The Rise and Fall of a Reindeer Herd

VICTOR B. SCHEFFER

Dr. Scheffer's work in zoology is well known, for he has been biologist and project leader in charge of research, Alaskan Fur Seal Herd, Fish and Wildlife Service, since 1940. In a technical paper in SCIENCE (**112**, *309 [1950]*), *he described some of the details of his research. On canine teeth taken from 75 fur seals of known age, growth layers accurately represented the age up to four years, and occasionally up to seven or eight, but tended to give false evidence above age four, largely owing to the variable rate of growth of the animal. Four years ago,* THE SCIENTIFIC MONTHLY *published his "Mystery of the Mima Mounds," those strange hummocks scattered by the countless thousands over the Western states from the Mexican border to northern Washington.*

IN THE fall of 1911 the United States government placed 40 reindeer on the Pribilof Islands, Alaska, to provide the native residents with a sustained source of fresh meat. The deer were descendants of stock imported by Sheldon Jackson from Siberia in the period 1892–1902 and placed at Teller, Alaska, from whence some were moved to Unalakleet and, finally, via the revenue cutter *Bear*, to the Pribilofs.[1, 2] Four bucks and 21 does were landed on St. Paul, and three bucks and 12 does were landed on St. George, the neighboring island forty-one miles to the south. Along with each group went an Eskimo herder to instruct the Pribilof Islanders in the handling of reindeer. The plantings were an immediate success, for in the following spring, 17 fawns were born on St. Paul and 11 on St. George.

The population records of the Pribilof herds since 1911 are of considerable interest to the student of wildlife behavior. In a sense, the Pribilof Islands have served as an outdoor laboratory where the deer have been held under observation for forty years. During this period they have been maintained in a semiwilderness environment, subjected to little hunting pressure. They have been completely free of attack by predators, for the only land carnivores on the islands are foxes and domestic cats. As G. Dallas Hanna[3] predicted in 1922, "It would seem that here is the place to maintain model reindeer herds and to determine many of the needed facts for the propagation of these animals on a large scale. At no other place are conditions so favorable."

But the trends of the reindeer populations since 1911 have been disappointing (Table 1 and Fig. 1). When Hanna published his report in 1922, the St. George herd had already reached its ceiling of 222 members, and was soon to subside to a small, stable population numbering 40 to 60. The St. Paul herd grew slowly and steadily until the early 1930s, when it suddenly erupted. By 1938 it included more than 2,000 animals—twelve years later only 8! (Estimates of the number are accurate to within about 10 per cent. An inventory is taken annually in the fall of the year by government employees, who scan the treeless tundra from the tops of low, volcanic hills.)

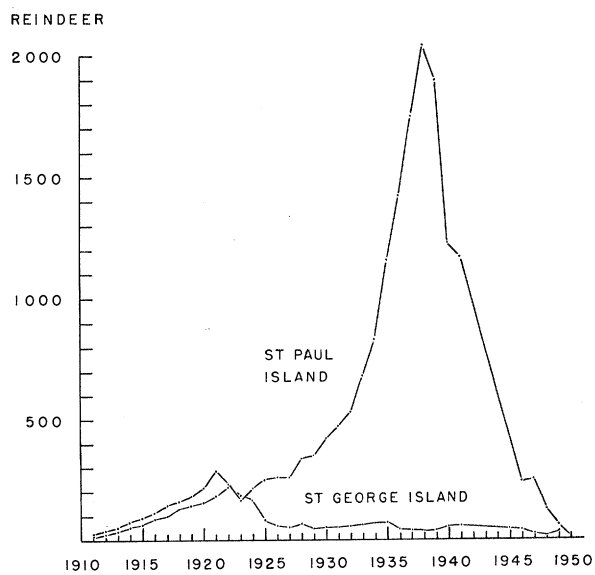

FIG. 1. Reindeer populations of the Pribilof Islands from 1911 to 1950. (Each point represents the combined number of deer killed for food and spared or, in years when no animals were killed, the number of deer counted at the end of the year. From Table 1.)

