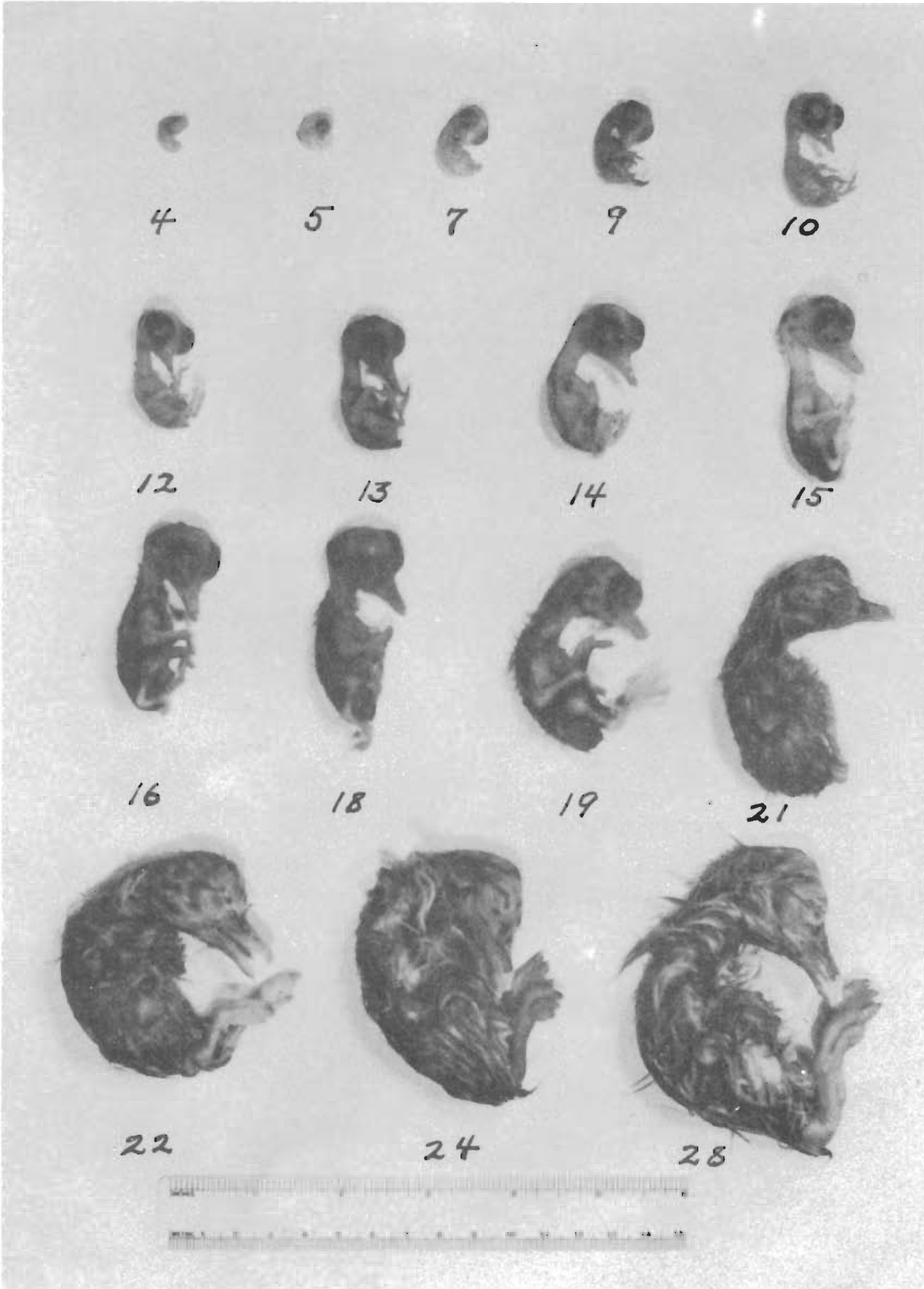
Herring Gull Embryos.

It is desirable in connection with the Herring Gull Control Project to know the approximate stage of incubation of the eggs treated. For this prupose a large series of embryos of known ages were prepared and representative stages were selected for descriptions and photographs. Because of the variation in the start of incubation (some individuals begin when the first egg is laid others only after the set is completed) there is a possible error of 2 days in the ages of the embryos. For practical purposes this error is of no great significance to the field worker who desires only an approximation of the age of the embryos of the eggs of any particular colony.

In the following tables are the weights and measurements of representative stages of the herring gull embryos ranging in age from 4 to 28 days. The photograph of the embryos selected for descriptions and measurements will serve as an aid in visualizing the size and appearance of the embryos. The age of each chick in days is indicated below each figure. The 28 day old chick was taken from a pipped egg.

Description of Herring Gull Embryos
(weights in grams; measurements in centimeters)

Age (Days)	Length	Length (Ext.)	Bill	Eye bill	Tarsus toe	Manus	Weight	Ventral down	Caudual down	Dorsal down	Crual down	Alar down	Head down
4	1.2	1.5					.2						
5	1.4	1.9					.35						
7	2.2	2.8		.5	.5	.35	1.21						
9	2.3	3.3		.6	.7	.5	1.84						
10	2.6	4.3		.9	1.0	.8	3.01		.08				
12	2.8	4.9		1.1	1.2	.8	3.30		.2	.08	.05		
13	3.3	5.1	.6	1.3	1.6	1.0	4.4		.35	.28	.23	.15	
14	3.4	5.5	.8	1.4	1.8	1.2	6.34	.05	.6	.38	.4	.22	.05
15	3.7	6.3	.9	1.6	2.0	1.3	8.11	.45	1.0	.7	.9	.3	.25
16	3.8	6.5	1.0	1.65	2.05	1.4	9.51	.74	1.05	1.0	1.1	.75	.3
18	4.0	6.7	1.	1.8	2.1	1.4	10.42	.85	1.1	1.2	1.2	.9	.32
19	4.7	7.5	1.15	2.	2.6	1.6	12.48	1.1	1.1	1.3	1.3	.9	.55
21	5.3	9.4	1.5	2.2	3.3	1.9	25.03	1.25	1.5	1.5	1.6	1.5	.5
22	6.	10.3	1.6	2.4	3.7	2.	32.36	2.1	2.3	2.1	2.4	2.0	1.0
23	6.3	10.5	1.7	2.6	4.1	2.1	34.77	2.3	2.3	2.4	2.7	2.4	1.1
28	7.1	12.8	2.1	2.9	5.2	2.4	59.260	2.7	3.01	2.9	2.9	2.5	1.2


4
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KEY TO THE OBSERVATION RECORDS WHICH FOLLOW

The dates on which the observations were made head the figures.

