XXVIII.—REPORT ON THE PROPAGATION OF PENOBSCOT SALMON IN 1879–'80.

By CHARLES G. ATKINS.

1.—CHANGE OF LOCATION.

The original experiments in the propagation of Penobscot salmon were made in 1871, in the towns of Bucksport and Orland, in the State of Maine. The fixtures for the development of the eggs were located in the town of Orland, at Craig's Brook (tributary to Alamoosook Lake and through that to Eastern River and the Penobscot), and the most of the salmon used that year were confined during the summer in an inclosure in the edge of Alamoosook Lake, in close proximity to the hatching-house. With a view to testing the capacity of different waters to sustain the breeding fish in health, a few of them were also confined in Dead Brook, another tributary of Eastern River, and a few more were turned into Spofford's Pond, commonly known as "Great Pond," a small sheet of water near Bucksport village. The fish in these three places did equally well, and came to the spawning season, in the months of October and November, in good health, as was proved by the few that came to hand at that date.

The site selected for a hatching-house was exceptionally good, but the facilities for keeping the breeding fish from June to November in that vicinity were far from satisfactory. The water of the brook, which is exceedingly pure, had been tried and found totally unfit. The temporary inclosure in the edge of the lake was entirely successful, but it was exposed to all the force of storms sweeping across two miles of open water, and would, therefore, never be safe from breach under the force of waves or drifting rubbish. Besides, the shore was straight, and a large inclosure would be costly. At Dead Brook the water was satisfactory, but there was no good site for a hatching-house. At Bucksport were found the best site for an inclosure, a convenient site for a hatching-house, and water, which was not, to be sure, so pure as at either of the other places, but which was believed to be quite good enough.

So, in 1872, the works were established at Bucksport, where operations were pushed as vigorously as the funds warranted, and with a fair degree of success, for four years. During these years it became apparent

that the water which supplied the hatching-house was not suitable for the purpose. The pond was shallow, with a bottom of black mud, very soft and very deep. The shores were partly marshy, and the brooks that fed it were devoid of copious springs and much affected by drought. The water was very dark in color, strongly impregnated with earthy and peaty solutions that were always unpleasantly prominent to the taste, especially when low and warm, as after midsummer. Copious rains, which commonly came in September or October, so far improved it that I think it was then equally good with ordinary river water for the development of salmon spawn; but the rains did not always fall in due quantity, and at the right season. That happened in 1874. The brook had ceased to flow from the pond in the summer and was giving but a very small stream, barely enough to supply the hatching-house, when the spawning time came. The salmon were taken with much less trouble than usual, and a large lot of spawn, apparently in the very best condition, was deposited in the troughs. The water was at first warm, and tasted very muddy, and was full of minute vegetation of a low order. I was not free from anxiety as to its effect on the eggs, but nothing could then be done but wait and see. The temperature soon fell, but the water mended but slowly in other respects. However, the eggs did not die. They were faithfully attended. Inspection showed that they were well impregnated. Midwinter came and the embryos were well grown and strong, as far as we could see, and I flattered myself with the hope that this would be the best lot of eggs ever sent out from the establishment. We began to pack them for shipment, and then discovered that the shells lacked strength. On exposure to the air they shrunk and put on the appearance of half-dried currants, and many of them collapsed altogether. But there was no escape from packing them up and sending them off to their destinations. Great loss ensued. It was not so bad with the eggs that were kept here and hatched for the State of Maine, which were nearly, if not quite, as good as ever.

The next year, 1875, the rains came in good season, and the eggs taken and distributed turned out remarkably well. But it was evidently necessary to provide a hatching-house where we could command better water, for use, at least, when that at the old hatching-house should be unsuitable from lack of rains. Just at this point the subscriptions of the United States and Connecticut commissions were withdrawn, the funds formerly appropriated being needed more in another direction. The remaining subscribers, the Maine and Massachusetts commissions, did not feel able to carry on the establishment alone, and it was, therefore, closed in 1876. The next year the lease under which the premises had been occupied expired, and being unable to meet the views of the proprietor as to the terms of a renewal, I was forced to look about for a new site for both the salmon pond and the hatching-house.

It was of course very desirable to have hatching-house and salmon pond close together. But I was limited in my search by the necessity

of having the salmon pond easily accessible from tide-water, and at convenient distance from the mouth of the Penobscot, where alone the breeding fish could be had in sufficient quantity for our use. After diligent examination of the whole region, I was forced to fix upon separate locations for the pond and hatching-house.