TABLE 1

THE REINDEER POPULATIONS OF THE PRIBILOF ISLANDS, 1911–50: NUMBERS KILLED ANNUALLY FOR FOOD AND NUMBERS SPARED*

YEAR	ST. PAUL ISLAND		TOTAL	ST. GEORGE ISLAND		TOTAL
	KILLED	SPARED		KILLED	SPARED	
1911		25	25		15	15
1912		40	40		25	25
1913		52	52		38	38
1914		75	75		58	58
1915		92	92		62	62
1916		111	111	2	85	87
1917		144	144	3	93	96
1918	2	155	157	18	114	132
1919	14	164	178	22	123	145
1920	22	192	214	31	125	156
1921	34	250	284	19	160	179
1922	38	190	228	22	200	222
1923	14	150	164	34	145	179
1924	13	200	213	18	150	168
1925	25	225	250	17	60	77
1926	10	250	260	10	50	60
1927	9	250	259		50	50
1928	22	315	337		66	66
1929	20	329	349		45	45
1930	17	404	421		51	51
1931	19	453	472	5	47	52
1932	47	485	532		57	57
1933	11	673	684		63	63
1934	14	820	834		72	72
1935	23	1,162	1,185	3	71	74
1936	37	1,388	1,425		44	44
1937	80	1,673	1,753	8	32	40
1938	103	1,943	2,046		38	38
1939	105	1,800	1,905		42	42
1940	265	962	1,227		54	54
1941	326	850	1,176	3	53	56
1942						
1943						
1944						
1945	56				41	41
1946		240	240		38	38
1947		250	250		20	20
1948		120	120		10	10
1949		60	60		30	30
1950		8	8			

* Data from published annual reports of the Alaska fur-seal industry and manuscript reports of the Fish and Wildlife Service. The data are incomplete for the war years 1942–45.

Several thoughts come to mind immediately. Why was there an abrupt rise and then a fall in the size of the St. Paul herd? What ecological, or perhaps genetic, factors were responsible for the fluctuation? Why does the pattern differ on St. Paul and St. George, two islands within a few miles of each other?

The St. Paul Herd

As compared to that of St. George, the fluctuation of the St. Paul herd has been more pronounced, thus throwing into sharper relief the underlying causes and permitting a clearer interpretation of them. Observations on St. Paul over the period 1940 to 1950 and examination of the records point to the inescapable conclusion that the lichen flora of the island is the key to the behavior of the herd. Certain lichens, chiefly the taller, shrublike forms of *Cladonia* and *Cetraria*, serve as emergency rations for reindeer. From Palmer's long experience in the study of the arctic tundra, he concludes that

> Although the lichens can not be said to be necessary for reindeer maintenance because of their nature or nutritive qualities, yet from the standpoint of a readily accessible winter food supply they are essential. The animals

seem to be able to detect lichens through as much as four feet of loose snow and reach them by pawing. Experimentally, when offered other winter foods in addition to lichens, the reindeer took the lichens in preference.[4] During the main winter period, December 20 to April 8, a lichen forage is necessary. Desirable forage at this time consists of 75 to 90 per cent lichens and other vegetation, including mosses.[5]

When the St. Paul herd was small, numbering in the hundreds only, growth of the food lichens kept pace with the demand.[3] The food lichens are now so rare, except on Sea Lion Neck and around the village—both places where the deer seldom venture—that diligent search is required to find representative specimens. Biologist Ford Wilke found that in late November 1942 "grasses appeared to make up the bulk of the contents of two stomachs we opened. The lichen commonly called reindeer moss is practically gone from the island. . . . None was seen in the stomachs (*in litt.*)."

From about the first of May to late November, depending upon the weather, there is sufficient food in the form of grasses and other flowering plants to carry the deer along. For example, in June the deer feed extensively on the common umbellifer, *Coelopleurum gmelini*, and the fernleaf, *Pedicularis verticillata*. During a slaughter of deer in late August, several stomachs examined were filled with fibers of the abundant grass *Elymus mollis*, which gives to St. Paul Island its bright green color; also fibers of crowberry, *Empetrum nigrum*.