The number of the nest is given in the left hand column and the number of eggs and young are given to the right of the nest number. The number of eggs in the the nest are given in the top row and the young immediately below.

	May		June					
	30	31	2	4	6	8	10	12
5	3	3	3	3	2	1		H-3
					1	2	3	
17	3	3	2*	1	0			

The above example illustrates the method in which the data was made. The "H" signifies that some of the eggs hatched and the number after the "H" (H-3) is the number of young hatching from the nest. The "O" signifies that as far as we could ascertain the eggs did not hatch but were either destroyed or rolled from the nest by the adult. The asterisk means that incubation of the eggs had stopped.

QUADRANGLE NUMBER ONE Treatment: Elgitol

	May		June														July														
	30	31	2	4	6	8	10	12	14	16	18	20	22	24	27	29	1	3	5	7	10	12	14	16	18	21	23	25	27	29	31
1	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0					
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	0									
3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	0																
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2*	2	1	1	1	0	
5	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2*	1	1	1	0									
6	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1	1	0													
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	0											
8	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	H-3 3															
9	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	0										
10	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	2_1	2	2*	2	1	1	0		h-1						
11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1_1	H-1															
12	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1	1	1	1	1	1	1*	1	1	1	1	1	1
13	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0															
14	1	2	2	2	2	3	2	2	2	2	2	2	1	1	$H_1$1																
15	3	3	3	3	3	3	3	3	3	3	3	3	1_2	$H_3$3																	
16	3	3	3	3	3	3	2	2	2	2	2	2	1	1	1	0															
17	1	0																													
18	2	2	3	3	3	3	3	3	3	3	3	3	3	3	H-2																
19	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	11	0					
20	3	3	3	3	3	3	3	3	3	3	2	1_1	1_1	1_1	$H_2$2																
21	3	3	3	3	3	3	3	3	2_1	1_1	1_1	$H_2$2																			
22	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	1	0													
23	2	3	3	3	3	3	3	3	3	3	3	3	3	3	1_2	1_2	1	0	H-2												
24	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2^*_1	1_2	1	1	1	1	0	H-2							
25	3	3	0																												
26	3	3	3	3	3	2	1	1	1	1	0																				
27	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	1	0					
28	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	0										
29	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0							
30	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	0												
31	2	2	3	1	0																										
32	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	1 2	1* 2	1	1	1	0	H-2									
33	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1*	1	1	1	1	1	1	1
34	3	3	3	3	3	3	3	3	3	3	3	3	3	2	$H_2$2																
35	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3*	1	1	0								
36	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	1_1	1^*_1	1_1	1_1	0	H-1											
37	1	0																													
38	2	2	3	3	3	3	3	2	2	2	2	2	2	2	0_2	H-2															
39	3	3	3	3	3	3	3	2	2	2	0																				
40	3	3	3	3	3	3	3	3	3	3	2_1	2_1	2_1	1_2	1*	1	1	0	H-2												
41	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	0										
42	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2	1^*_1	1_1	1	1	1	1	1	1	1	1	0	H-1			
43	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	0										
44	2	2	2	2	2	3	2	2	2	1_1	1_1	1_1	1_1	1^*_1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0 H-1
45	3	3	3	3	3	3	3	3	3	3	3	3	3	2^*_1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1 H-1
46	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1*	1	1	1	1	1	1	1	1	1	0				
47	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	1_2	1_2	1*	1	0	H-2										
48	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	1_1	1	0	H-1														
49	3	3	3	3	3	3	3	3	3	3	2	1	1	1	1	1	1	1	1*	1	0										
50	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2_1	1_1	1^*_1	1	1	1	1	1	1	1	1	1	1	1	1	1	1 H-1

QUADRANGLE NUMBER TWO Treatment: 5% Sodium borate

	May		June													July														
	30	31	2	4	6	8	10	12	14	16	18	20	22	24	27	29	1	3	5	7	10	12	14	16	18	21	23	25	27	29	31
1	2	3	0																												
2	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	0						
3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1*	1	1	1	1	1	0
4	3	3	3	3	3	3	3	3	3	3	2	2	1	1	0																
5	3	3	3	3	3	3	3	2	2	1	0																				
6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1	0				
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	0										
8	1	1	0																												
9	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	2_1	1	1*	1	1	1	1	1	1	0	H-1							
10	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1	0							
11	1	1	1	0																											
12	2	2	2	2	2	2	2	2	2	2	2	2	$H_2$2																		
13	2	3	3	3	3	3	3	3	3	3	3	3	3	1_2		$H_3$3															
14	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	1_2	1*	1	1	1	1	1	1	1	0	H-2						
15	1	1	2	2	2	2	2	2	2	2	2	2	2	2^1	2^2	2	H-2														
16	3	3	3	3	3	3	3	3	3	3	3	1_2	$H_1$3																		
17	2	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	0											
18	3	3	3	3	3	3	3	3	3	2_1	1_1	2	H-2																		
19	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	1_2	1^*_2	1_2	0	H-2											
20	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	1_2	1_2	1	1*	1	1	1	1	1	1	0	H-2				
21	3	3	3	3	3	3	3	3	3	3	3	3	2	1_1	1_1	1	1	1	0	H-1											
22	2	2	2	2	2	2	2	2	2	2	2	2	2	2^1	2	H-2															
23	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	H-3															
24	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	1_2	0	H-2													
25	1	1	1	1	1	0																									
26	1	0	1	1	0																										
27	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2^*_1	2_1	2_1	2	2	2	2	2	2	2	2	2	2	2	2	2	H-1
28	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	0				
29	2	2	3	3	3	3	3	3	3	3	3	3	3	3	1_2		H-3														
30	3	3	3	3	3	3	3	3	3	3	3	3_1	1_2	3	H-3	3															
31	3	3	3	3	3	3	3	3	3	3	1_2	1_1	$H_2$3																		
32	3	3	3	3	3	3	3	3	3	3	3	3	H-3																		
33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	H-1															
34	3	3	3	3	3	3	3	3	3	3	3	1_1	$H_2$2																		
35	3	3	3	3	3	3	3	3	3	3	3	2_1	1_2	H-3																	
36	1	2	2	2	2	2	2	2	2	2	2	2	1	1	1	H-1															
37	2	2	3	3	3	3	3	3	3	3	3	3	3	3		H-3															
38	3	3	3	3	3	3	3	3	3	3	2_1	1_2	1_2	1	1*	1	1	1	1	1	0	H-2									
39	3	3	3	3	3	3	3	3	3	3	3	2_1	1_2	1	1*	1	1	1	1	1	0	H-2									
40	1	1	2	3	3	3	3	3	3	3	3	3	3	3	2_1	1_2H															
41	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	$H_3$3																
42	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	1_2	1*	1	1	1	1	1	1	1	1	1	1	1	0	H-2			
43	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	0													
44	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	0										
45	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1_1	1^*_1	1_1	1_1	1_1	0	H-1									
46	3	3	3	3	3	3	3	3	2	1	1	1	1	1	1	0															
47	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	1_2	1_1	1	0	H-2											
48	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2*	2	2	2	1	1	1	0							
49	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3	2_1	1_2	1*	1	1	0	H-2									
50	3	3	3	3	3	3	3	3	2	2	2	2	2	1	0																

