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HEAD OF A TYPICAL ROOKERY BULL.
Drawn from nature by Bristow Adams.

THE

FUR SEALS AND FUR-SEAL ISLANDS

OF THE

NORTH PACIFIC OCEAN.

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WITH SPECIAL PAPERS BY OTHER CONTRIBUTORS.

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PART III.

SPECIAL PAPERS

RELATING TO

THE FUR SEAL AND TO THE NATURAL HISTORY OF THE PRIBILOF ISLANDS.

Stanford University,
California, August 30, 1898.

The present volume consists of a series of papers by different authors relating to the natural history and resources of the fur seal islands in Bering Sea. It has been compiled under the editorial supervision of Mr. Frederic A. Lucas.

David Starr Jordan,
Commissioner in Charge of Fur Seal Investigations.

Hon. Lyman J. Gage,
Secretary of the Treasury, Washington, D. C.

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THE MAIN DIVISIONS OF THE PINNIPEDIA.

By Frederic A. Lucas.

The lines of descent of the Pinnipedia are very imperfectly known, and little can be said save that both eared and earless seals have descended from the Creodonta, the earless seals having become most highly specialized, while the eared seals are more generalized and are structurally nearer the bears. From their distribution it would seem that the eared seals, and especially the fur seals, originated in the southern hemisphere and differentiated as they worked north. Furthermore, that this northward movement was along the west coast of America, being favored by the cold current setting northward along the coast of South America.

The northern seals have become generically distinct from their southern relatives, while the Asiatic and North American animals are more or less differentiated from one another, their differences being accorded specific value by Dr. Jordan.

In his Families of Mammals, Dr. Gill, although strongly tempted to do otherwise, grouped the eared and earless seals together in the superfamily Phocoidea, the walruses being set apart as a second superfamily Rosmaroidea.

Dr. Allen[1] made a different disposition of the pinnipeds, making the groups Gressigrada and Reptigrada, the former containing the *Odobaenidæ* and *Otariidæ*, the latter comprising the *Phocidæ*.

It has seemed to us better to follow Dr. Gill's unpublished ideas and to combine the eared seals and walruses in the superfamily Otarioidea, the earless seals forming a second superfamily Phocoidea.

With better material at hand than was in Dr. Allen's possession, it is possible to extend his diagnosis somewhat, and the following characteristics of the two superfamilies are herewith submitted.

OTARIOIDEA.

Neck long, hind feet capable of being turned forward and used in terrestrial locomotion. Grinders with single roots and simple, flattened or pointed crowns. Skull with mastoid large and salient, and large tentorium; an alisphenoid canal. Posterior ends of nasals abutting upon (*Odobænidæ*) or separated by frontals (*Otariidæ*). Anterior feet without claws, and with a broad cartilaginous border extending beyond the digits. Hind feet with phalanges terminating in long cartilaginous flaps, and with claws on three innermost digits only. Astragalus much shorter than calcaneum.

[1] History of North American Pinnipeds, pp. 3, 4.

Cuboid articulating with calcaneum only. First metatarsal articulating only with entocuneiform. A trochanter minor present on femur. Auditorial bullæ small and irregular in form.

PHOCOIDEA.

Neck short. Hind feet incapable of being turned forward. Grinders with complex roots and multicuspidate crowns. Mastoid swollen, but not salient. Tentorium moderate or small. No alisphenoid canal. Auditorial bullæ usually very large, pyriform in shape. Posterior end of nasals wedged in between frontals. Anterior digits all bearing claws, and claws present (usually) on all digits of hind feet. No cartilaginous flaps to any of the digits. Astragalus equaling calcaneum in length. Cuboid articulating with both calcaneum and astragalus (save in Monachus and Macrorhinus). First metatarsal articulating with entocuneiform and with second metatarsal as well. Femur with no trochanter minor.

THE SPECIES OF CALLORHINUS OR NORTHERN FUR SEAL.

By DAVID STARR JORDAN and GEORGE A. CLARK.

The fur-seal herds resorting to the islands of Bering Sea and the Sea of Okhotsk belong to the genus *Callorhinus;* while those resorting to the islands of the Tropics and the antarctic regions belong to a different group, called *Arctocephalus.*

The fur seal of the North was first made known by Steller, who, in 1741, inspected the South or Poludionnoye rookery of Bering Island, and wrote an account of his observations. On Steller's description of the "Sea Bear" of Bering Island Linnaeus based his classification of *Phoca ursina*, or "bear-like" seal. From the Linnaean name the fur seal of the North came to be called *Callorhinus ursinus*, and the type of the species is, of course, the Commander Islands herd.

The fact that the members of the Pribilof herd differ from those of the Commanders in color, in form, and in character of the fur has long been recognized. These differences, though slight, are permanent and constant. No intermediate forms are known, and, as the life courses of the herds are wholly distinct, apparently no intermediate forms can exist. We may therefore hold the Pribilof herd to be a species of fur seal distinct from that of the Commander Islands. This species may be called *Callorhinus alascanus* Jordan and Clark.

The species *alascanus* may be known by the stouter, broader head, by the thicker neck, by the prevalence of warm brown shades in the coloration of the female and the young males, by the more silvery color of the gray pups, which lack the distinct whitish patches on the rumps seen in *ursinus*, and, in general, by the lack of sharp contrasts between the coloration of the sides and belly. The fur in *alascanus* is also of superior quality, and exhibits sufficient difference to make it possible for dealers to distinguish by this means alone whether the skins come from the Commander or Pribilof herds. In the Pribilof seals the claws on the fore flippers are undeveloped, being represented by a pit in the skins.

The true *Callorhinus ursinus* has the head and neck slenderer; the females and young males are sooty, rather than brown, the light and dark shades being for the most part equally without ochraceous tints; the belly is usually rather sharply paler than the back; the gray pup is more brownish and less gray than in the Pribilof animal, having a pale patch on each side of the rump. The fore feet have two or three rudimentary claws.

The seals of Robben Island and the Kurils differ from both of the foregoing in the whitish color of the under fur. This is rusty brown in *ursinus* and *alascanus*, The head is said to be broader again than in *ursinus*, and photographs show a dusky coloration similar to this species. The fur of the Robben Island herd is different from either of the others. It was looked upon at first as distinctly inferior in quality, though a change in process in the removal of the water hair, which is accomplished with much greater difficulty, has removed the discrepancy in value of the fur. The fact remains, however, that these skins must be treated by a separate process.

The data regarding this third form of the Northern fur seal is inadequate to definitely characterize it, but such information as is at hand points to the probability of its being also a new species. It may be provisionally regarded as such under the name of *Callorhinus curilensis* Jordan and Clark, taking the seals of Robben Island as typical.

The following is a table showing comparative measurements of typical examples of *C. ursinus* and *C. alascanus:*

Comparative measurements (in millimeters) of typical specimens of fur seals from the Commander and Pribilof herds.[1]

	Adult male.		Adult female.		Bachelor.	
	Commander.	Pribilof.	Commander.	Pribilof.	Commander.	Pribilof.
Total length	1,930	1,887	1,283	1,262	1,285	1,224
Nose to end of outstretched hind feet	2,450	2,397	1,650	1,645	1,655	1,811
Nose to armpit	980	1,058	685	701	660	714
Nose to eye	98	115	67	89	80	76
Nose to ear	213	216	168	181	158	166
Distance between eyes	104	127	70	89	71	83
Distance between ears	173	306	138	204	138	217
Length of ear	52	64	45	64	47	51
Length of tail	50	51	53	37	47	57
Longest mustache bristle	113	191	125	102	105	102
Length of forelimb	540	548	345	402	395	333
Width of forefoot	223	216	123	127	125	139
Length of hind foot	597	548	415	408	420	327
Width at tarsus	135	166	95	102	85	102
Width at end of toes	285	191	170	115	177	102
Average length of toeflaps	230	344	162	255	161	255
Distance between tips of outstretched forelimbs	1,740	1,798	1,205	1,198	1,085	1,237
Girth—						
Of neck behind ears	598	637	405	446	405	522
Over shoulders	1,205	1.415	750	829	820	619
Behind forelimbs	1,155	1,530	780	739	740	791
Before hindlimbs	480	867	280	510	295	459

[1] The measurements of Commander Islands seals were taken by Dr. Stejneger on North rookery of Bering Island in August, 1883; those for the Pribilof seals were taken by Mr. Clark on St. Paul Island in October, 1896.

The body measurement of these animals can not be relied upon to show permanent conditions, as they necessarily vary according to the physical condition of the animals. Thus, the measurements of the bull taken on August 20 probably represents the animal after its long fast during the breeding season. The measurements of the Pribilof bull taken in October represented an animal which had been feeding and was well supplied with blubber. Similar differences might easily arise in connection with the other measurements of the body.

But with the head it should be different. If we take out the measurements which have to do with this feature we find that there is a marked difference corresponding to the general impression made by comparative observations on the two herds. These measurements reduced to percentage of the total length are as follows, the results being all the more striking because in each case the Pribilof animal shows a smaller total length:

Measurements (in millimeters), showing differences in the head of typical Commander and Pribilof seals, taken from the table just given.

	Adult male.		Adult female.		Bachelor.	
	Commander.	Pribilof.	Commander.	Pribilof.	Commander	Pribilof
Total length	1,930	1,887	1,283	1,262	1,285	1,224
Distance between eyes	104	127	70	89	71	83
Per cent of total length	5.3	6.7	5.4	7	5.5	6.7
Distance between ears	176	306	138	204	138	217
Per cent in total length	9.1	16.2	10.7	16.1	10.7	17.7
Distance nose to eye	98	115	67	89	80	76
Per cent in total length	5	6	5.2	7	6.2	6.2
Distance nose to ear	213	216	168	181	158	166
Per cent in total length	11	11.4	13.1	14.3	12.3	13.5

VARIATIONS IN SIZE AND COLOR OF THE PRIBILOF FUR SEAL.

By Frederic A. Lucas.

While the Pribilof fur seal varies in size, color, and proportions to such an extent that were but a few individuals known, they might be held as belonging to two distinct species; part of this, particularly the variation in color, is due to age. The young pups are black above, with a few gray hairs on the head and neck; the side of the neck is slightly tinged with gray and the greater part of the under surface is dusky brownish gray. There is a spot of yellowish-brown at the axilla and the region around the mouth is of the same color.

Between the middle of September and the middle of October the majority of pups have shed their black coats and assumed the silvery gray and white of the "gray-pup" stage. Up to the age of two years the young of both sexes are of a beautiful steel gray above, with the throat and belly white, the central portion of the latter being suffused with chestnut. On the breast, at the base of each flipper is a convex patch of gray which nearly meets its fellow of the opposite side, thus reducing the white at this place to a narrow isthmus, connecting the throat with the under parts. There is a dark spot at the anterior edge of the flipper and a light spot on the axil, this being retained for some time in the female. The white throat is very conspicuous even at a distance, and indicates that the animals have not reached a killable age.

The coloration deepens with age, the gray encroaching upon the white of the throat and the chestnut deepening in intensity on the under side until it becomes rich and dark, while the patches below the flippers unite to form a band across the chest, the dark spots on the anterior edge of the flippers becoming a dull chestnut.

Still later the chestnut under side gives place to gray with a slight chestnut tinge, the old females being dark gray above and lighter gray below; this last with a tinge of chestnut. There is a light patch on the center of the throat and a dark band running across the breast from flipper to flipper.

The throat of the male becomes gray at an earlier age—4 or 5 years—than does that of the female, and at the same time the belly becomes ashy, the junction of the back pelage with that of the under side being marked by a lighter chestnut-tinged line.

At the age of 6 or 7 years the males are an almost uniform dark gray, with the hairs of the top of the head and neck considerably longer than that of the rest of the body.

There seems to be some variation in the color of the older rookery bulls—those 7 years old and upward—some animals being of a rich seal brown, washed with yellowish-white on the neck and shoulders; others with a distinct reddish or yellowish cast.

Close examination, however, shows that even the darkest animals are more or less grizzled, and the reddish coloration is undoubtedly largely due to the length of time that the animal has been on land and undergone the bleaching effect of light and partial drying.

This change of color—due to exposure, and in a measure to dirt—is most noticeable among the females, those which have been longest out of water having a brown, sunburned appearance. The amount of dirt naturally varies according to the rookery, and is in some cases very noticeable when a female plunges into the wash of the surf, leaving a trail of muddy water behind. Still this explanation is not wholly satisfactory, and there is a certain amount of color variation which seems to be individual and not to be accounted for on the score of age.

The gray bulls seen here and there on the breeding grounds are either comparatively young animals which have been able to take and hold a place on the rookery, or cases where the assumption of the dark color of the adult has been delayed, or for some cause failed to take place. It is probable that the lightest colored males are those in this last condition, in which age manifests itself by a general lightening in the color of the coat.

As among birds, some seals undergo their color changes much more rapidly than others, and this results in occasionally finding a young female with the colors of old age, or old females with the light gray and white of the fresh 2-year-olds; these females are very noticeable among the other darker-colored females. As is only natural where individuals are so numerous, cases of albinism are occasionally noted, some being quite complete and others only partial. One or two pups have been taken of a yellowish color, with pink eyes and pale flippers, but no adult albino has been noted, the nearest approach to it being a cow of a yellowish cast seen on Lukanin, and another mottled with yellowish seen on Tolstoi.

The accompanying tables of measurements and weights may be considered as representing good average specimens of their respective classes. The weights of the two fetal specimens of April 22 were taken from nearly dry alcoholics, which were by no means so heavy as the fresh specimens would have been, so that $3\frac{1}{2}$ and $4\frac{1}{2}$ pounds would be well within the mark. The fetus at term is one of several obtained from dead cows on St. Paul and is a good average example, for while now and then a pup is seen noticeably below the others in size, none was measured less than 22 inches long. The measurements and weights of newly born pups given by Elliott are worthless. Save for his brown color, the young fetal seal is much like the adult, being well formed and well proportioned, the head not having the disproportionate size usually seen in mammals. Young pups measured between August 8 and August 20 were from 25 to 28 inches long, the males being as a rule the larger. It will be noticed that some of the measurements, as well as the weight of the gray pup, exceed those of the yearling, and it has already been pointed out by Elliott that the young gain little or nothing in weight between the time they leave in the fall and return in the following summer.