TABLE 2

SELECTED TEMPERATURE RECORDS FOR ST. PAUL ISLAND, ALASKA, 1926–50*

YEAR	MEAN TEMPERATURES		LOWEST TEMPERATURE	DATE
	JANUARY–MARCH†	ANNUAL		
1926	26.0	37.6	7	Feb 23
1927	24.4	33.6	– 4	Mar 19
1928	24.6	33.1	– 2	" 27
1929	29.0	36.8	2	" 15
1930	25.8	34.8	1	" 17
1931	23.1	35.3	1	Feb 21
1932	26.7	36.0	4	" 22
1933	24.1	34.7	– 15	Mar 15
1934	21.0	35.4	– 7	" 2
1935	30.5	38.5	5	Feb 11
1936	25.1	37.2	– 2	Jan 16
1937	33.6	38.9	8	Dec 11
1938	22.3	34.5	– 7	Mar 24
1939	24.3	33.7	– 1	Jan 22
1940	18.2	33.8	– 7	Feb 13
1941	23.0		– 6	Mar 7
1946	19.6	32.4	– 6	Feb 27
1947	20.8	33.2	– 17	Mar 12
1948	21.9	33.4	– 6	" 6
1949	26.4	34.9	0	Feb 9
1950	27.7	35.9	11	" 23
Mean	24.67	35.2	– 2	" 24

* From U. S. Weather Bureau, annual climatological data, Alaska section; records lacking from 1942 to 1945 because of war.
† Simple mean of the 3 mean monthly temperatures.

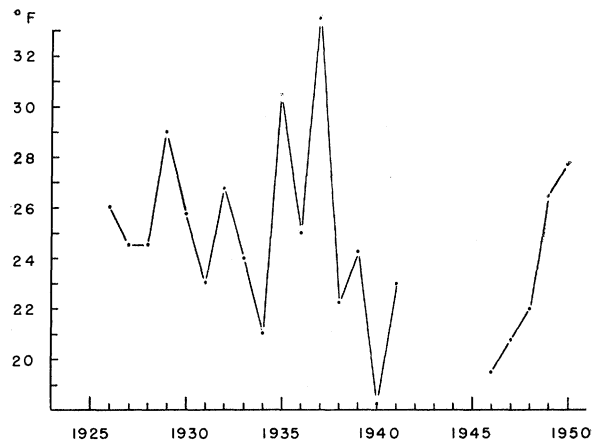

FIG. 2. Mean midwinter temperatures on St. Paul Island, 1926–50. (January, February, and March; from Table 2.)

How long will it take for the food lichens to recover on St. Paul? Hanna[3] believes that on the Pribilof Islands they grow more rapidly than on the mainland. "Areas completely denuded in 1914 were regrown by 1919. The difference in rate of growth is believed to be due to the longer growing season . . . and the much damper climate." But Palmer[5] states that "quadrat observations made on the coastal tundras indicate that recovery of lichen range following full cropping may take possibly 15 or 20 years," and "on an average range 33 acres is the minimum year-long grazing area requirement for each reindeer." The land area of St. Paul Island is 26,500 acres, which means that, at the peak of the population in 1938, there were only 13 acres of land for each deer, or actually about 11 acres of suitable grazing land. On this basis, *the reindeer population was at least three times the carrying capacity of the range.*

With the disappearance of the lichens the reindeer were left with inadequate winter food reserves. The year 1938 inaugurated a four-year cycle when midwinter temperatures fell below normal; the winter of 1940 was exceptionally cold (Table 2 and Fig. 2). According to the island records, in 1940 a crust of glare ice remained on the snow for several weeks, hindering the deer in their efforts to browse. Roger Chute, storekeeper, made a reconnaissance of the island between April 17 and May 9 and reported about 150 deer carcasses, most of them females and young. "Great acreages of interior highland grazing land, rich in