QUADRANGLE NUMBER THREE — Treatment: Thionin

	May 31	June 2	4	6	8	10	12	14	16	18	20	22	24	27	29	July 1	3	5	7	10	12	14	16	18	21	23	25	27	29	31
1	1	0																												
2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	H-1														
3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	1	0												
4	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	1	0											
5	2	3	3	3	3	3	3	3	3	3	3	3	3	1_1	1_1	1_1	1_1	1	1	1	1	1	1	1	1	1	1	o	H-1	
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0										
7	2	2	2	2	3	1	1	1	1	1	1	1	1	1	1	0														
8	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1					
9	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
10	3	3	3	3	3	3	3	3	3	3	3	3	3	2*	1	1	1	1	0											
11	3	3	3	3	3	3	3	3	3	3	3	1	1	0																
12	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1_1	1	1	1	1	1	1*	1	1	1	0	H-1				
13	2	2	2	2	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
14	3	3	3	3	3	3	3	3	2	2	2	2	1	1	0															
15	3	3	3	3	3	3	3	3	3	3	3	3	3	0																
16	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0														
17	2	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	2_1	2	2	2*	2	2	2	2	2	0	H-1				
18	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2*	1	1	0										
19	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	0											
20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	0										
21	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	1	2	1	0							
22	1	1	1	1	1	1	1	1	1	1	1	1	1	H-1																
23	3	3	3	3	3	3	3	1	3	3	2	2	1	1*	1	1	1	1	1	0										
24	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	0												
25	2	0	0	0	0	0	0	1	2	3	3	3	3	3	3	3	3	3	3	3	H-3									
26	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	0													
27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	H-1															
28	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	2	2	2	2*	2	1	1	1	1	1	0	H-1		
29	1	1	2	2	3	3	2	2	2	2	2	2	2	2	1_1	1*	1	1	0	H-1										
30	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1	1	1	1	0
31	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	1*	1	1	1	1	1	1	1	1	1	1	1	H-1		
32	3	2	3	3	3	3	2	2	3	3	2	2	2	2	2	2	2	2	1	1	1	1	0							
33	2	1	1	1	1	1	1	0																						
34	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0											
35	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1*	1	1	1	1	1	1	0	H-1							
36	2	3	2	2	2	0																								
37	2	2	2	2	2	2	2	2	2	2	1	1	1	0		(not sprayed)														
38	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2	2	1	1	0	H-1									
39	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	0		
40	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2*	2	2	2	1	1	1	1	1	0
41	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	0							
42	1	2	3	3	3	3	3	3	3	3	3	3	3	3	1_2	1_2	1	0	H-2											
																	(not sprayed)													
43	1	2	2	2	2	2	2	2	2	2	2	2	2	1_1	1_1	1	1	1	1	0	h-1									
44	3	3	3	3	3	3	3	3	3	2	2	1	1	1	H-1															
45	1	0																												
46	2	2	2	2	2	2	2	2	2	2	1	1	1	0																
47	3	3	3	3	3	2	2	2	2	2	2	2	2	0																
48	1	0	0	0	0	0	0	1	2	2	2	2	2	2	2	2	2	2	2	2	H-2									
49	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	0									
50	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1*	1	1	1	1	1	1	0			
51	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1	1	0							