For a pond we went back to Dead Brook—to the very spot tried in 1871; for a hatching-house to the original site on Craig's Brook.

Dead Brook is tributary to Eastern River, which it joins between Orland village and Orland Falls, in a low and swampy region, partly overflowed by the backwater from the dam at Orland. Its lower portion is from this cause broader and deeper and more sluggish than in its natural condition, as well as more accessible by water. The Orland dam is provided with a lock, and large boats have been accustomed to load with wood in Dead Brook for transportation down the river. Our salmon cars could thus reach the brook from any point in tide-water, and the salmon thus transferred to our inclosure without the overland carriage to which they were subject in Bucksport.

A section of the stream about 80 rods long was selected for our inclosure. The bottom was mostly gravel, partly overlaid by a thin stratum of mud supporting a rank growth of water weeds. The water itself was pure,—rather better than the average of rivers in Maine—the sources of the stream being in two natural ponds in a hilly and wooded district. Wooden racks, which had before done service in the pond at Bucksport village, were made into barriers to form the upper and lower ends of the inclosure. The sides were formed by the banks of the brook, which would be high enough to retain the water and the fish except in extreme freshets, but to guard against escape in any event close fences were built along all the banks liable to submergence.

The hatching-house is located at the mouth of Craig's Brook, on the east side of Alamoosook Lake, across which it is necessary to transport all the eggs as soon as taken, the distance being near two miles, a little more than half of it being by water. Aside from its location at a distance from the spawning place, this site has all the desiderata for a first-class hatching-house. The water is abundant and pure, part from springs and part from Craig's Pond, and the steep inclination of the ground affords complete facilities for managing and aerating the water. An old mill stood ready for our use, and was fitted up with troughs and other appurtenances, patterned after those in use at Grand Lake Stream.

In charge of the operations I placed Mr. H. H. Buck, of Orland, who had already had experience in the work at Bucksport and Grand Lake Stream.

2.—Collecting breeding salmon.

Arrangements for a supply of breeding salmon were made with several fishermen in the southwestern part of Verona—mostly the same men who had furnished salmon to the old establishment. They were

provided with dip-nets, cars, and boxes, such as they needed. Mr. Avery H. Whitmore was employed to receive the fish, agree upon their weight, and forward them to Orland. The collection of salmon from the weirs was done mainly in cars (transformed fishermen's dories), partly in boxes carried in the fishermen's boats. They were generally taken from the weirs just before low water and brought at once to Mr. Whitmore, who dispatched them to Orland on the flood of the very next day tide, except when the number was very small. The fleet of cars reached the lock at Orland just before high water, and were then given in charge to Mr. Buck, who dispatched them to the inclosures. The time occupied in transfer was about five hours.

The subscription to the fund warranted the purchase of a smaller stock of breeding fish than usual, and being quite sure of getting all we wanted in a few days, the purchase was delayed until the price had fallen to a low figure, as is always the case in June, when the catch, especially in the New Brunswick rivers, approaches the maximum. This year the time of plenty came earlier than usual, and for our first load of salmon, June 10, we had to pay but 8½ cents per pound. From this time the collecting proceeded without interruption until June 21, when, having impounded 264 salmon, we suspended operations for the season. The following is a daily record of the purchases:

Date.	Number of boat-loads.	Number of salmon.	Total weight.	Average weight.	Price.
1879.			*Pounds.*	*Pounds.*	*Per lb.*
June 10	4	60	730	12.17	$0 08½
June 11	2	85	395	11.28	09
June 12	1	14	169	12.07	09
June 13	2	24	314	13.08	09½
June 14	2	22	276½	12.57	12½
June 16	2	23	301	13.09	18½
June 18	1	17	188	11.06	18½
June 19	2	21	244	11.62	18½
June 21	3	48	630	13.12	
Total	19	264	3,247½	12.30	

The price per pound, it should be explained, is only one item in the cost of the salmon. Each fisherman received, in addition, a bounty of from thirty-five to sixty cents each for capturing, risking, and delivering them alive and in good condition to Mr. Whitmore. Then the transportation to the lock at Orland was another item, and the complete account would also include the wages of the men who took them from Orland to the inclosure in Dead Brook and the cost of the cars and other apparatus. The cost, delivered at Orland lock, exclusive of apparatus, is made up of items easily separated from others, and amounts to $558.92 for 264 salmon, averaging $2.16 for each. This is about as low as can be expected in the future, the price per pound hav-

ing ruled so much lower than usual as to probably offset any saving we may make in other directions hereafter.