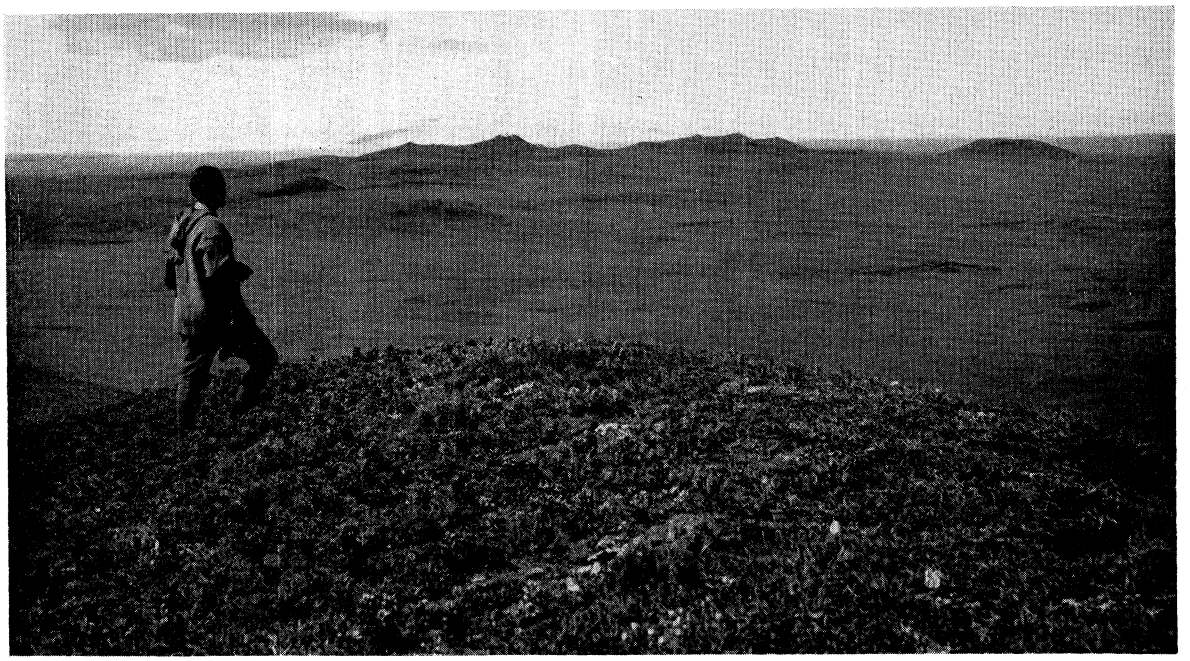

FIG. 3. The rolling tundra of St. Paul Island, studded with old volcanic craters (June 1940).

standing grass hay, have been abandoned by the deer herd throughout all the winter (*in litt.*)." (In our experience of ten years there has always been an abundance of *Elymus* on the Pribilofs. The availability of this grass, rather than the amount, is the critical factor.) Palmer[5] has cautioned that "because of winter rains . . . certain areas near the coast are subject to crusting, and under such conditions herds may suffer great losses through starvation, since the animals cannot paw through hard crust to get food."

Although the combination of depleted range and adverse weather seems clearly to have been responsible for the decline of the herd in the 1940s, the importance of other factors must be weighed (Figs. 3–6). The first of these is hunting by man. In 1942 the 500 residents of the Pribilof Islands were evacuated to southeast Alaska as a military measure and were returned in the summer of 1944. In the interim, troops were stationed on the islands. Quite naturally, no one paid serious attention to the reindeer herd on St. Paul until 1946, when an inventory revealed the dismaying total of 240 animals. Since the herd declined rapidly in the period of military occupation, some residents of the island believe that poaching was a major cause. But the form of the growth curve of the herd is clear evidence that the decline was well under way before 1942 and that it continued after 1944. In other words, we do not need the segment of the curve between 1942 and 1944 to enable us to recognize a familiar pattern. In their study of the population dynamics of the fruit fly, Chiang and Hodson[6] discuss the type of growth curve exemplified by the St. Paul herd.

> A population in a limited environment may increase in a logistic fashion, but, unless [it is] properly adjusted to the environment the fluctuation around the asymptote will be very brief or even be lacking, and a crash will immediately follow the production of the maximum population. This crash is a result, mainly, of the fact that the production of even one generation beyond a certain critical population level overshoots the maximum capacity which the environment can support.