QUADRANGLE NUMBER FOUR

Treatment: 5% Cresylic acid

	May	June														July												
	31	2	4	6	8	10	12	14	16	18	20	22	24	27	29	1	3	5	7	10	12	14	16	18	21	23	25	29
1	1	1	3	3	3	3	3	3	3	3	3	3	3	3	1_2	1_2	1	1*	1	0	H-2							
2	1	2	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	2_1	1	0	H-1								
3	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0												
4	2	2	2	2	3	2	2	2	2	2	1	1	1	0														
5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0												
6	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	0										
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	0						
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1*	1	0									
9	3	3	3	3	3	3	3	3	3	3	3	1	1	0														
10	2	2	3	3	3	3	3	3	3	3	3	3	2	2	1_1	1_1	1	0	H-1									
11	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	2	2	2	0	H-1							
																	(not sprayed)											
12	3	3	3	3	3	3	3	3	3	3	3	2	1	0														
13	3	3	3	3	3	3	3	2	2	2	1	$H_1$1																
14	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	0								
15	3	3	3	3	3	2	3	3	3	3	3	3	3	2	1*	1	1	1	1	1	0							
16	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	0										
17	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0									
18	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	0												
19	3	3	3	3	3	2	3	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0				
20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	2	0									
21	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2*	1	1	1	1	1	1	0		
22	3	3	3	3	3	3	3	2	3	2	3	3	2	2	1	0												
23	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3		3*	2	0									
24	2	1	1	1	1	1	1	0																				
25	3	3	3	3	3	3	3	3	3	3	3	3	2	0														
26	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	0												
27	1	2	2	2	2	2	2	2	2	2	2	2	2	2	$H_2$2													
28	3	3	3	3	3	3	3	2	3	3	2	1	1	0														
29	3	3	3	3	3	3	3	3	2	0																		
30	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	0						
31	3	3	3	3	3	2	2	2	2	2	3	1	1	1	1	1	1	1	1	0								
32	3	3	3	3	3	3	2	2	2	2	2	1	1	1	1	0												
33	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0				
34	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1*	1	1	1	1	1	0			
35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1_1	1_1	1	1	0	H-1								
36	3	3	3	3	3	3	3	3	3	2	0																	
37	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2		2*	1	0									
38	2	0	0	0	0	0	0	0	1	2	3	3	3	3	3	3	3	3	3	3	3	3	1_2	H-3				
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
40	1	2	0																								(still	
41	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0						incubated)	
42	2	2	2	2	2	2	2	1	1	0																		
43	2	1	1	1	1	1	1	1	1	1	1	1	1	1	H-1													
44	1	0	0	0	0	0	0	0	0	0	0	1	2	2	2	2	2	2	2	2	2	2	1_1	H-2				
45	3	3	3	3	3	3	3	3	3	3	3	2	2	0														
46	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1*	1	1	0				
47	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1_1	1_1	1_1	1	0	H-1								
48	1	0																										
49	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2_1	1	1	1	1*	1	0	H-1					
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	0		

QUADRANGLE NUMBER FIVE   Treatment: 5% Formaline

	May 31	June 2	4	6	8	10	12	14	16	18	20	22	24	27	29	July 1	3	5	7	10	12	14	16	18	21	23	25	27	29	31	
1	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
2	3	3	3	3	3	3	3	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	1	1	1	0							
5	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	0														
6	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	1	0									
7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	H	1	1	1	1	1	1	1	0		
8	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	H	0									
9	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	1	1	1	1	0						
10	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	0														
11	1	1	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0														
12	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	0															
13	1	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	1	0													
14	1	0	0	0	0	0	0	0	1	2	3	3	3	3	3	3	3	3	3	3	3	1_2	$_3$	H-3							
15	3	3	3	3	3	3	3	2	3	2	0																				
16	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	0							
17	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	1	0														
18	2	3	2	2	2	2	2	2	2	1	1	1	0																		
19	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1*	1	1	1	1	1	1	1	1	1	1	0	H-1
20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	1	1	1	1	0		1 not sprayed (typed over the July 1–12 entries)
21	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	1	1	1	1	0								
22	2	2	2	2	2	2	2	2	2	1	0																				
23	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1	1	0							
24	1	2	2	2	2	2	2	2	2	2	3	2	2	1_1	1	1	1	1	0												H-1 (not sprayed)
25	2	3	3	3	2	3	3	3	3	3	3	3	3	3	1_1	1	1	0													H-1 (not sprayed)
26	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	0								
27	2	3	3	3	3	3	3	3	3	3	1	3	3	2	1	1	1	1	1	1	1	1	1	0							
28	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1	1	1	1	1	1	0		
29	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	0												
30	3	3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	0							
31	3	3	3	3	3	3	3	3	3	2	3	2	2	1	1	1	1	1	1	0											
32	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	0	
33	3	3	3	3	3	3	3	3	3	3	0	2	2	2	0																
34	3	3	3	3	3	3	3	3	3	3	2	0																			
35	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	0															
36	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1_1	1	1	1	1*	1	1	1	1	1	1	1	1	1	0		H-1 (not sprayed)
37	3	3	2	2	2	3	3	3	3	3	2	1	1	0																	
38	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	0											
39	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2	2*	1	1	0										H-1
40	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2_1	2	2	2	2	2	2	2	2	2	2	2	2	2	0		H-1
41	2	3	3	3	3	3	3	3	3	2	3	3	3	2	1_1	1_1															H-2
42	3	3	3	3	3	3	3	3	3	3	3	2	1	0																	
43	2	2	0																												
44	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	0															
45	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	1	1	0			
46	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	0															
47	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	0															
48	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	0											
49	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	1*	1	1	1	1	0						
50	1	0	1	1	1	1	1	1	1	1	1	1	1	1	$_1$	H-1															

QUADRANGLE NUMBER SEVEN — Treatment: Elgitol

June / July

	27	28	30	2	4	6	10	11	14	15	17	21	23	25	27	29	31
1	2	2	2	2	2	2	1	1	1	1	0						
2	3	3	3	3	3	3	3	3	3	3	1	0					
3	2_1	2_1	2_1	2	2	2	0										
4	3	3	3	3	2	1	1	1	1	0							
5	1	1	H_1	1													
6	1	1	1	1	1	1	0										
7	1	1	1	1	1	1	0										
8	1	1	1	1	1	1	1	1	1	1	1	0					
9	1	H_1	1														
10	2	2^1	0														
11	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	0
12	1	1	1	1	1	1	1	1	1	1	1	0					
13	1	1	1	1	1	1	1	1	1	1	1	0					
14	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
15	2	2	2	2	2	1	1	1	1	1	1	0					
16	1_1	1*	1	1	1	1	0										
17	1	1	1	1	1	0											
18	3	3	3	3	3	3	3	3	3	3	2	1	0				
19	1	1	H_1	1													
20	2	2	1	1	1*	1	1	0									
21	1	1	1	1	0												
22	2	2	0														
23	2	1	1	1	1	1	1	1	0								
24	2	2	2	2	2*	2	2	2	1	1	0						
25	1	1	1	0													
26	2	2	2	2	2	2	0										
27	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
28	1	1	1	0													
29	1	1	1	0													
30	1_2	1	1	1*	1	1	1	0									
31	3	3	3	3	3	3	3	1	1	1	0						
32	3	3	3	2	2	2	1	1	1	1	1	1	1	0			
33	3	3	3	3	3	3	2	1	0								
34	1	H															
35	3	3	3	3	3	1	1	1	0								
36	3	3	3	3	3*	3	3	3	3	3	2	2	2	1	0		
37	1	1	1	1	1	1	1	1	1	1	1	0					
38	2	2	2	2	2	2	2	2	2	2	2	0					
39	2	2	1	1	1	1	1	1	1	1	1	0					
40	3	3	2	2	10_1												
41	3	3	3	3	3	3	1	1	1*	1	1	1	1	1	1	1	1
42	3	3	3	3	3	3	3	3	3	3	2	2	2	1	1	0	
43	2	2	2	2	2	2	2	2	2	2	2	1	1	0			
44	2	2	2	2*	2	2	2	2	2	2	2	0					
45	2	2	2	2	2	2	2	2	2	2	2	2	0				
46	2	2	2	2	2	2	0										
47	1	1	0														
48	1	1	0														
49	2	2	2	2	2	2	1	1	0								
50	2	2	2	2	2	2	2	2	0								