3.—A DISASTROUS SUMMER.

We had for the most part rather favorable weather, and the fish did not suffer much in capturing or transporting. The loss was, however, greater than used to be at Bucksport. Thirty-two salmon were found dead in the inclosure, and it is possible that a very few died and were not found. The most of these dead fish were found between June 30 and July 10—not any of them after the latter date. This goes to show that the fish died, not from anything deleterious in the inclosure, but from injuries received in transitu, although some of them were free from any external injury. There were many injured about the eyes, which may well have occurred in the cars. Mr. Buck's note-book has the following item about these fish:

"Some of these fish seemed to be in perfect condition when found; some had lost only an eye; others were badly chafed and bruised."

After the 10th of July the deaths had apparently ceased, and things went on prosperously in preparation for a yield of a million of eggs. But disappointment awaited us.

On the 17th and 18th of August a very heavy fall of rain occurred, and caused a high freshet in Dead Brook. Such an event was unexpected; yet we supposed we were ready for any such emergency. When the brook began to rise the men in charge watched carefully at the upper barrier, which, being at a narrower and shallower place, bore the brunt of the onset, and intercepted all the stumps, logs, brush, and other floating *debris* which were borne down from above. So long as this barrier was kept free and all the rubbish removed from the stream it was thought that the lower barrier, standing in deeper and wider water and a very gentle current, must surely take care of itself over night. But danger lay in an unsuspected quarter. The quiet water within the inclosure supported a dense growth of water-weeds, and a rise of two or three feet and a considerable increase in the strength of the current tore these from their roots and bore them down against the lower barrier, where they were arrested. In the course of the night so much of this material had accumulated as to close all the interstices as by a thick mat. The water, being thus impeded, rose above the barrier to such a height that the racks could no longer withstand the pressure, and they burst open, letting out all the salmon that chose to go.

It was at first hoped that while the freshet lasted the salmon would all be trying to ascend the stream, and would therefore, for the most part, remain in the inclosure until repairs were effected; but it afterwards became evident that most of them must have gone out of the gap during the few hours that it remained opened. Some of them were even taken in weirs four miles down the river within four days after the disaster. The full extent of the loss was not ascertained until the spawning time

arrived, and the fish remaining in the inclosure were seined up for manipulation. It was then found that out of the 232 salmon supposed to have remained on hand after July 10 but 59 remained to us, 40 males and 19 females.

4.—THE SPAWNING.

The fish gave evidence of approaching maturity as early as October 20, and on the 24th the first spawn was taken. The following statement exhibits all the spawning operations in detail:

Record of spawning operations at Dead Brook.

Date.	Females.		Eggs from each female.			Corrected No. of eggs.	Notes.
	Length.	Weight.	Weight.		Estimated number.		
1879.	*Inches.*	*Pounds.*	*Lbs.*	*Oz.*			
Oct. 24	29	6	2	6	6,300	17,141	Partly ripe.
24	35	15¾	1	0	3,100		
24	30	7	2	7	6,200		
27			2	4	6,300		From fish partly ripe on 24th.
27			0	14	1,800	24,313	Respawning.
27	31	9*	2	8	6,750		
27	31	9*	2	9	6,750		
30	36	15¾	4	10	10,800	12,549	Respawning.
30			1	9	3,600		
31	29	10½	1	14	5,400	6,938	Respawning.
Nov. 5			1	8	3,600		
5	38	17½	4	2	10,800	43,601	
5	37	17	4	10	10,350		
5	31	10	1	14	5,400		
5	30	11	2	10	6,750		
8			3	14	9,000	33,426	Respawning.
8	36	14½	4	0	9,200		
8	32	11½	3	5	8,800		
10			1	12	4,000	48,611	Respawning.
10	36	12¾	4	7	36,000		
10	30	7½	2	9			
10	38	15¼	5	10			
10	29	8¼	1	9			
12			2	2	3,600	12,107	Respawning.
12	30	7	2	8	6,400		
15			0	8	1,000	8,276	Respawning.
15	30	8*	2	4	6,400		
Total		213	71	5	178,300	211,692	

* These weights are estimated.

From these details we obtain the following generalizations:

	Inches.
Average length of the 19 females	32.5
	Pounds.
Average weight of same, exclusive of spawn	11.2
Average weight of same, inclusive of spawn	14.9
Total weight of spawn taken	71.3
Average weight of spawn from each female	3.7

The number of the eggs was underestimated. When those remaining sound in mid-December were packed for shipment they amounted to 200,500, and 11,192 by count had been picked out; total, thus computed, 211,692.