Except in length the 4-year-old female may be considered as a good average example of a full-sized cow; the majority of females obtained from the sealers were slightly under 4 feet in length, two or three specimens which seemed to be far above the average proving, when measured, to be only 4 feet 1 inch long from tip of nose to root of tail. The very largest female taken was 51 inches long, 33 inches around the shoulders, and weighed 73 pounds, so that 80 pounds may be looked upon as an exceptional weight for a cow.

The males from 1 to 5 years old are good examples of their respective ages, the measurements of the 3-year-old specimen coinciding with those of a similar animal selected by Mr. Redpath as a typical specimen for the United States National Museum.

The 7 or 6 year-old male is a good example of the males just below the grade of rookery bulls, being full grown, in some particulars, but lacking just a little of the muscular development necessary to enable him to enter the rookery and hold his own against the older animals. It will be noticed that in girth the younger male exceeds the others, but this is due to the fact that the old bulls having passed two months in fasting and fighting had, in consequence, lost much of their fat and some of their flesh. The fore flipper of this young bull was exceptionally short, the flippers of that class measuring ordinarily 20 to 21 inches in length. As a rule, the size of the fore flipper is a fairly good indication of the age of the animal since it increases in length with age in a fairly regular manner, the flippers of the males also exceeding those of the females in size.

The larger of the two bulls was one selected for the United States National Museum, on account of its size, being the largest of forty killed, and 80 to 82 inches may be held as representing the extreme length attained by the bulls, the average being 72. As these bulls had recently come off the rookeries, they were lean, and their girth was by no means what it would have been at the time of their arrival in May or June. Their measurements indicate to some extent the variations in size and proportions found among seals since the older bull was the shorter of the two, although in other ways nearly as bulky as the younger animal, while the flipper of the shorter specimen was an inch and a half longer than that of the other. It was not possible to weigh the large bulls, but in their lean condition they certainly did not weigh over 250 pounds, and it is doubtful if, even at his best, the bull weighs more than 400 pounds.

Dr. Stejneger has spoken of the difficulty of drawing any line between the seals of various ages, stating that no one on the killing grounds of the Commander Islands was able to point out the differences between them. While this difficulty does exist, yet there are, aside from mere size, distinction between the teeth, length of flippers, color of mustache bristles, and length of wig of the seals of various ages which are very perceptible to any one who has noted them long and carefully. Personally, I am unable to differentiate the seals to any great extent, although the difficulty was less on the second visit to the Pribilof than it was on the first, and I am under obligations to Mr. J. C. Redpath for calling my attention to various distinguishing features. The opinion of the natives is of little value, and with them the question undeniably resolves itself into a mental sorting of the killable seals into various classes. That definite age characters do exist is fairly well shown by the agreement in measurements between seals selected at different times by Mr. Redpath and myself as 3 and 4 year olds, the selection in my own case being based on the condition of the canines, whiskers, and wig. Of course, there is an overlapping of seals from the fact that the small 4-year-olds, for example, will be of the same size as the large 3-year-olds, but here the condition of the teeth, flippers, and whiskers will usually show clearly which are the older.

Table giving measurements and weights of seals of various ages.

	Fetus.			Gray pup, male. *a*	Yearling.		Two years, female.	Four years, female.
	April 22.	April 22.	At term, male.		Male.	Female.		
Length, tip of nose to root of tail..inches..	16	17	24	34½	38	36½	38	49½
Girth around smallest part of neck, inches	8⅔	9	10	....	19	17	17¾	17½
Girth around shoulders ....inches..	11½	12½	15	....	28	23½	28	32½
Girth back of flippers ....do....	....	....	14¼	22½	25	23	24	29
Girth around hips ....do....	9	9	13	....	18½	15¼	18	20
Length of fore flipper, tip to arm pit, inches	5½	6	9	11	13¼	11¼	13	15¾
Weight ....pounds..	3 1/16	4 10/16	11 4/16	33 10/16	47	32	55	73

	Two years, male.	Three years, male.	Four years, male. *b*	Five years, male. *b*	Seven years, male.	Over seven years, male.	Over eight years, male.
Length, tip of nose to root of tail..inches..	42	49	53	59	72	79	68
Girth around smallest part of neck, inches	20½	20½	25	27	28	33	32
Girth around shoulders..........inches..	32	36½	38	41	58	48	47
Girth back of flippers.............do....	29	31	....	....	50	50	47
Girth around hips ....do....	20½	21	23½	24	34	32	36
Length of fore flipper, tip to arm pit, inches	16	18	....	....	18	22½	24
Weight ....pounds..	66	86	....	....	319	....	....

a Measured by Mr. G. A. Clark.

b Measured by Mr. J. C. Redpath.

II—THE ANATOMY OF THE FUR SEAL.

THE DENTITION OF THE FUR SEAL.

By Frederic A. Lucas.

The dentition of the adult fur seal is i., $\frac{3}{2}$, c., $\frac{1}{1}$, pm., $\frac{4}{4}$, m., $\frac{2}{1}$, the conical premolars and molars all having simple roots, a well-developed cingulum on the inner side, and a small accessory cusp on the anterior face.

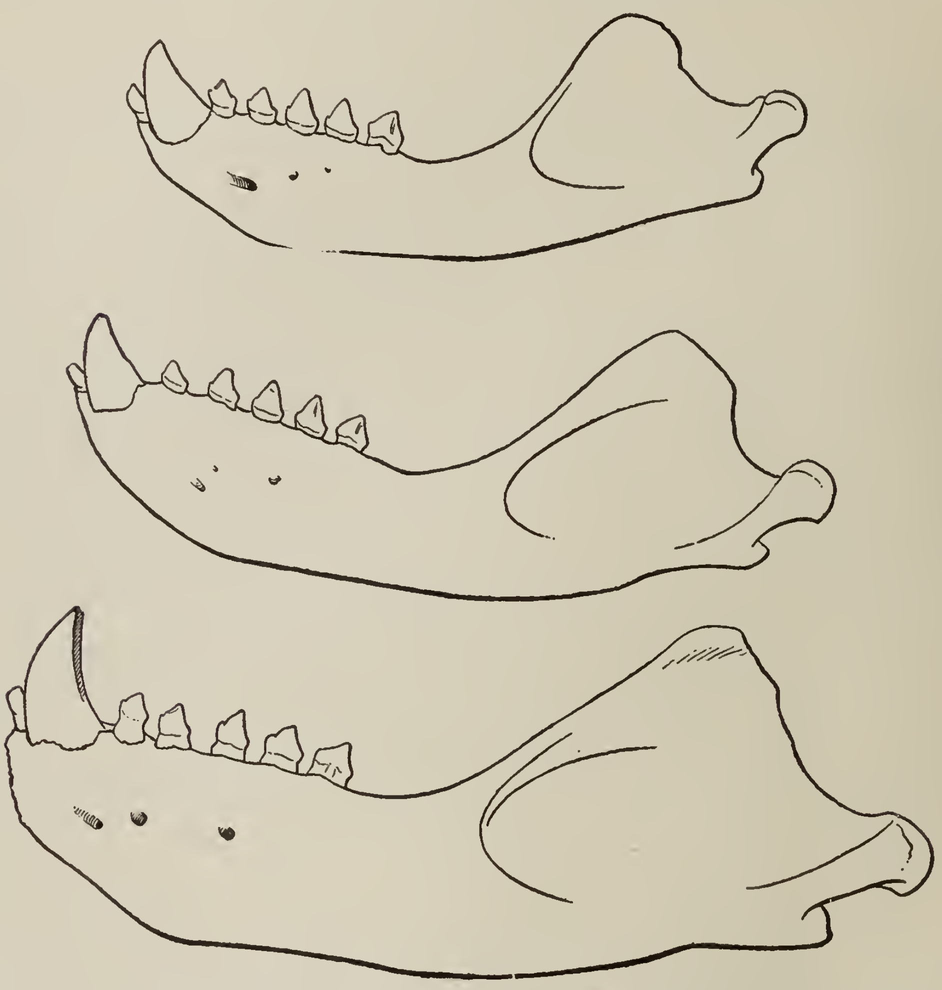
In a fetus taken April 22 the milk dentition is complete, consisting of i., $\frac{3}{2}$, c., $\frac{1}{1}$, m., $\frac{3}{3}$. The incisors are very minute, particularly the inner upper incisor, and there is no trace of a third lower incisor, although proper microscopic examination of a younger fetus might reveal it. So far as has come under my observation (five specimens at full term), the milk incisors are shed before birth, and this is doubtless often or usually the case with the milk molars and lower milk canines. In a full-grown fetus the lower canines were simply hanging to the gum, as were also the minute second and third lower milk molars; but in other fetal specimens and in some recently born animals the lower milk canines and lower and upper third (last) milk molars were still in place, as shown in Pl. I, fig. 1. These last are situated directly over the fourth premolars, so that in *Callorhinus* the third milk molars have vertical successors. The first and second milk molars of the fetus are sometimes mere spicules loosely attached to the gum. In other instances they are well formed though small teeth lying external to the second and third premolars. The order of appearance of the permanent upper teeth is as follows: incisors 1, 2, 3, premolar 1, premolar 2 and molar 1 (although sometimes the molar is slightly in advance of the premolar), premolar 3, premolar 4, molar 2.

In the lower jaw the incisors appear first and the premolars and molars in regular order from before backwards, the first and second premolars appearing almost simultaneously and slightly before the corresponding upper premolars. The canines appear at about the same time as the second true molar, but not until premolars 1 and 2 are well through. There is, however, considerable irregularity in the development of the teeth, for in some individuals the last milk molar and lower milk canines are retained for a fortnight or more after birth.

The teeth mature more rapidly in the female than in the male, for while the entire tooth row, including the canines, are fully developed in the 2-year-old female, the canines do not attain their maximum size in the males until the age of 4 or 5 years, at which time, or possibly a little later, the true molars have already begun to show some slight signs of absorption. There is also a decided increase in the length of the tooth row of the males between the ages of 1 and 6 of from five-sixteenths to five-eighths of an inch, with the natural result that in old animals the teeth are farther apart than in the young. (Compare figs. 1, 2, 3.) The changes in the jaw itself are much more marked than in the teeth, for this continues to increase in size and weight after the fifth year, this change being one of the important factors in the fighting abilities of the adult males.

The condition of the last, or true molars is of value, particularly in the female, in determining the age of a given animal, for while it can not be said how many years a particular seal may have lived, yet it is possible to tell from the appearance of the molars whether the animal is adult, middle-aged, or old. (See the various figures on Pl. I.)

As Dr. Allen has already noted,[1] irregularities in dentition are not infrequent in the fur seal through the failure of one or more of the grinders to develop. A good instance of this is shown in the skulls of two pups, a male and female, which were



Jaws of male fur-seals, three, four, and over seven years of age, three-fourths natural size.

collected on the same day and in the same locality, and, curiously enough, possessed a similarly abnormal dentition through the absence of the last molar in each side of each jaw.

Believers in the coalescence theory of the development of teeth may find a crumb of comfort in the fact that in both cases the last tooth in the row was slightly wider than usual, and a little more deeply grooved vertically. On the other hand, Mr. Andrew Halkett[2] has noted a case in which three upper molars were present.

[1] History of North American Pinnipeds, p. 329.

[2] MSS. report.

The teeth are colored as they protrude from the gum, the brown color appearing first at the tip and working downward.

PLATE I. All figures natural size.

Fig. 1. Recently born male with milk canines and fourth milk molar in place.
2. Male with upper milk canines still in place.
3. Male with last upper true molar not yet through the gum.
4. Male with all teeth in place and all save last upper molar well developed.
5. Dentition of 2-year-old female, showing the teeth at their maximum.
6. Dentition of middle-aged female, 4 or 5 years old, in which the absorption of the last molars has begun.
7. Dentition of old female with absorption of molars advanced.
8. Dentition of oldest female obtained, showing the true molars of both jaws worn away and absorbed and all teeth diminished in size.

PLATE II. All figures natural size.

Fig. 1. Dentition of yearling male.
2. Dentition of 4-year-old male.
3. Dentition of adult male, 7 or 8 years old, showing characteristic wearing of anterior face of upper canine.

NOTES ON THE ANATOMY OF THE FUR SEAL.

By Robert E. Snodgrass.

THE ALIMENTARY CANAL AND LIVER.

The pyloric end of the *stomach* is bent upon the anterior surface of the cardiac. In a bull the length from the cardiac end to the extreme right portion is about 18 inches,

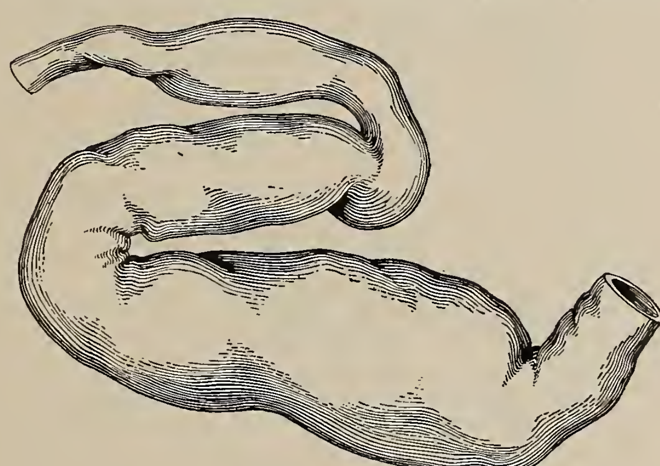


Fig. 1.—Stomach of seal pup, one-half natural size.

and from here to the *pyloris* 8 inches. The *small intestine* is extremely slender. In a bull it measures in length a little over 100 feet; in a cow, between 50 and 60 feet. The *large intestine* is likewise narrow and is about 7 feet long in a bull and 2 feet in a cow. In a pup 22 inches long the small intestine is about 28 feet and the large 10 inches. Hence the intestine increases in length proportionately as the animal matures. The *cæcum* is short and blunt. From the pyloris the small intestine goes backward and makes a curve to the right, then turns dorsally and backward to the posterior end of the right kidney. From here it again goes forward and is disposed in innumerable coils, ending in the large intestine just back of the pyloris. The large intestine runs first backward to the posterior end of the right kidney, makes a bend to the left and forward, then turns back, doubles upon itself ventrally, turns inward and posteriorly to the middle line of the body, and finally goes straight to the anus.