The government made a serious effort in 1940 and 1941 to reduce the size of the herd by doubling and tripling the annual kill (Table 1, Figs. 7–9). So

FIG. 4. Three-year-old male reindeer tamed by the villagers of St. Paul (August 1946).

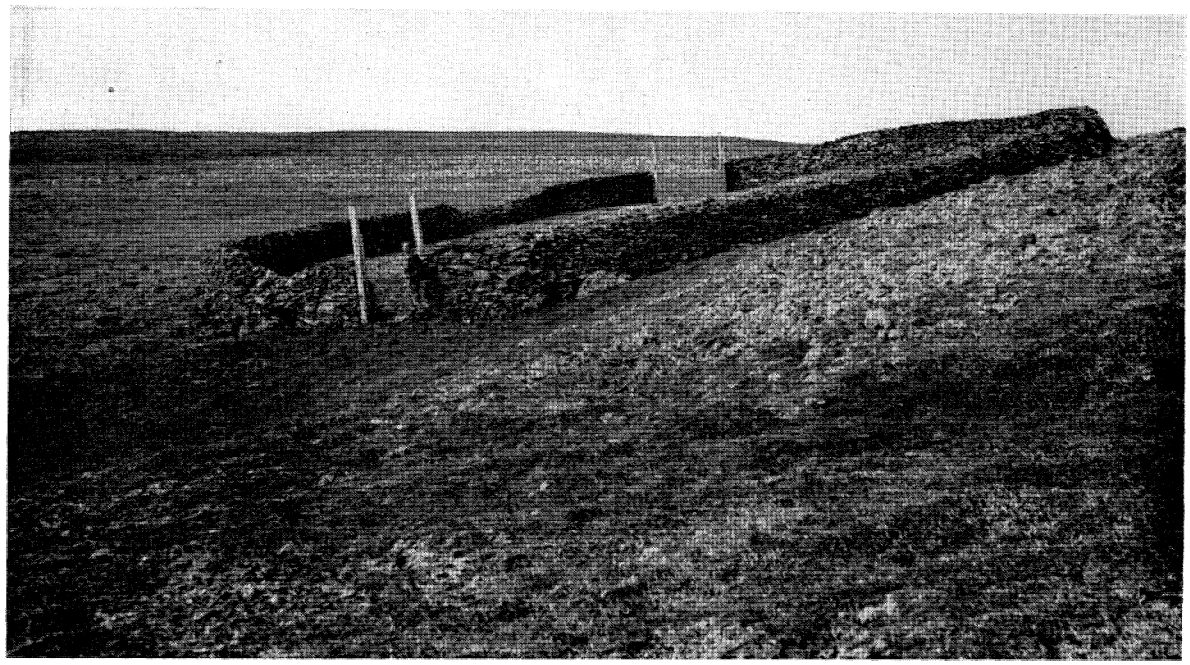

FIG. 5. Reindeer corral about 5 feet high and 40 feet in diameter, built of stones by an Eskimo herder on St. George Island and later abandoned (July 1940).

great was the momentum of the natural factors operating against the herd, however, that the decline continued almost to the zero point, even after killing was suspended in 1945.

Disease, the familiar sequel to starvation, has undoubtedly contributed to the decline of the herd. There is no evidence, though, that it has at any time become epizootic. Inbreeding, a scapegoat commonly used by sportsmen when faced with a dwindling population of big game, has also been accused of destroying the St. Paul herd. It might be pointed out that on the rugged Pribilofs only the fit survive. The occasional weakling developed through an accident of ancestry has little chance to live long enough to perpetuate his kind. Fighting, accidental deaths, and unfavorable sex ratios—these have also played their part. In the last analysis, however, *overpopulation* is primarily responsible for the type of growth curve with which we are dealing.