From this total we deduce the following averages:

Average number of eggs per mother fish..... 11,141
Average number of eggs per pound weight of mother fish.... 745
Average number of eggs per pound of spawn..... 2,981

The weight of males was not recorded. It was intended to weigh them all at last, but as they were chafing badly they were turned down the brook November 13, with a few exceptions, and we saw but few of them afterwards; and the ice having become troublesome, we did not think it worth while to try to catch them. (Mr. Buck's notes.)

Mr. Buck's success in impregnation of the eggs was equal to the best I ever knew. The following estimate comes, I think, pretty near the facts: At the time of packing the eggs there were picked out 3,408 unimpregnated eggs. If we assume that half of all those previously taken out were unimpregnated, we have a total of 7,329 unimpregnated eggs, equal to 3.46 per cent., from which it follows that 96.54 per cent. were impregnated.

5.—TRANSFER AND HATCHING OF THE EGGS.

Of the total number of eggs, 211,692, there were picked out 11,192, and the remainder, 200,500, distributed among the subscribers, as in subjoined Table II. There died in transitu 8,673, of which 8,000 hatched out in the moss, being too near their maturity for transportation. There were further losses of 4,268 before hatching, and 7,011 after hatching, leaving 180,264 healthy fish which were turned free. Thus of the original number 5 per cent. were rejected before shipping; 4 per cent. were lost in transitu; 2 per cent. more died in the troughs before hatching; 3½ per cent. died after hatching, and 85 per cent. reached the feeding age and were liberated.

Appended will be found a series of tables, from I to VI, exhibiting in detail the principal operations of the year, and observations noted.

TABLE I.—*Statement of salmon bought alive at Bucksport in* 1879.

Date.	Whence received.	Number of salmon.	Weight of salmon.			Daily summary.			
			Several weights.	Aggregate.	Average.	No. of salmon.	Weights.		Date.
							Aggregate.	Average.	
1879.			*Pounds.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	1879.
June 10	A. H. W.	9	23, 20, 15, 12, 12, 11, 11, 10, 8..	122	13.55				
10	J. W.	10	18, 12, 11½, 11½, 11, 11, 10½, 10½, 10, 10.	116	11.60				
10	H. W	12	22, 20, 19, 13, 12, 12, 12, 11, 11, 10, 10, 10.	162	13.50				
10	P. A	19	21, 20, 19, 11, 11, 11, 10, 10, 10, 10, 10, 10, 10, 9, 9, 9, 9, 9, 8.	210	11.37				
10	J. A.	5	12, 11, 11, 10, 10	54	10.80				
10	R. A	5	20, 11, 10, 10, 9	60	12.00				
						60	730	12.17	June 10

TABLE I.—*Statement of salmon bought alive at Bucksport in* 1879—Continued.