QUADRANGLE NUMBER EIGHT Treatment: Formaline

	June			July													
	27	28	30	2	4	6	10	11	14	15	17	21	23	25	27	29	31
1	3	1^{*}_{2}	1	1	1	1	1	1	1	1	1	0	H-2				
2	3	3	3	3	3	3	3	3	1	1	1	0					
3	1	1	H														
4	2	2	2	2	2	2	2	2	2	2	1	0					
5	2	1	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	2	H															
7	2	H															
8	3	2_1	1_2	1^{*}_{2}	1_2	1	1	1	1	1	1	0					
9	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
10	1	1	1	1	1	1	0										
11	3	3	3	3	3	3	3	3	3	3	3	2	2	1	1	0	
12	3	3	3	3	3	2	0										
13	2	2	2	2	2	2	2	2	2	2	1	1	0				
14	2	2	1	1	0												
15	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	0
16	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0		
17	2	1	1	0													
18	2	2	2	2	2	2	0										
19	3	3	3	3	3	3	3	3	3	3	1	1	1	0			
20	2	2	2	2	2	2	2	2	2	2	0						
21	2	2	2	1	1	1	0										
22	2	2	2	2	2	1	1	1	0								
23	2	2	2	2	2	2	0										
24	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
25	3	3	3	2*	1	1	1	1	1	0							
26	3	2_1	1_2	1*	1	1	0										
27	1	1	H														
28	2	2	2	2	2	1	0										
29	2	2	2	2	2	1*	1	0									
30	3	3	2_1	2*	2	1	1	1	0	H-1							
31	2	2	2	2	2	2	1	1	0								
32	3	3	3	3	3	2	2	2	2	2	1	0					
33	1	1	1	0													
34	2	2	2	2	1	1	0										
35	2	1_1	1_1	1^{*}_{1}	1	0	H-1										
36	2	2	1	2	2	2	2	2	1	0							
37	2	2	2	2	1_1	1	1*	1	1	1	1	1	1	1	1	0	H-1
38	2	2	2	2	2	2	2	2	1	1	1	0					
39	3	3	2	2	1	1	0										
40	1	1	1	1*	1	1	1	1	1	1	0						
41	3	1_2	1	1*	1	1	0	H-2									
42	1	1	1	0													
43	3	3	3	3	3	2	1	1	0								
44	1	1	1	1*	1	1	0										
45	2	2	2	2	2	2	1	1	0								
46	1	H-1															
47	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
48	1	1	1	1	1	1*	1	1	1	1	1	1	0				
49	2	2	2	2	2	2	2	1	1	1	1	1	1	1	0		
50	3	3	3	3	3	2	1	1	1	1	1	0					

QUADRANGLE NUMBER NINE Treatment: Picric acid

	June 27	28	30	July 2	4	6	10	11	14	15	17	21	23	25	27	29	31
1	2	2	2	2	2	2	2	1	1	1	1	0					
2	2	2	1	1	1	0											
3	2	2	2	2	2	2	2	2	2	2	2	0					
4	3	3	2_1	2	2	2	2	1	0	H-1							
5	2	2	2	2	1	1	0										
6	3	2_1	1_2	1	1	1	1	1	1	1	0	H-2					
7	1	1	1	1*	1	1	0										
8	2	2	2	2	2	2	1	1	0								
9	1	1	1	1	1	1	0										
10	3	3	3	3	3	3	2	2	2	2	2	1	0				
11	2	2	2	2	2	2	2	2	2	2	1	1*	1	1	1	1	0
12	1	1	1	1	1	1	1	1	0								
13	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0		
14	3	3	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1
15	3	3	3	3	3	3	2	2	0								
16	1	1	1	1	1	1	1	1	0								
17	3	3	2	2	2	1	0										
18	1	1	1	1	1	1	1	1	0								
19	1	1	1	1*	1	0											
20	2	2	1	1	1	1	0										
21	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
22	1	1	H_1-1														
23	1	H_1-1															
24	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1
25	2	H-2															
26	2	2	1_1	1_1	1_1	1*	1	1	1	1	1	1	1	1	1	0	H-1
27	2	2	2	2	2	2	2	2	1	1	1	1	0				
28	2	2	2	2	2	2	2	2	1	1	1	0					
29	1	1	1	1	1	1	1	1	0								
30	3	3	3	3	3	3	3	2	2	1	1	1	0				
31	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
32	2	1_1	1	1	1	0	H-1										
33	2	2	2	2	2	2	2	2	1	1	1	0					
34	3	2_1	1_2	1*	1	1	1	1	1	0	H-2						
35	3	3	3	3	3	3	3	3	2	2	1	1	0				
36	1	1	1	1	0												
37	1	1	0														
38	3	3	3	3	3	3	0	1	1	1	1	1	0				
39	2	2	1_1	1_1	1_1	1	1	1	0	H-1							
40	2	2	2	2	2	2	2	2	2	2	2	1	0				
41	2	2	2	2	2	2	2	2	1	1	0						
42	H_1-1																
43	2	2	H_2-2														
44	3	2_1	1_2	1	1	1	0	H-2									
45	1	1	1	1	1	1	1	1	1	1	1	1	1*	1	1	0	
46	3	3	3	3	3	1	1	1	0								
47	3	3	2_1	2_1	2	2	2	0	0	0*	1	1	0	H-1			
48	1	H_1-1															
49	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	0
50	2	2	2	2*	2	1	1	1	1	0							