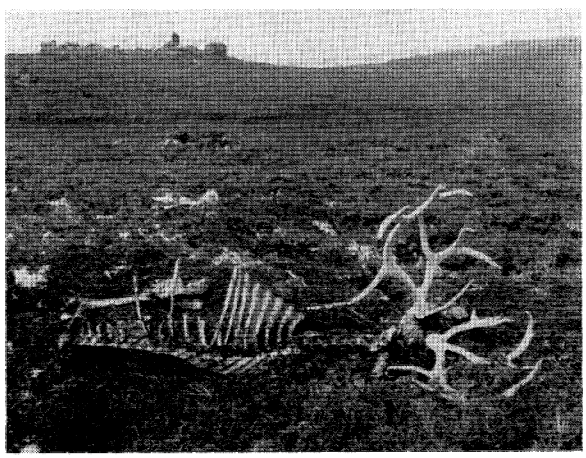

FIG. 6. Evidence of winter mortality on St. Paul Island (July 1940).

At this point it is timely to mention a resolution passed at the thirtieth annual meeting of the American Society of Mammalogists in 1950.

> [The Society] urges that the Canadian Government not undertake the introduction of reindeer into Ungava. Before any introduction is seriously considered, those persons involved in any planning are urged to make a thorough study beforehand of the problems of integrating lichen ecology, reindeer biology, and native culture—serious problems that have not been solved to date on any workable scale on the North American continent. It would be particularly deplorable if an introduction, to aid the natives, led to early successes and high hopes, then eventual failure.[7]

The St. George Herd

Over a twenty-five-year period, and with little interference from man, the St. George herd has fluctuated slowly between 10 and 74 animals. For unknown reasons the population has not erupted like the one on St. Paul. The area of the island is 22,400 acres, and at no time has the population exceeded one deer to 100 acres. Food lichens are still present in fair amounts. We can only point to cer-

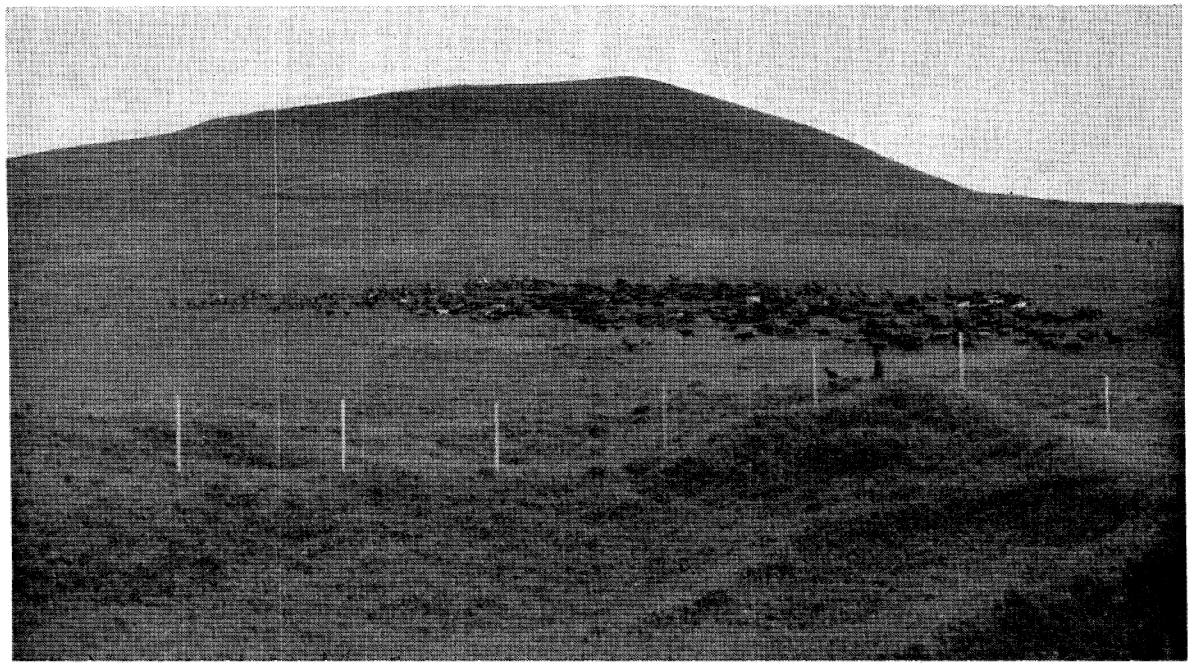

FIG. 7. A reindeer roundup on St. Paul Island, August 1940. Men are driving the frightened animals into a corral (not shown).