The *stomach* is large, elongate, and capable of great distension. It lies on the left side, and the pyloric end is bent upon the anterior surface of the cardiac. In an adult male the length from the cardiac end to the extreme right portion is about 18 inches, and from here to the pyloric 8 inches, the large part with more or less longitudinal, deep rugæ. The small reflexed, pyloric portion is slightly striated, and in this lodge the fish bones, etc., which are subsequently regurgitated.

The *liver* consists of two left lobes and three right lobes. The *gall-bladder* is pear-shaped and situated between the anterior and middle right hepatic lobes. The *cystic duct* is long and, near the posterior lobe of the liver, is joined by a *hepatic duct* formed by the union of three smaller ducts from different parts of the liver. The common duct formed by the cystic and hepatic ducts enters the duodenum about 2 inches below the pyloric.

The heart.—The anterior end of the *heart* lies between the third and fourth ribs. The ventricular part is somewhat ovate, the longest transverse diameter being in front of the middle, and the posterior part tapering and bluntly terminated. The auricular lobes are rather small. In an adult bull the *ventricular septum* is very thick, and is convex to the right. Its long axis is almost antero-posterior, but it joins the outer wall to the right of the apex of the heart, so that the right ventricle is smaller than the left by more than the thickness of the septum. A line joining any two extreme left points in the right ventricle does not pass through the left ventricle, so that, although the right ventricle is crescent-shaped in transverse section, it does not at all surround the left ventricle.

In the posterior half of the left ventricle are two large longitudinal masses of muscle. One projects into the cavity from the left ventral aspect of the interior wall as a mass flattened perpendicularly to the part of the ventricular wall from which it arises; the other projects from the left dorsal aspect of the same as a mass flattened in a line parallel to the part of the wall from which it arises. About two-thirds of its length forward from its posterior end the dorsal mass becomes decreased to half its diameter by an abrupt contraction. The transverse surface thus formed is ventral to the remaining longitudinal part and gives origin to two sets of *chordæ*, one ventral the other dorsal. The former consists of two large tendons, the latter of two large and two small, the small ones between the others. The remainder of this papillary muscle runs forward and bifurcates into a right and a left mass, both of which become lost in the wall of the ventricle back of the right valve. From near their anterior ends small fibers arise that are inserted upon the valve near its base. The ventral papillary muscle runs forward entire farther than the other, becomes suddenly contracted, leaving a transverse surface on the dorsal side, from which arise two sets of chordæ of two each. The remainder runs forward, indistinctly bifurcates, and becomes lost in the walls of the ventricle after giving off a few fibers to the base of the left valve. The left *mitral valve* is much the smaller of the two.

In the right ventricle the papillary muscles are very different from those in the left. There are three principal muscles. Two arise in the posterior end of the ventricle, one running forward along the septum and the other along the outer ventral

THE CIRCULATORY ORGANS.

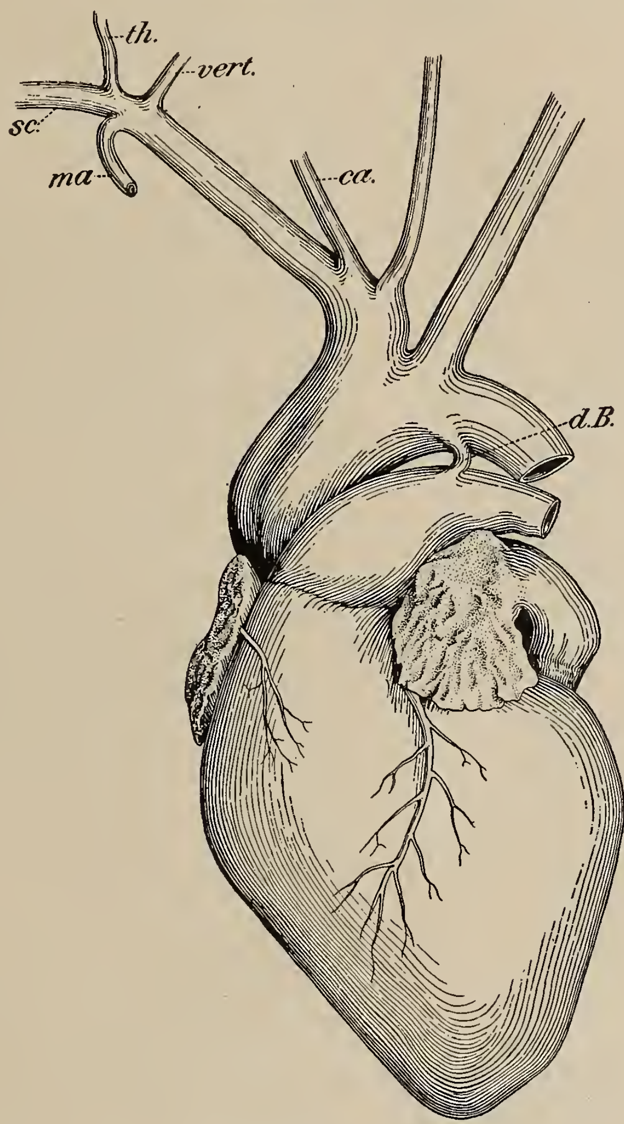


FIG. 2. Heart of seal pup, natural size.
ca. Carotid artery.
vert. Vertebral artery.
th. Thyroid axis.
ma. Internal mammary artery.
sc. Subclavian artery.
dB. Ductus Botalli.

wall. The inner one bifurcates a short distance from its origin, and each arm extends forward a little more than half this length, when it terminates, giving off three chordæ.

The right muscle runs forward about twice the distance of the inner, and divides into an outer and an inner branch. The latter becomes lost upon the ventral wall of the ventricle, while the other bears six chordæ tendinæ. The third papillary muscle is very short. It projects forward and to the right, into the cavity of the ventricle, from the septum near its ventral border, just back of the right auriculo-ventricular valve.

The pulmonary vessels.—The *ductus Botalli* persists throughout life as a hollow vessel, closed at each end by a membrane. It is proportionately larger in a pup than in an old animal, but even in the latter it is well developed.

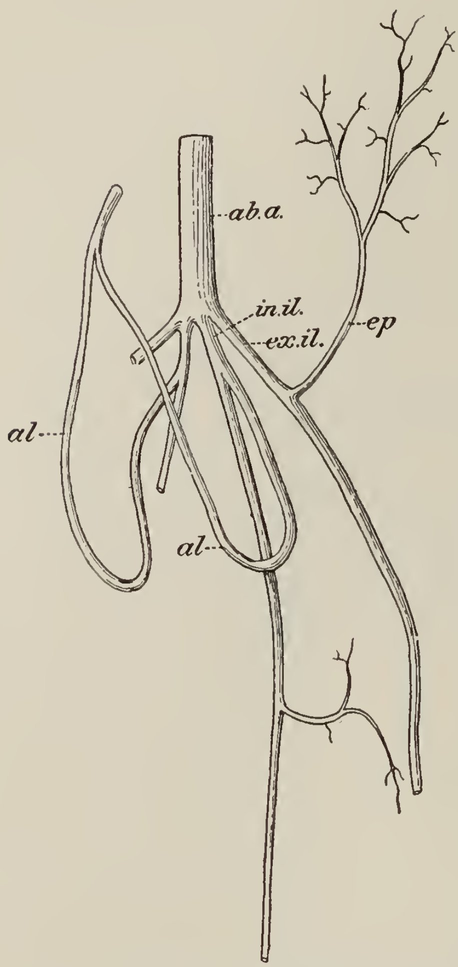


FIG. 3.—Posterior arterial system.
ab. a. Abdominal aorta.
ex. il. External iliac.
in. il. Internal iliac.
al. Allantoic vessels.
ep. Epigastric artery.

There are four *pulmonary veins.* On the left side one large one comes from the anterior lobe of the corresponding lung and enters the left auricle at its anterior left aspect. From the posterior lobe on the same side three veins, decreasing in size from before backward, converge toward the posterior outer aspect of the left auricle and unite near it, forming a single trunk less than half an inch long. On the right side a very large trunk comes from the most posterior lobe of the right lung and is joined by a smaller vein from the middle lobe. The common trunk thus formed is very short, resembling the one on the left. These two empty very close together into the posterior part of the left auricle. The anterior vein on the right side is formed by the union of numerous branches from the anterior and middle lobes of the lung, of which branches the most posterior is the largest, and goes backward and inward dorsad to the right auricle and base of anterior vena cava, to the anterior right aspect of the left auricle.

The systemic arteries.—The *aortic arch* gives off two main trunks, the *brachiocephalic* and *left subclavian.* The brachiocephalic is very short and gives off close together, first the *left common carotid* and then the *right common carotid.* The remainder of the trunk continues outward and forward as the *right subclavian.* Where the latter leaves the thoracic cavity it gives off three principal trunks, the *internal mammary*, the *vertebral*, and the *thyroid axis.*

The internal mammary runs inward and backward along the dorsal side of the costal cartilages just external to the sternum.

The vertebral artery arises from the subclavian a little internal to the origin of the internal mammary. It runs forward and inward, entering the canal of the vertebral foramina at the sixth vertebra. It passes through the transverse foramen in the atlas, turns dorsally and runs along the groove between the transverse process and the anterior expansion bearing the facet for articulation with the condyloid process, and then goes through the foramen in the dorsal part of this to enter the cranial cavity by the foramen magnum. After leaving the transverse foramen of the atlas it gives off a branch backward to the muscles of the back of the head and to the deep muscles of the dorsolateral aspect of the neck. The two arteries run forward along the ventrolateral aspects of the medulla oblongata, but toward its anterior end they converge and unite. The single median trunk thus formed just back of the pons Varolii gives off a branch on each side to the cerebellum. The remainder goes forward to the infundibulum, where it breaks up into a number of branches, one on each side to the anterior surface of the cerebellum and the others to the thalamencephalon and prosencephalon.

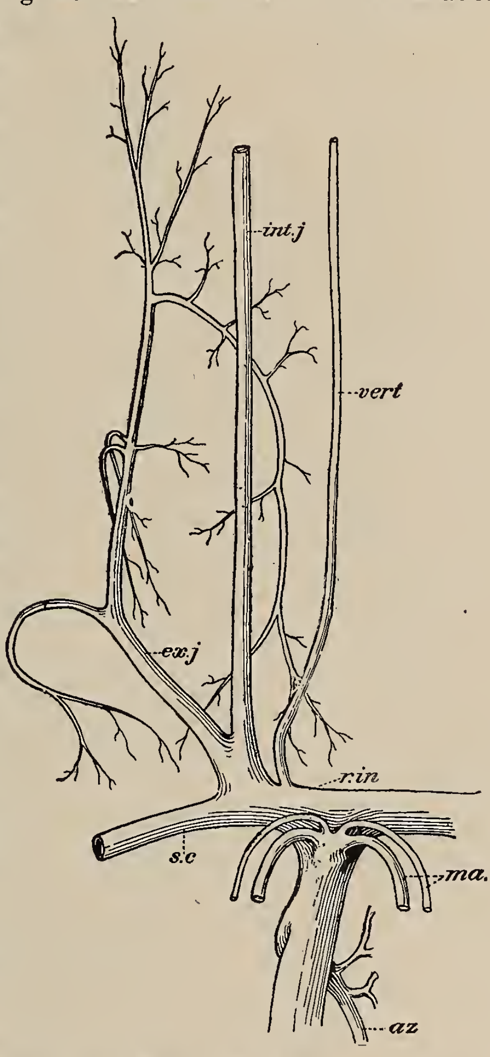


FIG. 4.—Right anterior venous system.
r. in. right innominate.
int.j. internal jugular.
ex.j. external jugular.
vert. vertebral vein.
az. azygos vein.
ma. internal mammary vein.

The thyroid axis is distributed to the muscles of the neck and shoulder. Its first branch is one given off outward, and curves over the anterior aspect of the shoulder, and then goes posteriorly to the muscles on the dorsal aspect of the same. In front of this a second branch is given off inwardly. This goes forward a short distance and then divides into two vessels, both of which curve over the anterior aspect of the shoulder to the superior muscles of the same. The main trunk turns dorsad and then backward, soon to divide into numerous small vessels to the deep muscles of the neck and shoulder.

Each common carotid at the base of the skull divides into an *external* and an *internal carotid*, the latter entering the cranium by the carotid canal.

The *abdominal aorta* gives off a *coeliac axis*, *upper* and *lower mesenteric*, *renal* and *genital vessels*, and then divides into an *external* and *internal iliac artery* on each side. In some cases the proximal ends of the internal iliacs form a short, common trunk. The external iliac gives off in the abdominal cavity an *epigastric artery*, which runs forward on the ventral wall of the abdomen, being distributed to the same, and then leaves the abdominal cavity and becomes the *femoral*. The internal iliac runs backward laterally into the pelvic cavity. It gives off an *allantoic vessel* a short distance back of its origin, which runs ventrally and forward along the side of the urinary bladder to the anterior end of the same, where the right and left vessels fuse with the urachis. They are hollow trunks in the adult and contain blood. Back of the head of the ilium the internal iliac artery gives off a small *sciatic* branch. Other branches are given off to the pelvic organs.

The systemic veins.—The *vena cava anterior* is formed by the union of the *right*

Fig. 5.—Veins of fore limb of pup, one-half natural size.

and *left innominate trunks.* These run transversely across the anterior part of the thoracic cavity, and hence with the vena cava anterior they make a T-shaped vessel. A short distance in front of the auricle the vena cava receives the *azygos vein*, which is joined near its termination by two smaller veins from the neighboring muscles. Just a little back of its anterior end it receives ventrally the *internal mammary vein.* This is formed by the union of four vessels, two large inner ones and two smaller outer ones. These run forward along the costal cartilages with the internal mammary artery between the two of each lateral pair. The common trunk formed by the union is very short.