Date.	Whence received.	Number of salmon.	Weight of salmon.			Daily summary.			
			Several weights.	Aggregate.	Average.	No. of salmon.	Weights.		Date.
							Aggregate.	Average.	
1879.			*Pounds.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	1879.
June 11	A. H. W	10	15, 13, 12, 12, 12, 11, 11, 10, 10, 9.	115	11. 50				
11	J. W	5	22, 12, 11, 10, 10	65	13. 00				
11	H. W	3	12, 11, 11	34	11. 33				
11	P. A	9	12, 12, 11, 11, 10, 10, 10, 10, 9	95	10. 55				
11	J. A	6	18, 11, 11, 10, 10, 9	64	10. 67				
11	R. A	2	11, 11	22	11. 00				
						35	395	11. 28	June 11
12	A. H. W	1	15	15	15. 00				
12	J. W	3	12, 11, 10	33	11. 00				
12	H. W	1	10	10	10. 00				
12	P. A	5	23, 12, 11, 10, 10	66	13. 20				
12	J. A	3	12, 11, 10	33	11. 00				
12	R. A	1	12	12	12. 00				
						14	169	12. 07	June 12
13	A. H. W	5	22, 15, 13, 11, 10	71	14. 20				
13	J. W	6	12, 11, 11, 10, 10, 9	63	10. 50				
13	H. W	2	22, 10	32	16. 00				
13	P. A	8	21, 15, 13, 12, 12, 11, 10, 10	104	13. 00				
13	R. A	2	20, 13	33	16. 50				
13	J. A	1	11	11	11. 00				
						24	314	13. 08	June 13
14	A. H. W	5	22, 12, 12, 11, 10	67	13 40				
14	J. W	2	12, 11	23	11. 50				
14	H. W	4	14, 12, 11, 11	48	12. 00				
14	P. A	6	15, 12, 11, 11, 11, 10	70	11. 67				
14	J. A	1	12	12	12. 00				
14	R. A	4	23½, 12, 11, 10	56½	14. 12				
						22	276½	12. 57	June 14
16	A. H. W	5	15, 13, 12, 12, 11	63	12. 60				
16	J. W	8	22, 21, 12, 11, 11, 10, 10, 9	106	13. 25				
16	H. W	6	22, 21, 13, 12, 11, 11	90	15. 00				
16	P. A	1	10	10	10. 00				
16	J. A								
16	R. A	3	13, 10, 9	32	10. 67				
						23	301	13. 09	June 16
18	A. H. W	5	12, 11, 10, 10, 9	52	10. 40				
18	J. W	5	12, 12, 10, 10, 8	52	10. 40				
18	H. W	7	20, 12, 11, 11, 10, 10, 10	84	12. 00				
						17	188	11. 06	June 18
19	A. H. W	7	15, 12, 11, 11, 10, 10, 9	78	11. 14				
19	J. W	1	10	10	10. 00				
19	H. W	3	17, 12, 10	39	13. 00				
19	P. A	5	13, 12, 12, 10, 8	55	11. 00				
19	J. A	2	16, 14	30	15. 00				
19	R. A	3	13, 10, 9	32	10. 67				
						21	244	11. 62	June 19
21	A. H. W	25	22, 20, 20, 20, 19, 18, 18, 15, 13, 12, 12, 12, 12, 12, 11, 11, 11, 11, 11, 11, 11, 10, 10, 10, 10.	342	13. 68				
21	J. W	6	22, 13, 13, 12, 12, 10	82	13. 67				
21	H. W	10	21, 17, 13, 12, 12, 11, 11, 11, 10, 9.	127	12. 70				
21	P. A	7	14, 12, 12, 11, 10, 10, 10	79	11. 28				
						48	630	13. 12	June 21
			Total			264	3, 247½	12. 30	

TABLE II.—*Record of shipment of salmon spawn from Bucksport, December, 1879.*

Date.	Consignee.	Address.	On whose account.	For what State.	Number of eggs.			Hours on route.	Distance.	Date of arrival.	Date of unpacking.	Condition.	Died on journey.
					Belonging to State.	Donated by United States.	Total.						
1879.									*Miles.*				
Dec. 15	A. H. Powers ...	Plymouth, N. H.	New Hampshire commission.	New Hampshire.	22,500	.....	22,500	24	351	Dec. 16.....	.....	Poor .	*8,000
16	...do	....do	Massachusetts commission.	Massachusetts ..	22,500	.....	22,500	24	351	Dec. 17.....	.....	Good.	78
24	....do	....do	New Hampshire commission.	New Hampshire.	8,000	.....	8,000	48	351	Dec. 26.....	.....	..do ..	38
17	H. J. Fenton	Windsor, Conn..	Connecticut commission.	Connecticut	60,000	.....	60,000	44	343	10 a. m., Dec. 19	4 p. m., Dec. 19	..do ..	226
24	Mrs. J. H. Slack.	Bloomsbury, N. J	New Jersey commission.	New Jersey	.....	25,000	25,000	45	525	11 a. m., Dec. 26	2 p. m., Dec. 26	..do ..	80
24	T. B. Ferguson..	Druid Hill Park, Baltimore, Md.	United States commission.	Maryland	.....	62,500	62,500	50	661	4 p. m., Dec. 26	9 a. m., Dec. 27	..do ..	251
					113,000	87,500	200,500						

* These were all hatched on the way.

TABLE III.—*Statement of the hatching of Penobscot salmon eggs,* 1880.

In charge of hatching.	Place of hatching.	Total number of eggs sent to each establishment.	Died on journey.	Died in incubation.	Number hatched.	Died after hatching.	Sent out.	Actually planted.
A. H. Powers	Plymouth, N. H	53,500	*8,116	1,669	43,215	192	43,023	43,023
H. J. Fenton	Poquonock, Conn	60,000	226	880	58,894	610	58,000	58,000
A. A. Anderson	Bloomsbury, N. J	25,000	80	219	24,701	4,189	20,512	20,512
Frank Behler	Baltimore, Md	62,500	251	1,500	60,749	2,020	58,729	58,729
		200,500	8,673	4,268	187,559	7,011	180,264	180,264

*8,000 of these hatched on the journey.