QUADRANGLE NUMBER TEN — Treatment: 5% Sodium Borate

	June		July															August
	27	28	30	2	4	6	10	11	14	15	17	21	23	25	27	29	31	3
1	3	2	1_2	H_3	3													
2	1	1	0															
3	2	2	2	2	2	1	1	1	1	H_1-1								
4	1	1	2	2	2	2	2	2	2	2	2	2	2	1	H_1-1			
5	1		H-1															
6	2	$^{1}2$	1_1	H_2	2													
7	2	2	1_1	1_1	0	H-1												
8	1	1	1	1	0													
9	2	2	2	2	2	2	2	2	2	2	1	0						
10	2	2	2	2	2	2	2	2	0									
11	2	2	2	2	2	2	0											
12	1	1	1	1	1	1	1	1	0									
13	2	2	2	2*	2	2	0											
14	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0
15	1	1	1	1	1	1	1	1	0									
16	3	3	3	3	3	3	3	3	3	2_1	2_1	2	0	H-1				
17	3	2_1	2_1	2^*_1	1	1	1	1	1	1	1	0	H-1					
18	2	2	2	2	2	2	1	1	1	1	1	1	0					
19	3	3	3	3	3	2_1	1_2	H_3	3									
20	3	3	3	3	3	3	3	1_1	1	1	1*	1	1	0	H-1			
21	3	2_1	1_2	1_2	1*	1	1	1	1	1	1	0	H-2					
22	3	3	3	3	3	3	3	3	3	3	3	3	3	2	0			
23	2	2	2	2	2	2	2	1	1	1	1	1	0					
24	2	2	2	1_1	H_1	2												
25	2	2	2	2	2	2	2	2	H_2	2								
26	2	2	2	2	2	2	1_1	1_1	0	h-1								
27	3	3	3	3	3	3	2	2	1	1	0							
28	3	3	3	3	3	3	3	2	2	2	2	0						
29	1	1	1	1	1	0												
30	2	1_1	2	1*	1	1	1	1	1	1	1	1	1	0	H-1			
31	3	3	3	3	3	3	3	3	3	3	2*	2	2	0				
32	1	1	1	1	1	1	1	1	1	1	0							
33	3	3	3	3	3	3	3	3	3	3	3	1	1	1	0			
34	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	
35	1	1	1	1	0													
36	2	2	2*	1_1	1	0	H-1											
37	1	1	0															
38	2	2	2	2	2	2	2	2	1	1	1	0						
39	2	1_1	1	1	1	1	1	1	0	H-1								
40	2	2	1	1	1	1	0											
41	1	1	1	0														
42	3	2_1	1_2	1*	1	1	1	1	1	1	H-2							
43	1	1	1	0														
44	2	2	2	2	2	2	1	1	1	1	0							
45	2	1	1	1*	1	1	1	1	1	1	1	0						
46	1	1	1	1	1	1	0											
47	1	1	1	1	1	1	0											
48	2	1_1	1	1	1	1	1	0	H-1									
49	3	3	3	3	3	3	3	3	2	2	2	1	1	1	1	1	0	
50	1	1_1	1_1	0	H-1													

Water-dwelling Protozoa of Three Islands
(by Horace B. Taylor, Bowdoin '43)

The purpose of this paper is to provide a survey of the distribution of protozoan life in the neighborhood of Three Islands; to present experimental data on culture media; and to give information regarding fixing and staining techniques. It is hoped the results will provide a basis for future protozoölogical studies on Kent Island.

Distribution

In the spring drainage of the northern end of Kent Island, in Hay Island pond, and in numerous fresh water pools there is an abundance of mesosaprobic animals. In each of these places there is active oxidation of organic matter, and they are all exposed to sunlight. Generally speaking, these animals do not contain chlorophyll, are comparatively large, and are almost entirely ciliates. No accurate quantitative determination could be made since both a tow net and Sedgwick-Rafter equipment were lacking. However, each cubic centimeter of water from the above places is estimated to contain from ten to fifty animals, depending on the area sampled. The pH of each of the above places is a fairly constant 6.5 (Chlor-phenol red). The temperature range of Hay Island pond water is roughly from 55° F to 70° F; that of the well drainage, from 50° F to 70° F; and that of the pools, from 50° F to 75° F.

The majority of the animals found in the above locations were holotrichs. Several forms of paramecium including Paramecium caudatum, Colpoda, and a peritrich similar to Vorticella were identified positively. Many other animals were not classified.

The Sheep Island pond, a putrid, brackish pool, containing approximately 20% more salt than sea water, and filled with decaying animals and plant matter; as well as in the brackish rock pools just above the high tide mark on the northeastern side of Kent Island; there is an abundance of polysaprobic and oligosaprobic animals. These animals are generally smaller than the mesosaprobic types. The pH of these brackish water is a fairly constant 7.9 (Phenol red), but it varies in the tenths with the concentration of sea water. The temperature range of Sheep Island pond is roughly 55° F to 70°F; and that of the rock pools, from 50° F to 80° F. Quantitative determination, again estimated, show that the water from the above locations contains in the neighborhood of four hundred animals per cubic centimeter.

The protozoan life in the above locations is divided between flagellates, many of which are chlorophyll-bearing and have red eye-spots, and ciliates, holotrichous ciliates again being in the majority. Euglena was identified.

In sea water collected from the "flats" outside the "basin" on the northern end of Kent Island, there are numerous protozoa, an estimated ten animals per drop. The temperature range of the sea water is from 38° F to 45° F, but the "flats" warm up to approximately 70° F at low tide on hot days.

Flagellates and dinoflagellates are in the majority in the sea water, but some ciliates are present.

The spring water shows no evidence of protozoan life, although some diatoms and other Chlorophyceae are present. This water has a pH of 6.4, and its temperature range is from 45° F to 50° F.

All of the animals observed in any of the above locations were either flagellates or ciliates, ranging in size from Paramecium caudatum(215m) to animals of bacterial size. No Sarcodina or Sporozoa were observed at any time. It is estimated that there are two hundred different species of protozoa on and about Kent Island.