Each innominate divides into three trunks, the *vertebral*, *common jugular*, and *subclavian*. The vertebral goes to the head through the vertebral canal. The common jugular is very short and is formed by the union of an *external* and *internal jugular*. The external lies laterally along the neck. It is formed at the base of the skull by the union of veins from the exterior of the head and lower jaw. A short distance back of its anterior end it is joined by a vein running forward from the dorsal aspect of the shoulder and neck. About half way down two smaller ones unite with it that come from the dorsal surface of the neck. Near its lower end, finally, a large branch curves over the anterior aspect of the shoulder from the dorsal surface of the same and unites with it just in front of the shoulder. The muscles of the neck and shoulder are hence abundantly supplied with both arteries and veins; the veins of this region emptying into the external jugular corresponding in size and numbers with the branches of the thyroid axis. The internal jugular is formed at the base of the skull by the union of numerous branches from the exterior and interior of the head. The most important of these are: Two veins curving around the posterior ends of the lower jaw from the muscles laterad of this and from the posterior lateral aspect of the head; a vein from the interior of the cranium which leaves the same by a small foramen in the anterior part of the ear capsule and which then goes backward and downward along the lesser cornu of the hyoid and receives a branch from the tongue; a vein from the base of the head and the soft palate, and the main trunk from the jugular foramen in the skull. The internal jugular is much larger than the external. It receives no important additions along the neck.

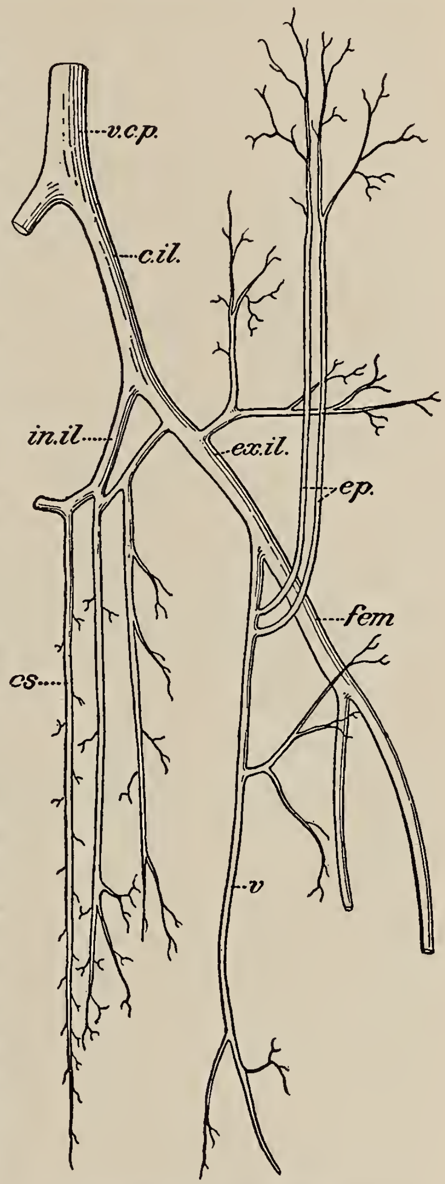


Fig. 6.—Posterior venous system of left side.
v. c. p. vena cava posterior.
c. il. common iliac vein.
ex. il. external iliac vein.
in. il. internal iliac vein.
fem. femoral vein.
v. vein from plantar surface of hind flipper.
c. s. median caudal and sacral vein.

The subclavian vein is formed by the union of numerous veins from the fore limb.

The *inferior vena cava* is formed at a variable point either between or back of the kidneys by the union of the converging *common iliac veins*. Each of these is formed farther back by the union of the *external* and *internal iliac veins.* The former is composed of the *femoral vein* from the hind limb, where it is formed by the union of numerous trunks, of which the *long saphenous* is the largest, and of another vein beginning on the plantar surface of the hind flipper and then running forward superficially along the inside of the tibia and across the upper end of the thigh into the abdominal cavity. Where the latter vein pierces the peritoneum it receives the two *epigastric veins* of the same side. These lie one on each side of the epigastric artery. The external iliac receives a vein from the dorsal wall of the abdominal cavity. The internal iliac is formed at the posterior end of the pelvic cavity by the union of veins in that region. It increases as it passes forward along the dorsal wall of the pelvis by receiving veins along its course. In the posterior part of the abdominal cavity the two internal iliacs are united by a transverse commissure, into which a small median caudal and sacral vein empties. Beyond this the internal iliac veins diverge and each unites with the corresponding external iliac. The external and internal iliac veins are connected also by a commissure, joining the latter just back of that between it and its fellow and the former a short distance back of its anterior end. A lateral vein from the pelvic organs empties into this commissure near its inner end.

The veins of the reproductive glands join the vena cava just back of the *renal veins.*

The portal vein.—The *portal vein* remains throughout life connected with the umbilicus by a hollow *vitelline vein*, and with the vena cava inferior just where this vessel pierces the diaphragm by a likewise hollow *ductus venosus.* Both of these unite with the portal vein between its two branches, going to the anterior right and left lobes of the liver.

THE REPRODUCTIVE ORGANS.

The male organs.—The *testis* is elongatedly oval, with the dorsal border a little concave. The *epididymis* begins at the anterior end, goes backward along the concave side, enlarging at the same time, and then at the posterior end of the testis turns forward on the inner side of the first part. It then again decreases in size and becomes the but slightly convoluted *vas deferens.*

The *scrotum* is very long, but is entirely shut off from the abdominal cavity. By means of the extremely elongated *cremaster muscles*, however, each pouch can be drawn up far under the skin and fat of the pelvic region of the body close to the ventral pelvic muscles. Each cremaster arises from the ventral surface of the vertebra, just back of the posterior border of the kidneys, and is inserted along the entire length of the corresponding scrotal sac.

The upper part of the *urethra* is enlarged and its walls are greatly thickened and glandular. The vasa deferentia unite into a common tube a short distance back of the neck of the bladder, which immediately enters the glandular part of the urethra and open within on a flabby papilla.

The *spermatic veins* join the vena cava just back of the renal vessels. Each is formed by numerous veins near the surface of the testis, which converge and unite at its anterior end. Except near the vena cava the spermatic veins are very much convoluted, and each is surrounded by an inner layer of spongy tissue and by an outer membranous sheath.

The *penis* is composed of two large *corpora cavernosa* having their distal halves ossified, and of a membranous *corpus spongiosum* and *glans.* The penis of a bull is from

10 to 11 inches long. The corpora cavernosa are united, the lines of their union being represented by a dense vertical plate. Between the two ventrally is a groove, the *sulcus urethralis*, the floor of which is formed by the membranous corpus spongiosum. The distal half of the penis is composed mostly of a *bone*, club-shaped proximally and expanded vertically at its distal end. Transverse sections of the penis show that this bone consists of the united and ossified terminal halves of the corpora cavernosa. The posterior end of the corpus spongiosum forms no differentiated glans, but covers the end of the bone simply as a thin membrane. The *urethra* enters the penis at about its middle, and opens to the exterior below the distal end. The penis is ordinarily bent into a V-shaped position, the angle being at the anterior end of the bone. The proximal unossified half projects backward and the distal half forward below the other.

The female organs.—Each *ovary* is shaped somewhat like a spherical wedge with the edge lying longitudinally and turned dorsally. It is also slightly notched so that the ovary is kidney-shaped in dorso-ventral profile. It is connected with the *ligamentum latum* at the notch and near it on the inner surface with the anterior inner aspect of the horn of the *uterus* on the same side, the exterior of the latter being directly continuous with the ligamentum latum in front. Each ovary is inclosed in a recurved fold of the suspending ligament forming a pouch almost closed, a small opening being left on the inner side near the dorsal edge. The *vagina* is wide and expands anteriorly. Below the widened part it receives the *urethra* on its ventral surface. The *uterus* is double; the two *horns* diverge in front, but their approximated posterior ends are coalesced for some distance. The distal end of each horn is rounded and lies close to the ovary of the same side. The very much convoluted Fallopian tube enters very near the extremity on the anterior dorsal aspect. It runs forward to the anterior end of the ovary, going ventral to it, and then runs backward again on the inner side to near the posterior end. Here it opens on the inside of the ovarian sac by a slightly enlarged mouth with plicated edges. The ovaries are supplied with blood by vessels from the inferior vena cava and the abdominal aorta. The vagina and uterus receive their blood from branches of the pelvic vessels.

Fig. 7.—Testis and spermatic vein of young male, natural size.

About 2 inches forward from the posterior opening of the vagina its inner walls present a large backward-projecting fold. The free margin of this fold is very irregular and above and below it is extended in two wide conical flaps. The free end of the lower one is slit transversely and this fissure forms the vaginal opening of the urethra. This fold separates a lower *vestibular* region of the vagina from the vagina proper. The *clitoris* lies along the floor of the former. About half way forward to the point of divergence of the uterine horns is a second internal fold in the walls of the vagina. The dorsal part of this fold forms a thick pad-like thickening on the vaginal wall. The free border is elsewhere produced into papillæ. The lumen above this fold is much smaller than below and is soon divided by a vertical partition. This marks the beginning of the horns of the uterus, and the free lower end of the septum

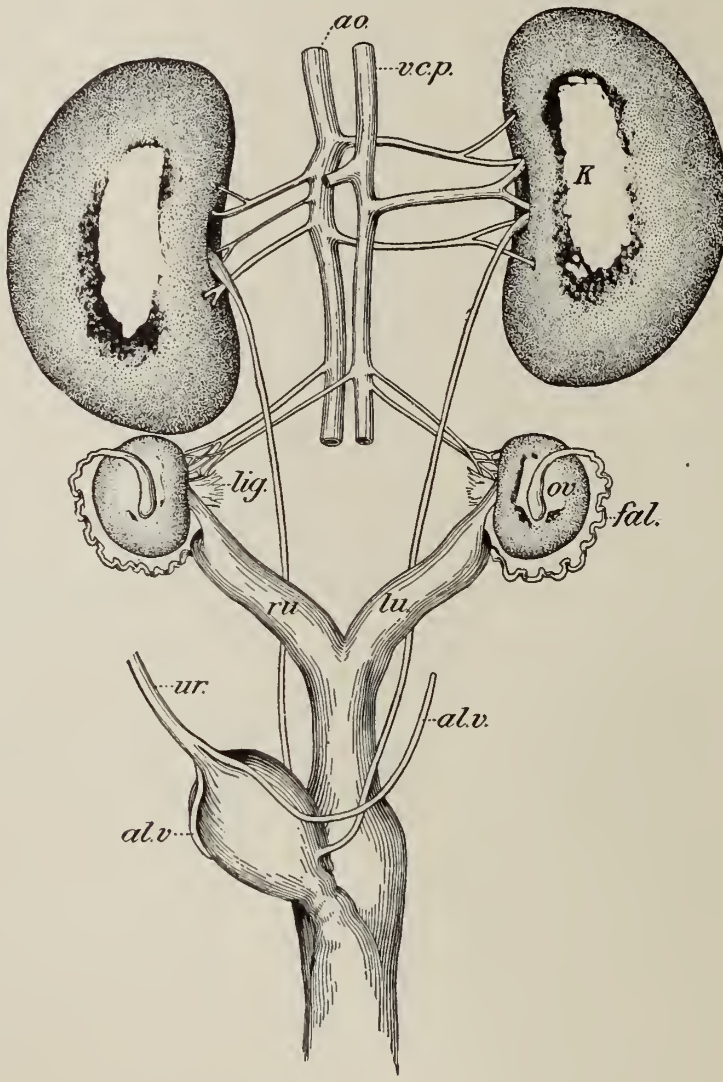


FIG. 8.—Urogenital organs of female, reduced.
ao. Dorsal aorta.
v. c. p. Posterior vena cava.
al. v. Allantoic veins.
ur. Urachis, the ovarian capsule of the ligamentum latum is round.
lig. Ligament attaching ovary to ligamentum latum.
K. Kidney.
ov. Ovary.
fal. Fallopian tube.

is terminated by a small papilla-like valve that may close either opening. In the nongravid uterus the lumina in the fused parts are considerably narrower than in the divergent parts of the horns.

The *mammary glands* are two in number. Each is long and triangular, reaching from the fore limb to the posterior end of the body. The two are divergent in front, but posteriorly are closely approximated but not united. Each is provided with two very small abdominal *teats.* In a very old cow the mammary glands become absorbed and mostly replaced by fat.

THE URINARY ORGANS.

The *kidneys* are oval, with the inner border slightly concave, and are a little flattened dorso-ventrally. In a bull they are about 4.75 inches long. The *hilus* is small. The *pelvis* of each divides ultimately into a large number of small tubules, ending each in a *calyx.* The *papillæ* opening into these calices have no regular arrangement, since they are turned in all directions either toward or away from the hilus. The *urinary bladder* is small, about 2.5 inches in a bull, and is pear-shaped. The *urachis* is large and remains so throughout life.

THE BRAIN OF THE FUR SEAL, CALLORHINUS URSINUS;

WITH A COMPARATIVE DESCRIPTION OF THOSE OF ZALOPHUS CALIFORNIANUS, PHOCA VITULINA, URSUS AMERICANUS, AND MONACHUS TROPICALIS.

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INTRODUCTION.

The specimen was from a young male pup 25 inches in length, weighing about 12 pounds. The brain was still incased in the dura, and on the basal surface portions of the cranial bones were left adherent to this membrane. An occasional cut through the dura caused a protrusion or hernia of the cerebral substance.

The weight of the brain in the fresh condition, as reported by Mr. Lucas, was 10 ounces and 240 grains. This included the dura with the attached cranial fragments.

The specimen was preserved in a "rather strong solution of formalin," and, except for some swelling of the tissue and softening of the interior, was in a very good condition. The bloating was indicated by the increased weight, which, immediately after the receipt of the specimen, December 12, was found to be 13 ounces, a gain of about 3 ounces; the closure of the fissures and the cerebral hernias. The weight without dura and attached fragments of cranial bones after preservation from September 1 to December 12 was 9½ ounces and 80 grains (avoirdupois). The lateral girth was 26 centimeters. The longitudinal girth with the oblongata cut off at an even level with the caudal surface of the cerebellum was 24 centimeters, being slightly less than the former. This may, perhaps, be accounted for to some extent by the tape resting slightly in the intercerebral cleft, and to the bloating, as this would affect the lateral rather than the longitudinal circumference.