TABLE IV.—*Distribution of Penobscot salmon reared from eggs collected in* 1879.

States.	Where finally hatched.	Waters stocked.	Tributaries in which fish were placed.	Locality.	Date of transfer.	Number of fish.
New Hampshire	Plymouth	Merrimack River	Pemigewasset River	Campton, Grafton County	Apr. 21, 1880	43,023
Connecticut	Poquonock	Farmington River, tributary to Connecticut River.	West Brook	Windsor, Hartford County	Apr. 10, 1880	10,000
		Do	Birch Brook	do	— —, 1880	6,000
		Do	Thrall's South Brook	do	— —, 1880	10,000
		Do	Thrall's North Brook	do	— —, 1880	10,000
		Do	White Brook	do	— —, 1880	10,000
		Do	Trout Brook	do	— —, 1880	12,000
New Jersey	Bloomsbury	Delaware River	Shumaker's Eddy	Warren County	Mar. 24, 1880	20,512
Pennsylvania	Baltimore, Md	Susquehanna River	Trout Run	Williamsport	Mar. 23, 1880	12,000
		Do	Juniata River	Huntington	Mar. 23, 1880	11,000
		Monocacy River	Rock Creek	Gettysburg	Apr. 9, 1880	7,729
		Potomac River	Conococheague Creek	Greencastle	Apr. 9, 1880	5,000
Maryland	Baltimore, Md	Monocacy River	Hunting Creek	Mechanictown	Mar. 24, 1880	3,000
		Monongahela River	Youghiogheny River	Oakland, Md	Apr. 5, 1880	10,000
		Chesapeake Bay	Potomac River	Piedmont	Apr. 6, 1880	10,000

TABLE V.—*Temperature of water in Dead Brook.*

Date.	Hour.	Temperature.	Date.	Hour.	Temperature.
1879.		*Deg. Fahr.*	1879.		*Deg. Fahr.*
June 9	8 a. m	60	July 9	7 a. m	61
11	8 a. m	55	10	7 a. m	62
12	8 a. m	55	11	7 a. m	63
21	8 a. m	62	15	10 a. m	71
25	8 a. m	70	16	10 a. m	71
29	8 a. m	67	17	8 a. m	71
30	8.30 a. m	66	18	9 a. m	66
July 2	7 a. m	64	21	7 a. m	67
3	7 a. m	66	22	8.30 a. m	67
5	7.30 a. m	64	23	9 a. m	64
6	8 a. m	64	27	9 a. m	62
7	8 a. m	62	Aug. 4	9 a. m	70
8	7 a. m	62	5	7.30 a. m	69

Average for 7 observations in June 62.14
Average for 17 observations in July 65.12
Average for 2 observations in August 69.50
Average for 26 observations between June 9 and August 5 ..... 64.65

TABLE VI.—*Temperature of water in hatching-house at Craig's Pond Brook.*

Date.	Hour.	Temperature.	Date.	Hour.	Temperature.
1879.		*Deg. Fahr.*	1879.		*Deg. Fahr.*
Oct. 25	3 p. m	51	Nov. 23	10 a. m	49
27	4 p. m	53	24	4 p. m	46
30	12 m	54	26	8 a. m	47
31	3.30 p. m	49	27	8 a. m	46
Nov. 2	11 a. m	50	28	11 a. m	50
3	4 p. m	50	29	12 m	50
5	4 p. m	49	30	9 a. m	44
7	3 p. m	51	Dec. 2	10 a. m	49
9	4 p. m	53	3	1 p. m	46
10	5 p. m	52	4	1 p. m	48
11	2 p. m	52	5	2 p. m	45
12	4 p. m	51	6	1 p. m	45
14	5 p. m	48	8	4 p. m	47
15	4 p. m	52	10	2 p. m	43
16	9 a. m	51	12	4 p. m	44
17	5 p. m	51	15	3 p. m	40
18	5 p. m	48	18	1 p. m	37
19	3 p. m	50	20	3 p. m	36
20	9 a. m	48	24		35

Average for 4 observations in October 51.75
Average for 22 observations in November 49.45
Average for 12 observations in December 42.92
Average for 38 observations between October 25 and December 24 ..... 47.68

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