Culture media

Paramecium caudatum was selected as a representative animal for fresh water culture experiments. This animal is relatively impervious to a pH change. An animal living in a medium of pH 6.5 may be placed in a medium of pH 5.5 with no immediate ill effects, although it will not live for long. Experimental evidence shows that the animal lives best in the range pH 6.4 to pH 6.7, the most successful being pH 6.5. By keeping the cultures in test tubes in absence of yeasts and chlorophyll-bearing algae the pH is kept constant, and the amount of oxygen on the surface is reduced.

The following media in solution made from spring water of pH 6.4 were injected with a single, isolated animal:

Timothy hay	pH 6.5
baker's yeast	pH 7.0
vegetable gelatine from Grinella americana (Rhodophyceae)	pH 6.6
Agrostis alba (hay)	pH 6.4
beef extrace 1%	pH 6.4
5%	pH 6.4
10%	pH 6.5
25%	pH 6.6

Each of the above media was placed in one cotton-plugged and one unplugged test tube. At the end of twenty-four hours all the cultures showed evidence of life except the yeast and the twenty-five per cent beef broth. Both of the Timothy hay infusions had three animals present; the Agrostis alba infusion, two animals; the 1% and 5% beef broths, two animals; and the vegetable gelatin and the 10% beef broth, one animal. At forty-eight hours all the cultures were extinct with the exception of the two Timothy hay infusions which had approximately ten animals apiece, the unplugged Agrostis alba infusion with six animals, and the 1% beef broth with eight animals.

These four cultures continued to thrive for two weeks, at the end of which time the unplugged Timothy hay infusion showed probably three times as many animals as any one of the others. The Timothy hay tea was made from 250 cubic centimeters of spring water and 50 inches of Timothy hay, thoroughly dried and cut into one inch lengths. It was boiled for ten minutes and immediately stoppered to prevent lowering of the pH by yeasts. When used as a culture medium, it was diluted with an equal part of spring water.

In order to determine the correct pH to use, the pH of the infusion was subtly lowered by addition of brewers' yeast which formed alcohol which oxidized to yield acetic acid. The pH was raised by allowing a green algae to use the carbon diozide in the culture in photosynthesis, thus removing the carbon dioxide as fast as it was formed. By this experiment pH 6.5 was found to be the most successful.

At the end of forty-eight hours the surface of a Timothy hay infusion became covered with a film of coccus and bacillus bacteria. In absence of agar this bacteria was cultured on plates made of the vegetable gelatine extracted from Confrus crispus (Irish moss). That this bacteria is nutrient is indicated by an experiment in which the animals thrived for more than two weeks on a solution of bacteria and spring water, and a solution of bacteria, vegetable gelatine and spring water; but they failed to live on a solution of vegetable gelatine and spring water. The bacteria for this experiment was cultured under sterile conditions, and the Paramecium caudatum was crudely sterilized by dilution.

It is improbable that the bacteria mentioned above come from the air of the laboratory since a plate left exposed to that air produced no evidence of the bacteria. The answer therefore, must be that the animal carries the bacteria in its food vacuoles and on its cilia from the natural habitat to the wild culture, and from there to other cultures, if transfered without sterilization.

In the latter case stated above, the reason the animals failed to live is that the bacteria introduced into the medium with the animals were not in sufficient numbers to meet the animals' food requirements; and that the vegetable gelatine in itself was not a good source of food for the animals.

The following conclusions from the above experiments were accepted as hypotheses for experiments on culture media for brackish water protozoa:

(1) that a Timothy hay infusion is a good medium;
(2) that the pH of the culture should be kept at the same (or very nearly the same) as the natural habitat.

The brackish water was purified by twice filtering heating to 85° C for ten minutes, and a third filtering. The Timothy hay tea was made as previously stated, but its pH dropped from 7.9 to 6.8 in the process of boiling.

Because of the pH difference between the Timothy hay tea and the natural habitat a change in technique was necessitated. Four inches of the boiled hay were placed in each of five plugged and five unplugged test tubes, and the following percentages of hay tea and purified, brackish water were added.

hay tea	water	pH
50%	50%	7.3
25%	75%	7.5
12%	88%	7.7
5%	95%	7.8
0%	100%	7.9

The animal selected was an unidentified holotrichous ciliate, roughly thirty microns in length and similar to a paramecium in shape. Because of the difficulty in tracing the growth of such a small animal, no attempt was made to isolate one; but instead, a drop of water containing approximately fifty animals was injected into each test tube.

At the end of twenty-four hours all the cultures were extinct with the exception of the unplugged pH 7.8 and pH 7.9, both of which showed about ten animals per drop. At forty-eight hours the pH 7.9 culture showed roughly twenty animals per drop; and the pH 7.8 culture, about fifteen per drop. Green algae introduced into the pH 7.8 culture raised the pH slightly so that at the end of a week both cultures showed about fifty animals per drop. (The word "drop" above means one fifteenth of a cubic centimeter.)

Chlorophyll-bearing flagellates were cultured successfully in the pure, brackish water by keeping the water fairly saturated with carbon dioxide from the breath and exposing it to sunlight.

No attempt was made to culture marine protozoa.

In all the above cases the protozoa did not condtion the culture media unfavorably. Cultures of Paramecium caudatum, other fresh water animals, brackish water animals, and flagellates have been kept alive for periods as long as a month in their original media with periodic dilutions to compensate for evaporation.

Permanent mounts and staining.

The standard fixing agents (i.e. Bouin's, Zenker's, and Gilson's) were found to distort the animals somewhat. A solution developed by Mr. J. W. Blunt containing glacial acetic acid, 95% alcohol, and formalin in equal parts and saturated with iodine and picric acid proved excellent. After fixing with the above solution for two minutes, 70% alcohol is used to cleave the animals to the slip.

Ciliates for the most part were stained by the standard borax-carmine technique. It was found that methylene blue with an eosin counterstain showed flagella very clearly. A safranin O stain, developed by the author, proved excellent for showing the cytoplasmic inclusions in larger ciliates; but since it causes some distortion it can not be used effectively with the small protozoa. The technique follows:

Safranin O (saturated soltuion in 95% alcohol)	5 cc.
Distilled water	50 cc.