The brain, as indicated by the girth measurements, was of a subglobular form, slightly tapering at the ends, and its outer substance, though firm, was not unyielding. Twenty-four hours' immersion in 95 per cent alcohol served to contract the nervous tissue sufficiently to open the fissures, and yet to retain enough flexibility of their walls to permit of an easy examination of their depths. In order to obtain the desired results, after photographing the dorsal and ventral surfaces of the entire brain it was cut across and the crura cerebri or mesencephalon and the cerebellum and oblongata separated. The cerebrum was then divided by a section along the median line, separating it as nearly as possible into two equal halves.

REMOVAL OF DURA.

The falx showed an interesting development; its frontal portion, especially in the region of the olfactory bulbs, being of considerable depth, then becoming very shallow along the middle of the length of the cerebrum and becoming very deep again in the intercerebral cleft in the caudal region of the cerebrum. A distinct longitudinal venous sinus as in the human brain is not present; but in place of it is a vein of some size lying to the right of the intercerebral cleft and receiving the contents of the dorsal cerebral veins. In connection with the weak development of the falx along the middle of its length, there was noticed an interdigitation of the gyres of the mesal surface of the hemicerebrums in this region. This intimate overlapping of the gyres on the mesal surfaces of the two hemicerebrums is possibly correlated with the deficiency of growth of the falx here, and may serve in a measure to increase the firmness of the union of this region and prevent any undue strain upon the callosum, which lies some little distance from the dorsal surface of the cerebrum.

This interdigitation of the mesal gyres is also present in the sheep, where the falx is also deficiently developed. If the hemicerebrums be divided with a sharp knife without first separating the pial adhesion of the gyres, the gyres will be cut. An artifact of this nature has, indeed, been mistaken by one writer, in an article on *Phoca*, for the cut surface of a bundle of fibers dorsal to and larger than the callosum, and designated by him as the commissura suprema.

The tentorium in *Callorhinus* is very strongly developed, apparently extending the whole depth of the transverse archlike cleft between the cerebrum and cerebellum. The tough, fibrous tissue of the tentorium is, moreover, very noticeably reenforced by the presence of osseous tissue. Where the falx joins the tentorium there is an extension of this osseous tissue in a vertical direction into the falx—a circumstance which certainly is not common in the majority of other animals, but has been noted by Turner in *Macrorhinus*.

TERMINOLOGY.

With the existing uncertainty relating to the homology of the fissures of the brains of the carnivora and that of the human species, much confusion has resulted in the present nomenclatare. Some have made a direct homology, others have proposed a fissural type solely and only for the lower forms, while still others have blended the two, and some have utilized a system of names devised by themselves. On the lateral surface of the various fissured brain types there is at least one fissure—the Sylvian—which is quite constantly present and on the mesal surface the hippocampal fissure.

In the matter of nomenclature no attempt has been made to follow the law of priority; but those fissural names, whether of old or recent date, which seemed most appropriate concerning position and relation have been adopted, and, with perhaps but one or two exceptions, no new names have been introduced. It has been the purpose to use an intrinsic terminology and to substitute for the sometimes indefinite terms, "anterior," "posterior," "superior," and "inferior," terms of more universal applicability—"cephalic," "caudal," "dorsal," and "ventral." For "cephalic" and "caudal" Professor Wilder has recently suggested "praeal" and "postal" as equivalents; and for "cephalad" and "caudad," "praead," and "postad."

Where certain of the fissures or gyres have been submerged for a portion or the whole of their course, they have been designated as such, or the equivalent terms, "subfissure" or "subgyre," proposed by Wilder, have been used.

In the study of the fissures mere surface appearances are not accepted as final. A fissural entity is not always easy to define. The best apparent guide is the relative depth throughout the course of the fissure. We may commonly assume that the greatest depth is at about the middle of its length, and that it becomes gradually shallow toward each end until it reaches the surface. Such a simple condition, however, does not usually exist. One fissure may join the end of another, giving the appearance at the surface of a long, continuous fissure. By separating its walls or "sounding" its depth the true state of affairs is easily perceived. The presence of a shallow, whether it be near or at a distance from the end of a fissure, would seem to indicate that at some time during development this shallow has been or will be represented at the surface and serve to separate two independent fissures.

CALLORHINUS URSINUS.

Cranial nerves.—The cranial nerve roots of *Callorhinus* are well developed and need no special comment. In the case of the optic nerves we do not find the X-shaped chiasma, as in *Phoca*, but the nerves run parallel to each other for a short distance from the chiasma before diverging toward the eyes.

The third pair or oculomotor nerves have a straight lateral direction from their apparent origins, but at the lateral border of the hypophysis they bend abruptly upon themselves and proceed cephalad, forming a very distinct right angle.

The olfactory lobes are fairly well developed.

Fissures.—No special mention will be made of the gyres (convolutions). These are naturally formed from the involutions of the fissures, and it is believed that a careful description of these furrows will by implication include that of the gyres sufficiently for our present purpose.

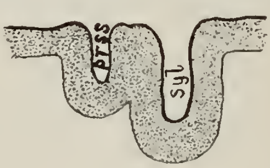
The olfactory fissure is completely hidden by the olfactory crus and bulb; when these are removed a shallow fissure is apparent, which becomes deeper toward the base of the lobe.

Forming the lateral boundary of the olfactory lobe is the rhinal fissure, which passes in a caudo-lateral direction to the Sylvian. An apparent continuation of the rhinal from the Sylvian is known as the postrhinal fissure. It extends in a meso-caudal direction for a centimeter and a half, stopping just short of the cleft between the cerebrum and cerebellum. A careful examination of the postrhinal shows that it has no connection whatever with the rhinal, but is continuous, superficially at least, with the subfissure (postica) lying in the caudal wall of the Sylvian. This condition also obtains in the adult specimen examined.

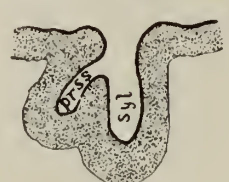
LATERAL ASPECT.

The Sylvian is a convenient fissure to begin with. There is usually some evidence of it if the brain is at all fissured, and, in the lower animals at least, it forms a center around which the other fissures are more or less regularly arranged. In *Callorhinus* the Sylvian extends in a dorso-caudal direction, inclining somewhat toward the vertical. Apparently it terminates in a fork, but when the walls of the fissure are divaricated it is seen that the cephalic or anterior branch is really another fissure, which, after its superficial union with the Sylvian, becomes a submerged fissure lying just beneath the surface in its cephalic wall and running parallel with it to the base of the brain, but not actually connecting either with the Sylvian or with the rhinal. The Sylvian, on account of the subfissural complication, appears to be a larger fissure than it really is.

In a former paper[1] attention was called to the fact that this vertical fissure (superficial vertical branch of the Sylvian) had been mistaken for the true Sylvian. Both fissures are well marked and can not be ignored; but it is an unusual circumstance for the Sylvian to assume a strictly vertical position in the adult, and there would, moreover, remain a fissure in the usual situation of the Sylvian unaccounted for. In my former paper I designated this vertical fissure as the anterior of the *Felidæ*, and found at a later date, while consulting Krueg's article,[2] that he questioningly represents a similar fissure by the same name in *Phoca vitulina*. *Callorhinus*, while showing this fissure similarly situated, instead of elucidating the complications seems rather to add to them and to suggest a probable doubt as to the correctness of the homology with the anterior fissure. Indeed, the conditions are strongly suggestive of its being nothing more than the frontal portion of the supersylvian fissure. An examination of the brains of certain bears tends to illuminate this view. In the family *Ursidæ*, as in the *Canidæ*, the supersylvian forms a complete arch, the caudal portion being known as the posterior supersylvian (Krueg), or postsylvian (Owen). The frontal portion of this arch varies in its distance from the Sylvian. Occasionally the frontal and caudal portions are about equally distant, but when there is any difference in this distance it appears that the frontal portion approaches more closely to the Sylvian than does the caudal. In *Ursus arctos*, or the brown bear, Krueg figures the frontal portion of the supersylvian as approximating very closely to the Sylvian. The condition in *Callorhinus* might be considered as a stage just beyond this. In the brown bear the frontal portion of the supersylvian is still visible upon the lateral surface close to the Sylvian. In the case of the seal it has passed over the brink, so to speak, and is no longer visible its entire length on the lateral surface. The following diagrams will illustrate the conditions more clearly:



Bear.



Seal.

A diagrammatic representation of the relation of the Sylvian and supersylvian fissures in the bear and seal, as if seen in section. Prss., presupersylvian; Syl., Sylvian fissure.

At the bottom of the Sylvian fissure lies the insula, presenting but a slight degree of development. There is a suggestion of a circuminsular fissure, but in other respects

[1] 1896, P. A. Fish: A note on the Cerebral Fissuration of the Seal (*Phoca vitulina*). Jour. Comp. Neurol., VI, 15–19.

[2] 1880, J. Krueg: Ueber die Furchen auf der Grosshirnrinde der zonoplacentalen Säugethiere. Zeit. f. wiss. Zoologie, XXXIII, 595–672, 5 plates.

the surface is entirely smooth. In the caudal wall of the Sylvian is a well-marked subfissure. It separates a portion of the concealed cortex, forming a subgyre, which from its size and position might be easily mistaken for the insula. The appearances would suggest that the subfissure is the postica and the subgyre a remnant of the Sylvian gyre.

The *supersylvian* fissure shows some variation on the two sides. It presents the usual arrangement on the right hemicerebrum, forming, superficially at least, a complete arch around the Sylvian. The presence of a shallow and a slight bifurcation near the level of the free end of the Sylvian indicates the separation of a postsupersylvian fissure—postsylvian of other writers. (Pl. I., fig. 4.) The supersylvian curves around the free end of the Sylvian at rather a sharp angle and soon apparently enters the Sylvian, but in reality is submerged in its cephalic wall. A very short cephalic branch is given off toward the ansate fissure before the supersylvian enters the Sylvian. On the left hemicerebrum there are three distinct portions; the postsupersylvian has a slightly more oblique dorso-caudal course, the supersylvian proper is quite branching and more inclined to a vertical than horizontal course. One of its branches appears to enter the Sylvian from behind, but a shallow shuts off any deep connection. The frontal portion appears as a surface fissure for only one-third of its course, then, as on the other side, it becomes submerged in the Sylvian. As this portion bears much the same relation to the supersylvian as the postsupersylvian whether they be disconnected or not, the frontal portion will be designated as the presupersylvian fissure. In a second specimen of the brain of an adult *Callorhinus*, kindly loaned me by Mr. True, the executive curator of the United States National Museum, both hemicerebrums showed a distinct separation of the postsupersylvian, more pronounced than on the right hemicerebrum of the pup; but there was no separation nor distinct appearance of a shallow indicating an independent presupersylvian as in the left hemicerebrum of the pup. In the adult, as in the pup, each supersylvian gave off a short cephalic branch before entering the Sylvian.

The *lateral fissure*, on account of the breadth of the brain, does not show in its entirety upon the lateral aspect. It is 12 centimeters long, by far the longest fissure, and is seen for a short portion of its course upon the ventral aspect, extending, on the left hemicerebrum, to within 5 millimeters of the ventral portion of the postsupersylvian. It lies in this region just in advance of the margin of the cleft between the cerebrum and cerebellum. It then arches caudo-dorsally approximately parallel with the hemicerebral margin, but receding from it until it fully reaches the dorsal surface, then approaching to within 8 or 9 millimeters of the intercerebral cleft, it continues its arched course in a cephalo-ventral direction, approaching to within 5 millimeters of the presupersylvian fissure at about the level where the latter becomes submerged into the sylvian.

The lateral is a deep fissure, and no distinct evidence of shallows could be detected along its course, although in certain places the presence of submerged buttresses interfered to some extent with the soundings, the average depth being from 10 to 13 millimeters. The cephalic extremity of the fissure terminates in a fork, more marked upon the left hemicerebrum than on the right. Does this widely forked terminus represent the ansate fissure? It has the same appearance and relation to the lateral as seen in the cat, and, provisionally, it is here so designated.

The gyre, bounded by the lateral and supersylvian fissures and their parts, is indented by numerous branches originating from the above-named fissures. There are also occasionally independent minor fissures present in this gyre.

The ectolateral fissure.—The ectolateral on the right hemicerebrum is a distinct fissure. It is present on the ventral surface near the termination of the postrhinal. It then proceeds dorso-caudally, parallel with the postsupersylvian and for about the same distance. On the left side it is a shorter fissure and superficially is continuous with the dorsal portion of the postsupersylvian, but a shallow separates a deeper connection. In the adult *Callorhinus* the fissure is as on the right hemicerebrum of the pup.

The *coronal fissure* is about 3 centimeters in length and extends, except for a slight caudal convexity, in an almost vertical (dorso-caudal) direction. Its greatest depth is 8 millimeters. On the left hemicerebrum it gives off a slight spur, pointing toward the Sylvian. In *Callorhinus* it represents, perhaps, the least complicated fissure in the brain.

The *cruciate fissure* is not at all represented upon the mesal surface of the brain. It is seen best from a dorsal view. It arises at the margin of the intercerebral cleft. It arches in an obliquely cephalo-lateral direction. From the cephalic extremity of the cruciate, at a depth of 15 millimeters, there passes off another fissure, which Krueg has represented as the precruciate in certain carnivora, nearly to the mesal margin, just dorsal to the olfactory bulb. The depth of these fissures at their junction is from 12 to 15 millimeters. Between these fissures and the intercerebral cleft there is a triangular-shaped area, to which Mivart has applied the name of "ursine lozenge" (Turner), thought by Mivart to be of considerable significance. Just caudal to the cruciate fissure is a small fissure corresponding to the postcruciate of Krueg. On the left hemicerebrum it is triradiate; on the right it is straight.

The *superorbital fissure* has no connection with the rhinal. Its length is 25 millimeters and its depth 8 to 10 millimeters. It has a slight lateral convexity, but has no branches.