FIG. 8. Butchering reindeer for the use of natives, St. Paul Island (August 1940).

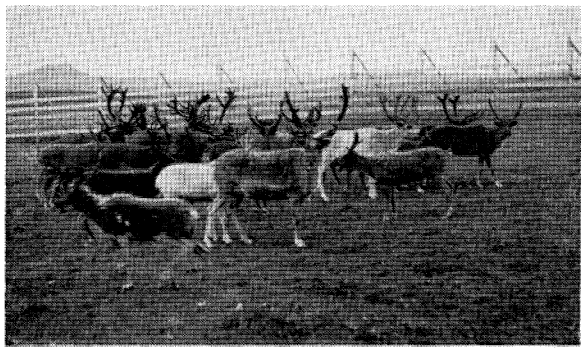

FIG. 9. Reindeer in a corral at butchering time, St. Paul Island (August 1940).

tain ecological differences between the two islands and trust that somewhere among them lies the answer.

The most conspicuous difference is the far greater proportion of shoreline cliffs on St. George Island. Some of these drop almost vertically for 900 feet into the sea. Since reindeer habitually feed upwind, it is easily imaginable that individuals in the leading ranks might press into the face of a blizzard and go blindly over the edge of a cliff.

Again, the two islands lie on a critical line between Arctic Ocean and North Pacific influences, where slight discrepancies in weather conditions and ocean temperatures bring about noticeable differences in the fauna and flora. The mean southern limit of the arctic drift ice lies midway between the islands. The climate is slightly warmer, and the tundra is wetter on St. George. Certain flowers characteristic of the Aleutian chain (e.g., *Anemone narcissiflora* and *Fritillaria camschatcensis*) are common on St. George but rare on St. Paul. The bumblebee, *Bremus kincaidi,* is confined to St. Paul. The winter wren, *Nannus hiemalis,* is abundant on St. George but is almost never seen on St. Paul. The lemming, *Lemmus nigripes,* is limited to St. George, and the shrew, *Sorex alascensis pribilofensis,* to St. Paul. Whether the environment of St. George has "dampened" the fluctuation of the deer population remains an interesting but unanswered question.

References

1. EVERMANN, B. W. *Fishery and Fur Industries of Alaska in 1912.* U. S. Bur. Fish. Doc. 780 (1913).
2. LANTIS, M. *Arctic,* **3**, 27 (1950).
3. HANNA, G. D. *Sci. Monthly,* **15**, 181 (1922).
4. PALMER, L. J. *The Alaska Tundra and its Use by Reindeer.* U. S. Office of Indian Affairs (mimeo.) (1945).
5. PALMER, L. J. *Raising Reindeer in Alaska.* U. S. Dept. Agr. Misc. Pub. 207 (1934).
6. CHIANG, H. C., and HODSON, A. C. *Ecol. Monographs,* **20**, 173 (1950).

SMO ON THE AIR

STATION	SPONSOR	TIME
	Sunday	
KLBM, La Grande, Ore.	Baker-Union Department of Health (Research Report)	10:15 A.M.
	Monday	
WOI-FM, Ames, Iowa	Iowa State College of Agriculture and Mechanic Arts (Articles of Interest)	7:45 P.M.
	Tuesday	
WEVD, New York City	Wendell W. Rázim (Science for the People)	9:00 P.M.
	Wednesday	
CKPC, Brantford, Ont.	The Telephone City Broadcast Limited (Modern Science)	9:45 P.M.
	(Irregular)	
KBKR, Baker, Ore.	Baker-Union Department of Health (Research Report)	....

The Editor of THE SCIENTIFIC MONTHLY will be glad to cooperate with university or other educational stations interested in securing scientific material suitable for broadcasting.