(These proportions are from the counterstain in the Hucker modification of the Gram stain.) Fix with Blunt's solution; cleave with 70% alcohol; stain in safranin O for 45 seconds; wash in water; wash in 70% alcohol; differentiate in 95% alcohol for 20 seconds; dehydrate in 100% alcohol; clear in zylol; mount in Canada balsam.

The above staining times are accurate for Paramecium caudatum. The times vary with other animals. It is recommended that in using this technique, the investigator work out his own times, bearing in mind that since the times are so short, accurate timing and fast work are essential.

ALGAE OF KENT ISLAND

(by Charles H. Bowers, Bowdoin '42)

The chief purpose of this account is to demonstrate that the botanist or more specifically the phycologist will find nothing new in the way of aquatic plants on Kent Island. That is, the flora closely resembles that of the Maine and Canadian coasts; a correlation naturally to be expected. The great difference lies in the fact that the water of the Bay of Fundy is colder than elsewhere (12^{o} - 17^{o} C; 35^{o} - 37^{o}F) hence the specimens flourish in their natural state for longer periods than do their counterparts in warmer waters; the tremendous tide changes allow for a wider collecting range. Throughout July, all forms can be found will developed and in an excellent healthy condition. When collecting in more southern water one is often confronted with distortions, diseases, or anomalies brought about or enhanced by the warmer water. From the economic standpoint and from that of pure speculation, I might mention that the above advantages, namely; tide changes, fine condition of the specimens, long season; might prove fertile ground for industries interested in removing bromine from sea weed; plant gelatin and vitamins. For example, Irish moss (Chondrus crispus) the Maine dessert food, and the kelps grow in great abundance between and beyong the tide levels.

Through the later part of July and August, I began a study of the histology of the herring gull (Larus argentatus)in the hope of establishing a basic technique which would be of use in approaching the more difficult aspects of botanical technique.

By way of passing, before presenting a list of the common marine algae of Kent Island - I might mention that from the ecological standpoint it is astounding (particularly to the novice on his first field trip) to observe the number of animal phyla dependent upon the algae for protection, food, place for laying eggs; even to the extent of symbiotic and epiphytic relationships. However, this is another study in itself.

Most of the collecting was done along the pools and beach of the southeast, east and northeast sea-walls of Kent Island. The following species were collected.

Chlorophyceae
- Chaetomorpha aerea
- Enteromorpha compressa
- Enteromorpha marginata
- Enteromorpha prolifera
- Ulva Lactura
- Cladophora
- Cladophora refracta
- Ectocarpus granulosus
- Chardafilum

Phaeophyceae
- Asperococcus echinatus
- Laminaria digitala
- Laminaria Agardhii
- Laminaria stenophylla
- Laminaria intermedia
- Laminaria longerius

Phaeophyceae (continued)

Alaria esculenta
Agarum chibrosum
Fucus edentatus
Fucus filiformis
Fucus evanescens
Fucus vesiculosus
Ascophyium Machaii
Ascophylum nodosum

Rhodophyae

Porphyra umbilicalis
Acrochaetium secundatum
Polyides rotundum
Gelidium crinale
Cystocloneum purpureum
Agardhiella tenera
Rhodymenia palmata
Champia parvula
Antithamnion cruceatum
Spyridia filimentosa
Ceramium - (?)
Polysiphonia - (?)

References:

Arnold, A. F., Sea Beach at Ebb Tide.
Collins, F. S. Phycotheca Boreali-Americana.
Fritsch, F. E., Strucutre and Reproduction of the Algae.
Taylor, W. R., Marine Algae of the Northeast Coast of North America.

BIRD BANDING

During the summer of 1941, Ivan Spear, Bowdoin '44 assisted by members of the Station banded 1, 453 Herring Gulls including 153 adults. A smaller number of Eider Ducks, Barn and Tree Swallows and Savannah Sparrows were also banded.

Since the beginning of banding operations at Kent Island in 1934, 31,045 Herring Gulls have been banded from which 1, 156 returns have been received up to January 1, 1942. An analysis of 773 returns received up to January 1, 1940 was presented in contribution Number 8 of the publications by the Station.

Because of the lack of space the details of the records of 158 returns during the past year will not be included in this report.

CONTRIBUTIONS

in addition to the annual reports of the Bowdoin-Kent Island Scientific Station the following contributions have been published.

1. Gross, William A. O.
1935 The Life History Cycle of Leach's Petrel (Oceanodroma leucorhoa leucorhoa) on the Outer Sea Islands of the Bay of Fundy. Auk, vol. 52, no. 4, pp. 382-399. Illus. 4 plates, 11 fig. and 8 tables.

1936 Kent Island - Outpost of Science. Natural History Magazine, vol. 37, no. 4, pp. 195-210. Illus. 22 photographs.

2. Gross, Thomas A. W1JZM, VE1IN
1937 Designing the First Stage of the Speech Amplifier. Q.S.T. vol. 21, no. 12, pp. 33-100. Illus. 1 plate, 1 fig.

3. Gross, Alfred O.
1938 Eider Ducks of Kent Island. Auk, vol. 55, no. 3, pp. 387-400 Illus. 3 plates, 6 fig.

4. Gross, Thomas A., W1JZM, VE1IN
1938 Operation of Zero-bias Modulators. Radio, no. 230 pp. 21-33. Illus. 7 fig.

5. Pettingill, Olin S., Jr.
1939 The Bird Life of the Grand Manan Archipelago. Proc. Nova Scotia Institute of Science. vol. 19, pt. 4, pp. 293-372. Illus, 3 plates, 3 fig.

6. Griffin, Donald R.
1940 Homing Experiments with Leach's Petrels. Auk, vol. 57, no. 1, pp. 61-74. Illus. 7 text fig.

7. Gross, Alfred O.
1940 The Migration of Kent Island Herring Gulls. Bird Banding, vol. 11, no. 4, pp. 129-155. Illus. 1 photograph, 2 maps, 3 charts.

8. Cunningham, Robert M.
1941 Chloride Content of Fog Water in Relation to Air Trajectory. Bull. American Meteorological Society, vo. 22, no. 1, pp. 17-20. Illus. 2 figs.

A number of copies of the above publications are still available for distribution and can be secured by writing to the Director of the station.