The medilateral fissure.—The name of this fissure is particularly appropriate in *Callorhinus.* Not only is it on the mesal side of the lateral, but for a portion of its course is actually on the mesal aspect of the brain. It curves around the caudal margin of the hemicerebrum just on the verge of the margin. Between the lateral and medilateral fissures there is a gyre averaging about 15 millimeters in width, in which there are two or three secondary fissures, which would seem to indicate an attempt at the division of this gyre into two.

MESAL ASPECT.

The *callosal fissure* presents no marked peculiarity except upon the left hemicerebrum, where, instead of continuing around the genu of the callosum, it proceeds toward the dorsal margin, or is continuous, with a fissure coming from this margin. On neither hemicerebrum is there any appearance of a fissure immediately surrounding the genu. The hippocampal fissure occupies its usual position, arching from the splenium around the optic thalamus to the lip of the pyriform or temporal lobe.

The splenial fissure.—On the right hemicerebrum this fissure, if prolonged upon the dorsal aspect, would be continuous with the cruciate. It is separated by a gyre 4 millimeters in width. The fissure passes ventro-caudally and a little beyond the splenium on the ventral aspect, and it apparently terminates in a wide fork or else enters a fissure passing at right angles to its own course. Sounding the fissure at this point gives some indication of a shallow separating the dorsal branch of the fork. Following the appearances designated by Krueg in his diagrams of the conditions found in some of the carnivora, the splenial proper includes the ventral branch of the fork, while the dorsal branch may represent what he calls the postsplenial. On the left hemicerebrum the splenial fissure penetrates the hemicerebral margin and appears for a short distance on the dorsal surface. A smaller but well-defined fissure lies in front of the splenial. On the left side it cuts the dorsal margin. For the present we may designate it as the presplenial fissure. It corresponds very well with the fissure which Kükenthal has called fissura sublimica anterior.

The *marginal* or supersplenial just passes the meso-ventral margin of the hemicerebrum about 10 millimeters caudad of the splenial. It extends approximately parallel with it to the dorsal margin, which it cuts, and on the right hemicerebrum extends on the dorsal surface for about 15 millimeters. On the left hemicerebrum the fissure branches just at the margin. The main portion, however, continues latero-cephalad for about 20 millimeters. In the gyre between the splenial and marginal fissures a well-represented secondary fissure is seen.

A well-defined but unnamed fissure lies on the meso-ventral surface. It arises at the caudal margin and proceeds in an angular course toward the ventral end of the splenial; it then swerves latero-cephalad and terminates not far from the postrhinal. Its position corresponds approximately to the collateral fissure in the human brain. This tentorial surface of the cerebrum has numerous secondary fissures and branchings, some of which seem large enough to merit special mention. One such inconstant fissure, lying parallel with the postsplenial, suggests a similarity to the occipital. It cuts the hemicerebral margin slightly, and the relation of the lateral fissure at this point suggests in a way the paroccipital of man. This occurs on the left hemicerebrum. On the right the postsplenial has much the same appearance.

At the cephalic end of the mesal surface beyond the genu of the callosum there are two pretty well marked fissures. The one nearest the callosum corresponds to the genualis of Krueg; part of falcial, Owen; or falcial, Wilder. On each hemicerebrum this fissure cuts the dorsal margin slightly. The other and more slightly developed fissure lies nearer to the olfactory bulb. It does not reach the dorsal margin, but extends farther in the ventral direction. This fissure corresponds to the rostralis of Krueg; part of falcial, Owen; or subfalcial, Wilder.

PHOCA VITULINA.

The frontal portion of the cerebrum is more foreshortened than in *Callorhinus*, and there is therefore a slightly different arrangement of corresponding fissures in that region. One of the most striking differences is the olfactory portion of the brain. In *Callorhinus* it is the larger, the olfactory bulb is of considerable size, the crus is correspondingly wide and lies flush with the mesal surface. In *Phoca* the bulb is relatively smaller and the crus has atrophied to scarcely more than a pedicle; it lies deeply imbedded in the olfactory fissure; it is removed 6 to 8 millimeters from the mesal surface by a portion of the cortex which projects fully 5 millimeters beyond the crus.

The precribrum (anterior perforated space) is well developed and shows with greater distinctness than in *Callorhinus*.

The rhinal fissure is apparently continuous with the Sylvian, but upon raising the overlapping portion of the frontal lobe it is seen to maintain its continuity and to appear again caudal to the Sylvian as a true postrhinal, differentiating a larger pyriform lobe than in the case of *Callorhinus*. There is no connection between the postrhinal and the subfissure in the caudal wall of the Sylvian as in *Callorhinus*.

LATERAL ASPECT.

The *Sylvian fissure* pursues a much more obliquely dorso-caudal course than in *Callorhinus* and presents the same amount of complexity with relation to the surrounding fissures. In its caudal wall lies a subfissure (postica?) and the intervening Sylvian gyre. Both are relatively better developed than in *Callorhinus*. The supersylvian has much the same relation to the Sylvian as in *Callorhinus*. It is not distinctly separated from the postsupersylvian, although the interlocking of some of the subgyral buttresses suggests the possibility of an attempt at separation. On each hemicerebrum there is a continuation of the postsupersylvian dorso-caudad beyond the supersylvian.

The frontal end of the supersylvian apparently forks, one branch bending toward the Sylvian, the other continuing cephalad. The ventral branch has a superficial union with the vertical fissure which has been mistaken for the Sylvian. In my former paper[1] I designated this fissure as the anterior. Krueg also had taken the same view.

FIG. 3.

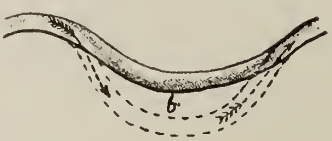


FIG. 4.

FIG. 3. A cross section of a fissure showing the obliquity of its walls.

FIG. 4. A diagram to show the difference in the course of a fissure at its surface and depth. The heavy lines represent the fissural walls at the surface. The dotted-lines and arrow represent the buttress (b) bounded by the deep course of the fissure.

From the conditions already described in *Callorhinus*, it seems to me that this fissure is, after all, a disconnected portion of the supersylvian and that presupersylvian would in some ways be a suitable name for it. It is submerged in the cephalic wall of the Sylvian for the ventral third of its course. In *Callorhinus* the ventral two-thirds of the corresponding fissure becomes submerged.

The *lateral fissure*, as in the case of *Callorhinus*, is the longest fissure in the brain. In *Phoca*, however, it is confined entirely to the dorsal aspect of the cerebrum, and at its caudal end it appears to terminate in a widely diverging fork or perhaps a small transverse fissure, possibly corresponding to the lunate (Wilder) of the cat. Its course is approximately parallel with the intercerebral cleft and is somewhat tortuous. At its cephalic end it appears to communicate with the cephalic branch of the supersylvian. This appearance will be discussed more fully under the description of the ansate fissure.

The *ectolateral fissure* occupies a relatively higher or more dorsal and caudal position than in *Callorhinus*. It is of a more secondary character and courses approximately parallel with the postsupersylvian.

[1] Loc cit.

The *cruciate*, unlike that of *Callorhinus*, is represented upon both the mesal and dorsal aspects. On the left hemicerebrum a shallow is present in the dorsal portion not far from the margin. No distinct "ursine lozenge" is present here as in *Callorhinus.* The foreshortened condition of this region may have something to do with its absence.

A well-defined *postcruciate fissure* is present on the left side. It presents a zygal (Wilder) or quadriradiate form. A slight secondary fissure near the olfactory bulb may represent a rudimentary precruciate fissure.

The *superorbital fissure* shows a better development than in *Callorhinus* and, similarly, has no connection with the rhinal. But the opposite end, dissimilarly, extends farther and is overlapped by the olfactory bulb.

The *medilateral* is not present in *Phoca* as a distinct fissure. Its location is occupied by a series of short, disconnected fissures.

The *coronal fissure* is a relatively longer fissure than in *Callorhinus*, but is not so entirely disconnected from adjacent fissures. Its dorsal end lies caudal to the cruciate. On the left hemicerebrum it is separated by a shallow from an apparant connection with a continuation of the cephalic branch of the supersylvian. On the right hemicerebrum the shallow is suggested by the interlocking at this point of two submerged buttresses.

The *ansate fissure*, while not distinctly represented as an independent fissure, would, it seems to me, be indicated by the fissure extending from the coronal to the cephalic branch of the supersylvian, where, on each hemicerebrum, the interlocking of submerged buttresses would again suggest a shallow shutting it off from the branch of the supersylvian, and then continuing to the lateral fissure, where a slight spur pointing toward the intercerebral might indicate its separation from the lateral. Owen in his figure of the hemicerebrum of *Phoca* represents a corresponding fissure as the coronal.

MESAL ASPECT.

There is a slight appearance of the *callosal fissure* in the splenial half of the callosum, but none at all for the remaining half.

The *hippocampal fissure* is well developed and needs no special comment.

The *splenial fissure* is well developed and in general is as described for *Callorhinus*, except that its position is farther removed from the frontal portion of the cerebrum and that its cephalic end cuts the margin and is shown upon the dorsal surface. The postsplenial has about the same relations as in *Callorhinus.*

The *sublimica fissura* of Kükenthal[1] is poorly represented in my specimen of *Phoca*, and is somewhat confused with smaller branches and secondary fissures. It lies between the splenial and the callosum. Kükenthal finds this fissure also present in *Phoca grœnlandica*, *Phoca barbata*, *Macrorhinus leoninus*, and *Otaria jubata.* In *Callorhinus* there was no appearance of this fissure whatever. The fissura sublimica anterior of the same author is more clearly represented. In my former paper, on account of its position dorsal to the callosum, I designated it questioningly as the supercallosal. On the left hemicerebrum it is well developed and connects with the cruciate. On the right side, however, the fissure is independent and much smaller. In addition to this fissure, on each hemicerebrum, there is another dorsal to it and in front of the splenial. In *Callorhinus* I have called it the presplenial.

[1] Untersuchungen an Walthieren, 1889.

The *marginal* or *supersplenial* is well shown in *Phoca* as in *Callorhinus*, but lies nearer to the dorso-caudal margin, approximately parallel with the splenial. In the intervening gyre there are a few secondary fissures.

On the meso-ventral surface a fissure corresponding to the collateral is also present, but, unlike *Callorhinus*, it has connection with the postrhinal. Between the collateral and the postsplenial there is another well-marked but unnamed fissure which is parallel to the former. It corresponds, perhaps, to the fissure in *Callorhinus* which I have spoken of tentatively in connection with the occipital.

The *genualis* and *rostralis* are represented, but the latter differs from that in *Callorhinus* in being much less developed and occupying a more ventral position at a more or less acute angle to the genualis.

URSUS AMERICANUS.

This brain, while fairly well preserved, had been considerably mutilated in removal, so that for purposes of illustration and reference, a specimen from *Ursus thibetianus*, kindly loaned by Prof. B. G. Wilder, was utilized; so that while the figures of the lateral and mesal aspects are from the latter specimen, the description is based almost entirely upon the former. The general arrangement of the fissures is similar, and the minor details need not cause misapprehension. The fissural plan of the brain is much like that of the canine, minus the first circumsylvian arch.

The olfactory bulbs and crura are far superior in size to those of either of the seals. The olfactory fissure is likewise well marked.

The rhinal fissure passes into the Sylvian and continues, after forming an angle delimiting a well-developed pyriform lobe, as the postrhinal, and ending freely.

The subfissure (postica?) in the caudal wall of the Sylvian extends to and on one side actually appeared to communicate with the postrhinal.

LATERAL ASPECT.

The *Sylvian* is directed in the usual dorso-caudal direction at the bottom of which is a small and simple area representing the insula. There is no appearance of a transinsular fissure, although the presence of a subgyre and subfissure (postica?) in the caudal wall of the Sylvian might superficially indicate it.

The *supersylvian fissure* forms a complete arch around the Sylvian. There is no indication of a separation of a post supersylvian except near the free end of the Sylvian, where a branch from the supersylvian extends into the adjacent gyre.

The *lateral fissure* forms a curve approximately parallel with the supersylvian. As compared with *Phoca* and *Callorhinus* it is much shorter. If the conception of the ectolateral is correct, the latter is continuous caudally with the lateral, a slight spur indicating the place of probable separation. The ectolateral extends parallel with the postsupersylvian, but its ventral end does not reach so far in *Ursus americanus*, while in the Thibet bear the reverse is the case.

The *ansate fissure* is a cephalo-ventral continuation of the lateral, a small spur of the latter indicating a point of separation. The ansate describes a curve, the convexity pointing toward the Sylvian.

The *coronal fissure* continues from the ansate and ends freely near the superorbital. The convexity of its curve like that of the ansate points toward the Sylvian. The point of its separation from the ansate is indicated by a spur more marked than that between the ansate and the lateral.

The *supcrorbital*, unlike *Phoca* and *Callorhinus*, has a very distinct connection with the rhinal fissure at about half of the distance from the Sylvian fissure to the olfactory bulb. It curves cephalo-dorsad with its convexity pointing cephalad.

The *cruciate* fissure is more highly developed than in either of the seals. It appears slightly upon the mesal aspect and on the dorsal surface extends obliquely cephalo-laterad. Around its free end the coronal fissure demarcates a well-formed sigmoid gyre. The appearances found in *Phoca* approximate the conditions regarding the gyre more than in *Callorhinus*.

Between the cruciate and ansate lies the postcruciate fissure. On the left hemicerebrum it is well marked; on the right it is smaller and superficially connected with a minor fissure.

On the right hemicerebrum a branch is given off from the cruciate extending cephalo-mesad. It is the precruciate fissure. On the left hemicerebrum it is an independent fissure. In neither case does it reach the mesal surface. The precruciate with the cruciate forms a well-defined triangular area—the "ursine lozenge" of Mivart. On the dorsal surface between the lateral fissure and the intercerebral cleft it is well marked, but is not as deep as the other fissures. It is the confinis. On the right hemicerebrum a short fissure connects it with the lateral.

The *medilateral fissure* arises at the caudal end of the cerebrum near the mesal margin, in much the same position as in *Callorhinus*, and continues down the ventral aspect close to the caudal margin.

MESAL ASPECT.

The *splenial fissure* does not reach the dorsal margin as in the case of *Phoca* and as on one side in *Callorhinus*. Its cephalic end is also nearer the caudal end of the cerebrum than in either of the other two forms. In this respect the fissure occupies an intermediate position in *Phoca*. It arches around the splenium of the callosum and courses along the tentorial surface of the cerebrum as far as the caudo-lateral margin, ending eight millimeters from the free end of the postsupersylvian. Two or three short branches are given off along its course. Beyond the presence of a slight spur, there is no evidence of a postsplenial fissure, nor of a supersplenial or marginal, as in the case of the seals. A well-developed presplenial or fissura sublimica anterior ot Kükenthal is present, resembling that of *Phoca* more than *Callorhinus*. No distinct fissura sublimica was present, except in the case of the Thibet bear, where a small minor fissure held the proper position.

The *genual* and *rostral fissures* were present, and occupied the same general relations to the cephalic end of the callosum as in *Callorhinus*. The callosal and *hippocampal fissures* have the same general relations as in other forms.

ZALOPHUS CALIFORNIANUS.

Through the kind permission of Professor Wilder I was permitted to remove the brain from this young sea lion. Its mother came originally from the Pacific coast, and the present specimen was found dead in the cage with her while in transit to the East, and was presumably not far from "term." It measured 43 centimeters long, and has been in the Cornell Museum of Vertebrate Zoology for some years.

The brain was in a fairly good state of preservation, and was photographed soon after its removal. It was too delicate to permit of much manipulation, and some of the fissures were not sounded as thoroughly as in the other specimens. The cerebrum of this specimen does not show the same degree of complexity relative to the fissuration as indicated by Murie[1] in *Otaria jubata.* A direct comparison of the fissures, however, is not easy, as the latter author attempts to homologise them with those of the human cerebrum.

The olfactory apparatus is well developed. Not as largely as in the bear, however, but greater than in either of the seals. The rhinal fissure, as in the other forms, is well marked, and passes caudad into the mouth of the Sylvian fissure. The postrhinal is formed from the subfissure (postica?) and has no connection whatever with either the rhinal or Sylvian.

LATERAL ASPECT.

The *Sylvian* is prominent and occupies its usual position. In its caudal wall is a subfissure (postica?) and subgyre, which, as in *Callorhinus*, is continuous on the ventral aspect with the pyriform or temporal lobe.

The *supersylvian*, with its cephalic and caudal portions, the pre- and postsupersylvian, is more nearly in accord with the conditions found in the bear than in either of the seals. It represents an intermediate condition between the two. The presupersylvian lies very close to the Sylvian, but does not actually enter it, as in the seals. Its average distance from it is about 4 millimeters, while the distance from the Sylvian to the postsupersylvian is four times as great, or 16 millimeters. There is no sign of disconnection between either the supersylvian and the postsupersylvian, or the supersylvian and the presupersylvian. The supersylvian forks or sends out a branch cephalad connecting with the ansate fissure exactly as in *Phoca.*

The *lateral fissure* is, relatively to the length of the cerebrum, shorter than in any of the other forms. Its cephalic end and its relation to the ansate is again exactly the same as in *Phoca.* On the left hemicerebrum the lateral is disconnected at a little more than half of its length by a narrow isthmus.

The *coronal fissure* corresponds with that of *Phoca*, connecting, superficially at least, with the ansate, and thus, indirectly, with the cephalic branch of the supersylvian and the lateral.

The *ansate fissure*, as has already been intimated, like that of *Phoca*, is irregular in its form and connects with the fissures above mentioned.

The *ectolateral fissure* is quite well down toward the ventral portion of the cerebrum and, as in *Callorhinus*, appears upon the ventral aspect.

The *medilateral fissure* is scarcely perceptible on the lateral aspect; it lies exactly along the caudal margin of the hemicerebrum, as in *Callorhinus*, and is better seen in a mesal view.

The *cruciate* accords, in position and relation, more closely with the conditions found in the bear and *Callorhinus;* but while it reaches to the mesal surface of the hemicerebrum it does not cut it as far as in the bear and *Phoca.*

The *precruciate* and the postcruciate fissures are likewise present and have exactly the same relations as in the bear and *Callorhinus.*

MESAL ASPECT.

The *callosal fissure* is well developed. On the right hemicerebrum it does not continue around the genu, as in the left.

[1] 1874, Transactions of the Zoological Society of London.

The *splenial fissure* does not extend as far cephalad as in *Callorhinus*, nor as far dorsad as in *Phoca*. It is situated more closely to the splenial half of the callosum than in either of the preceding or in the bear. A branch is given off in the region of the splenium proper which seems comparable to the postsplenial in the seals. A slight spur in this region in the bear may indicate an analogy.

The *presplenial* is not represented as a distinct fissure on the left hemicerebrum, the only possible suggestion of it being a forking at the cephalic end of the splenial. On the right hemicerebrum a small but distinct fissure lying cephalad of the splenial may represent the presplenial.

The *marginal fissure* is well represented, and on both hemicerebrums cuts the dorsal surface, as in *Callorhinus*. In *Phoca*, although relatively long, it does not reach the dorsal margin at all. In the bear the marginal fissure is not represented.

The *genual and rostral* fissures are but slightly developed in this specimen and bear the same relations as in other forms.

The *cruciate* fissure shows slightly on the mesal aspect, and in its relations to the other parts resembles that of the bear more than any of the others.

FISSURAL INTERPRETATIONS OF OTHER WRITERS.

The Sylvian fissure, in *Phoca*, at least, has been located as a vertical fissure (presupersylvian) which has, for a portion, only, of its length, been submerged in the cephalic wall of the true Sylvian. Numerous writers have also described this condition as the anterior and posterior branches of the Sylvian. The two fissures morphologically are entirely distinct. In *Hyrax* Krueg does not represent any indication of a Sylvian fissure whatever.

The supersylvian is very commonly called the suprasylvian. Leuret and Gratiolet have confused this fissure with the lateral in *Phoca*.

Following Krueg, the fissure which is designated as the postsupersylvian is commonly known as the postsylvian of Owen. What I have designated as the presupersylvian, and which is only exceptionally independent, is usually described as the anterior or frontal portion of the supersylvian.

A fissure corresponding to the coronal is represented by Krueg as the presylvian in *Phoca*. Kükenthal makes a similar representation. Turner, in *Macrorhinus*, represents a corresponding fissure as the presylvian and a branch connecting with it as the coronal. In *Odobænus* (walrus) he figures as the presylvian an apparent continuation of the lateral, and represents as the coronal an apparent continuation of a third arched fissure, designated by him as the medilateral.

The superorbital fissure in carnivora generally is designated as the presylvian by many writers.

The cruciate fissure is shown by Krueg, in *Phoca*, as existing only on the mesal aspect, occupying the position of the presplenial, or anterior sublimica of Kükenthal. Leuret and Gratiolet represent the fissure as seen on the ventral aspect at the cephalic end. Other writers place it as usually seen in carnivora at the cephalic end of the dorsal aspect, where it may or may not reach the mesal surface.

THE LATERAL VENTRICLE (PARACOELE).

On removing the dorsal portion of the hemicerebrum just dorsal to the callosum the lateral ventricle is revealed. In the bear the cavity bends cephalo-ventrad to form the precornu and caudo-latero-ventrad to form the medicornu. The striatum is a well-defined body forming a portion of the floor of the ventricle in the cephalic region. Parallel with the oblique margin of the striatum is the fimbrial margin of the hippocamp. Between these two margins—the rima (great transverse fissure), the choroid (para) plexus—a continuation of the velum enters the floor of the cavity. The hippocamp pursues its usual curved direction in the medicornu.

In *Phoca* the lateral ventricle is relatively very much larger than in the bear, and the parts present quite different relations to each other. The striatum is the same as in the bear; along its margin is a well-developed plexus, but between this and the fimbrial edge of the hippocamp there is an area equally as large as the striatum; this is the optic thalamus, but that portion of it represented in the floor of the cavity presents the same general appearance as to its surface (endymal) as do the other parts. The supposed delicate endymal membrane extending from the plexus to the fimbria has been designated as the paratela by Wilder. The hippocamp, then, is removed some little distance from the striatum and arches around the surface of the thalamus in a ventral direction. Caudal to the hippocamp, the cavity is about as largely represented, and in size forms a disproportionately large postcornu. Along the mesal wall just caudal to the hippocamp is an ental ridge correlated with an ectal depression—the splenial fissure. This is comparable to the calcar or hippocampus minor of the anthropoid and human brains. It is larger in proportion than in either of the above. The splenial in this case, for a part of its course, at least, is therefore a total (Wilder) or complete (Cunningham) fissure, since the whole thickness of the parietes is involved, the ental elevation being correlated with the fissural depression. In this specimen of *Phoca*, then, we have two total fissures—the hippocampal (always) and a portion of the splenial.

The conditions just described might naturally suggest a homology with the ape and human calcar, and that the splenial fissure, in this seal possessing a postcornu, might be homologized with the occipital or calcarine fissure in man. A question might properly arise here as to which fissure it might be homologized with. In the human fœtus the occipital is a total fissure, but loses its totality (ental elevation) in the adult. Its position might favor its homology with the splenial, for if the latter were rotated farther caudad it would come to occupy approximately the same position as the occipital. To homologize with the calcarine we would have to imagine a still farther rotation of the splenial. The calcarine is a total fissure throughout life, and is the correlative of the calcar. Some doubt may, therefore, be expressed, assuming the homology to be reasonable, whether this hippocampus minor represents the occipital eminence—a fœtal condition in the human brain—or the calcar, a structure persistent in the adult.

The relative disproportion in the growth of the caudal or occipital portion of the cerebrum may have some bearing in accounting for the presence of the postcornu. Tiedemann, in his figure of the lateral ventricle of *Phoca*, gives no indication whatever of a postcornu.

In *Callorhinus* the conditions resemble more closely those in the bear; the rima is narrow and the thalamus does not appear at all in the floor of the ventricle. A slight caudal spur of the cavity at the medicornu represents the postcornu. The splenial fissure, so to speak, just escapes the cavity, lying immediately caudal to it.

In the walrus, Turner[1] represents a dissection of this cavity, but shows no indication of a postcornu; but in the text he states: "Where the cavity of the ventricle curved downward and outward into the horn, an indication of a recess was seen in its posterior horn, but it did not amount to a cornu, and there was no elevation which could be called a hippocampus minor."

Murie,[2] on the form and structure of the manatee, figures a well-developed postcornu. He states that "there is an undoubted posterior cornu, a fully developed hippocampus minor, and an eminence I am inclined to recognize as eminentia collateralis." The same author, on the anatomy of the sea lion *Otaria jubata* figures a more extensive postcornu than is represented in the manatee, and describes it as "stretching backward and outward with a very regular sweeping arch, and goes well back into the occipital lobe, terminating in a shallow, tapering extremity. The eminentia collateralis is not distinctly defined, but what appears to represent the outwardly bulging hippocampus minor has a length of 0.7 of an inch, and at widest is 0.3 to 0.4 broad."

Wilder, in the Anatomical Technology, in indicating the lines of inquiry likely to be most productive of results in the homology of the human and feline fissures, states that "between the ordinary carnivora and the monkeys are two groups whose brains should be studied with especial care; the seals have a rudimentary postcornu and occipital lobe, and these parts are said to be developed in the *Lemurs*, which have affinities with both the carnivora and the primates."

In none of the accounts have I seen any direct mention of the correlation of the splenial fissure with the calcar in these aquatic forms. This fact, even if it be of no direct use for homology, is at least interesting.

MONACHUS TROPICALIS.

In August, 1897, I was fortunate to obtain, through the courtesy of Dr. A. H. Hassall, Washington, D. C., two brains from male and female specimens of the West Indian seal (*Monachus tropicalis*). They arrived at an exceedingly opportune time for comparison with the other brains dealt with in this article. A study of their form and fissural relations throws much light on some of the points which seemed quite aberrant in *Phoca* when compared with *Callorhinus* alone.

The general form of the brain would suggest a position intermediate between the fur seal and *Phoca*, particularly in the frontal region which is somewhat foreshortened and broader than in *Callorhinus*. The caudal portion of the cerebrum is much elongated, noticed particularly upon the mesal aspect when measured from the splenium of the callosum, as if, perhaps, to compensate for the foreshortened frontal region. The cerebrum also shows a slightly greater overlapping of the cerebellum. The olfactory bulb and crus resemble the corresponding parts in *Phoca*, but show a slightly greater development.

FISSURES.

Postica.—In all four hemicerebrums, this fissure sends a branch to the surface, thus appearing superficially as a branch of the Sylvian. The postica is less easily distinguished in *Monachus* than in any of the other forms, as it is submerged practically to the bottom of the Sylvian fissure. In *Callorhinus* there is a branch

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1888, [1] Turner, report on the seals collected during the voyage of H. M. S. *Challenger* in the years 1873–1876.

[2] Loc. cit.

corresponding to that of *Monachus*, but it does not extend deeply enough to connect with the postica.

The *postrhinal* appears as the merest trace of a fissure, and has a very superficial connection with the postica.

The *Sylvian* fissure. It is in the Sylvian region that we get numerous clews to the intermediate position of *Monachus*. In the brain of the female, the Sylvian has practically the same direction as in *Callorhinus*. In the male, the true Sylvian really branches cephalad, although there is a superficial extension in the usual dorso-caudal direction. Apparently some unusual conditions exist here, which may perhaps be accounted for by the nearly complete disappearance of the postica.

The *presupersylvian* resembles the corresponding fissure in *Phoca* regarding its extreme vertical position and apparent union with the Sylvian for only the ventral third of its course. It differs from *Phoca* in not being disconnected from the supersylvian.

The *supersylvian* fissure resembles that of *Phoca* in extending a branch of good size to connect with the ansate.

Postsupersylvian.—In the two hemicerebrums of the male there was a connection between the supersylvian and the postsupersylvian, much as in *Phoca*. In the hemicerebrums of the female there was an entire disconnection of these fissures.

The *cruciate* fissure more than in any of the others resembled that of the *Phoca*. It forms a good intermediate stage between *Callorhinus* and *Phoca*. As with *Phoca* the fissure is represented on the mesal surface as much, if not more than, upon the dorsal. In the left hemicerebrums of both brains the cruciate is apparently continuous with the splenial. Upon the right hemicerebrums there is no such connection.

Precruciate.—In all four hemicerebrums the precruciate extends over upon the mesal surface for some little distance. It is more largely represented upon the dorsal surface, and its lateral end makes a very decided curve toward the coronal fissure. There is almost a superficial connection between the cruciate and precruciate. The conditions in *Phoca* indicate that such a connection has occurred even to the extent of their almost complete mergence into each other.

"*Ursine lozenge.*"—This area is, with the exception of *Phoca*, where it is undistinguishable, smaller than in any of the other forms. It is nothing more than a narrow gyre, situated at a slightly lower level than the adjacent gyres, suggesting a probable preparation of its loss of identity in *Phoca*.

Postcruciate.—In *Monachus* this fissure was the least satisfactorily represented than in any of the other forms. In the two hemicerebrums it does not seem to be represented at all, unless we interpret a slight branch from the cruciate as representing it. In the right hemicerebrums the fissure is distinctiy present, but is very small.

The *Splenial* accords more closely with *Phoca* in its position, reaching the mid-dorsal region instead of extending farther cephalad, as in *Callorhinus*. It sends off a branch corresponding to the postsplenial as in the other brains.

The *Presplenial* is well represented in the two right hemicerebrums, but in the two left it appears to connect the true splenial with the cruciate. The interlocking of submerged buttresses at the proper points indicates a superficial connection merely.

The *Marginal* fissure is more poorly developed than in any of the other forms, except the bear. A series of short or interrupted fissures take its place.

A well-marked *Collateral* fissure is present and resembles the corresponding fissure in *Callorhinus* very closely.

Postcornu.—Perhaps the most important point in connecting *Monachus* with *Phoca* is a very well developed postcornu. *Callorhinus* shows the merest trace of one and in the bears it is absent. In *Monachus* it does not go so far as in *Phoca*, a greater portion of the caudal wall being solid. The floor of the postcornu in *Monachus* is quite distinctly convex. This convexity of the internal surface is found to be correlated with an external depression, the lower or ventral portion of the splenial fissure. At the more vertical portion of the fissure, namely, opposite the caudal end of the callosum, the splenial fissure loses its totality and becomes an ordinary fissure for the remainder of its upward course. The postcornu stops at the level of the depth of the splenial fissure in the callosal region. We have not, therefore, as in *Phoca*, a well-developed calcar (*Hippocampus minor*). The internal convex surface already spoken of in connection with the ventral portion of the splenial fissure offers a suggestion as to the inception of the calcar which finds its fulfillment in *Phoca*.

GENERAL CONSIDERATIONS.

The average canine brain, as a matter of convenience, may be accepted as a simple type of a carnivore brain. The fissures are clearly demarcated, and there is an absence of much branching or secondary fissuration.

Around the Sylvian there are three arched fissures separating the cortical substance into four distinct folds or gyres. In the brain of cats, and occasionally in dogs, we find that the arched fissure nearest the Sylvian is not a complete one; that only the pillars are represented, the keystone being absent.

In *Hyena* and *Proteles* the frontal portion of this arch is wanting (Krueg), but the caudal portion, fissura postica, is well represented.

In certain others of the carnivora no trace of the first arch or Sylvian gyre, with its limiting fissure (anterior-postica), is at all present. The first arch with its fissure has disappeared, apparently swallowed up by the Sylvian. There are represented, then, on the lateral aspect only two arched fissures, the supersylvian and lateral and the three gyres which they separate. In those forms in which only the two arched fissures are present, if the distance from the frontal portion of the supersylvian to the Sylvian be compared with the distance from the latter to the postsupersylvian, it will generally be found to be less in the former, and this becomes much more emphasized in the case of some of the bears, where the frontal portion of an undoubted supersylvian almost enters the Sylvian fissure.

In his description of the brain of the polar bear, *Ursus maritimus*, Turner[1] says:

> On opening up the Sylvian fissure I found to my surprise that a definite arched convolution was completely concealed within it. It was separated from the convolution which bounded the Sylvian fissure by a deep fissure, which was also concealed. Its anterior limb, not quite so bulky as the posterior, was continued into the supraorbital area immediately external to the rhinal fissure and to the outer root of the olfactory peduncle. Its posterior limb reached the postrhinal fissure and the *lobus hippocampi*. I could not but think that we had here, more completely than either in the walrus or seals, a sinking into the Sylvian fissure of the convolution which ought to have bounded it, so that both the Sylvian convolution, properly so called, and the suprasylvian fissure were concealed within it. If this be a proper explanation of the arrangement, then the three convolutions on the cranial aspect would be sagittal, mediolateral, and suprasylvian, while the two complete curved fissures between them would be the mediolateral and lateral.

[1] Loc. cit.

The question arises if the fissure concealed in the Sylvian may not be the equivalent of the anterior-postica of Krueg, and the two remaining visible on the cranial surface the supersylvian and lateral.

The mediolateral of other authors does not attain the size nor continued length in the frontal direction as ascribed to the mediolateral by Turner.

In a specimen of *Ursus americanus*, I had the good fortune to discover a stage one step beyond that described by Professor Turner. On opening the Sylvian fissure I found in its caudal wall a completely submerged fissure, with a remnant of the Sylvian gyre, which might possibly be mistaken for the insula. A true insula, although small, is present. This submerged fissure I take to be the disappearing vestige of the ectosylvian (Owen) or anterior-postica (Krueg).

It would seem, then, that the condition thus described in the polar bear and American bear would represent the method of disappearance, rather than the appearance, of the first circumsylvian arch, and prepare us for the conditions that we find in the sea lion (*Zalophus*) and the seals (*Phoca* and *Callorhinus*).

In the sea lion the conditions regarding the frontal portion of the Sylvian gyre are intermediate between the bears and seals. The presupersylvian fissure approaches very closely to the Sylvian fissure, and the intervening portion of the Sylvian gyre, besides being narrower than in the bears, has also sunk slightly lower than the adjacent surfaces, as if prophesying the conditions found in the seals.

In the seals there appears to be some evidence, if the interpretation as to the frontal portion of the supersylvian fissure be correct, that after breaking up into branches, with, perhaps, some disconnection of its parts, it shows a tendency to follow the example of the anterior-postica fissure, because in *Phoca*, at least, the supersylvian bifurcates a little beyond the free end of the Sylvian, one branch forming a well-defined arch around it, the other branch passing on in the frontal region. The branch, however, which forms the arch is not a long one, but it extends to and superficially connects with a vertical fissure which, for half its distance, is submerged in the frontal wall of the Sylvian, and crops out again on the ventral aspect of the brain. This condition holds for both hemicerebrums of *Phoca*. *Callorhinus* throws a little light on this matter. In the right hemicerebrum the supersylvian is clearly continuous with the vertical fissure submerged in the frontal wall of the Sylvian, but gives off a very short frontal branch. Superficially it is continuous with the postsupersylvian, but a shallow at this point indicates a partial separation. The direct continuity in the depth of the supersylvian with the vertical fissure would seem to point to the fact that the latter, after all, was nothing more than the frontal portion of the supersylvian, namely, the presupersylvian.

In the left hemicerebrum the parts are a little more complicated. The postsupersylvian is entirely separated, the supersylvian is entirely distinct from the frontal portion, and is quite irregular and branching in its course, but mainly vertical in its direction.

Thus, taking the canine brain as exemplifying a simple fissural pattern, and passing through the *Felidæ* and *Ursidæ* and sea lion to the seals, where the fissures are more numerous and complicated by the presence of branches of considerable size, and more or less disconnection of some of the principal fissures, we may arrive at some understanding of the relationship and changes effected in passing from simple to complex conditions.

In the general form of the brains that of the sea lion seemed to bear a closer resemblance to that of the bear than either *Callorhinus* or *Phoca*—the latter the least of all. The elongated and narrowed frontal portion of the brain as seen in the bear is represented in *Phoca* by a foreshortened and broadened region, less marked in *Callorhinus* and still less in *Zalophus*.

The development of the olfactory lobes is also interesting. They attain their highest growth in the bear, next in *Zalophus*, then *Callorhinus* and least, in *Phoca*.

The triangular area on each hemicerebrum located between the cruciate and precruciate fissures and the intercerebral cleft, designated by Mivart as the ursine lozenge and believed by him to be of considerable importance in indicating a phylogenetic relationship between the Pinnipedia and the ursine group of carnivora, was developed equally well in *Zalophus* and *Callorhinus*. In *Phoca* it was not observable, although Turner states that in this form it is present but rudimentary and concealed in the mesal fissure of the cerebrum.

The length of the lateral fissure in *Callorhinus* is somewhat unexpected, and in relation resembles the continuous lateral and ectolateral of the bear. In the sea lion and *Phoca* the lateral is a relatively short fissure. In all but the bear there is an independent ectolateral fissure, but it is not so satisfactorily developed in *Phoca*.

The postrhinal fissure shows an interesting variation in the different forms. In *Callorhinus* and *Zalophus* it has no connection with the rhinal or Sylvian, but is a direct continuation of the subfissure—postica. In *Ursus* the subfissure may occasionally reach to it, but as a rule it is distinct and the postrhinal continues as an elongation of the rhinal. In *Phoca* the separation of the subfissure and the postrhinal is still more marked, so that the rhinal and postrhinal are practically different parts of one and the same fissure, differentiated from each other by the presence of the Sylvian.

The presupersylvian fissure is directly continuous with the supersylvian in *Ursus;* it is likewise continuous in *Zalophus* and in *Callorhinus* except upon the left hemicerebrum of the pup. In *Phoca* the two fissures are distinctly separated.

The postsupersylvian is continuous with the supersylvian in *Ursus* and *Zalophus*, but separated in *Callorhinus*. They are apparently continuous in *Phoca*, but a dorsocaudal branch and the presence of submerged buttresses at this point of junction would indicate that there was some attempt at separation.

In the bear there is no elongation of the paracoele to form a postcornu; in the sea lion Murie finds a distinct postcornu present; in *Callorhinus* it is quite rudimentary; in *Phoca* Tiedemann represents the paracoele with no appearance whatever of a postcornu. My own specimen, which, so far as I know, is normal, shows a postcornu relatively as large or larger than in the primate brain, with a distinct calcar or hippocampus minor in which a portion of the splenial appears as a total fissure.

With the exception of the bear, concerning which I have no data, and the additional brain from an adult *Callorhinus* and *Monachus*, all of my material was from specimens not more than one year of age. It is believed, judging from a comparison of the brain of the young with that of the adult *Callorhinus* as to bulk and complexity of fissuration, that comparatively little or no change occurs, especially in the latter respect.

Mr. Lucas, who has had casts of the cranial cavities prepared from the male and female fur seals, finds but slight difference in the size of the cavities (see his figures of casts), notwithstanding the fact that the bulk of the body of the male is about four times as great as that of the female.

Of the representatives of the four groups examined, the brain of *Callorhinus* shows a greater number of minor fissures and a more intricate arrangement and branching of the larger fissures.

With regard to the ground plan of the fundamental fissures, and allowing for the difference in the shape of the brains, that of the eared seals—*Callorhinus* and *Zalophus*—approximate in general more closely to that of the ursine carnivora than does *Phoca*. The latter, or earless seal, in some respects appears aberrant. The arrangement of the cruciate and postrhinal fissures would seem to link it with the canine and feline carnivora, while the peculiar development of the occipital region and the large development of the postcornu with its calcar point toward primate conditions. The group of lemurs is also said to possess a postcornu and to have affinities with both the carnivora and the primates.

As a matter of convenience, a table of the more interesting regions in the representatives of the different groups examined is herewith appended:

Region.	Ursus.	Zalophus.	Callorhinus.	Monachus.	Phoca.
1. Subfissure postica.	Present	Present	Present	Not very distinct	Present.
2. Postrhinal	Continuation of rhinal, exceptionally of postica.	Continuation of postica.	Continuation of postica.	A mere trace, very superficial connection with postica.	Continuation of rhinal.
3. Presupersylvian.	Continuous with supersylvian.	Continuous with supersylvian.	On left hemicerebrum of pup, disconnected, but usually continuous.	Connected with supersylvian.	Disconnected.
4. Postsupersylvian.	.....do	Continuous	Disconnected	In four hemicerebrums; two showed a connection and the other two a disconnection.	Continuous, but with indications of shallows.
5. Precruciate	Mostly dorsal	Dorsal	Dorsal	Mesal and dorsal	Not clearly shown.
6. Cruciate	Dorsal, just cutting mesal margin.	.....do	.....do	Dorsal and mesal	Dorsal and mesal.
7. Postcruciate	Present	Present	Present	Rudimentary	Present.
8. Minor fissures	Rare	Not many	Numerous	Quite numerous	Quite numerous.
9. "Ursine Lozenge."	Present	Present	Present	Small	Absent.
10. Postcornu	Absent	Small	Small	Large	Very large.
11. Calcar	.....do	Absent	Absent	Indistinct	Very distinct.
12. Medilateral fissure.	Present	Present	Present	Present	A series of small disconnected fissures.
13. Marginal fissure.	Absent	.....do	.....do	A series of short interrupted fissures.	Present.
14. Collateral fissure.	.....do	Rudimentary	.....do	Present	Present, but connects with postrhinal.
15. Insula	Slight	Slight	Slight	Slight	Slight.

Reference letters.

ans ..... ansate.	pcr ..... postcruciate.
b .... buttress.	pl .... plexus.
cal ...... callosum.	prc ..... precornu.
calc ..... calcar.	prcr .... precruciate.
cf .... confinis.	prh ..... postrhinal.
cl .... callosal fissure.	prsp .... presplenial.
col ...... collateral.	prss .... presupersylvian.
cor ..... coronal.	psp ..... postsplenial.
cr ...... cruciate.	pss ..... postsupersylvian.
el .... ectolateral.	r .... rostral.
f .... fimbria.	rh ...... rhinal.
g .... genual.	so ...... superorbital.
hip ..... hippocampus.	sp ...... splenial.
l .... lateral.	str ...... striatum.
marg .... marginal.	Syl ..... Sylvian.
mc ...... medicornu.	ss .... supersylvian.
ml ...... medilateral.	th ...... thalamus.
pc ...... postcornu.	ur ...... ursine lozenge.

EXPLANATION OF PLATE V.

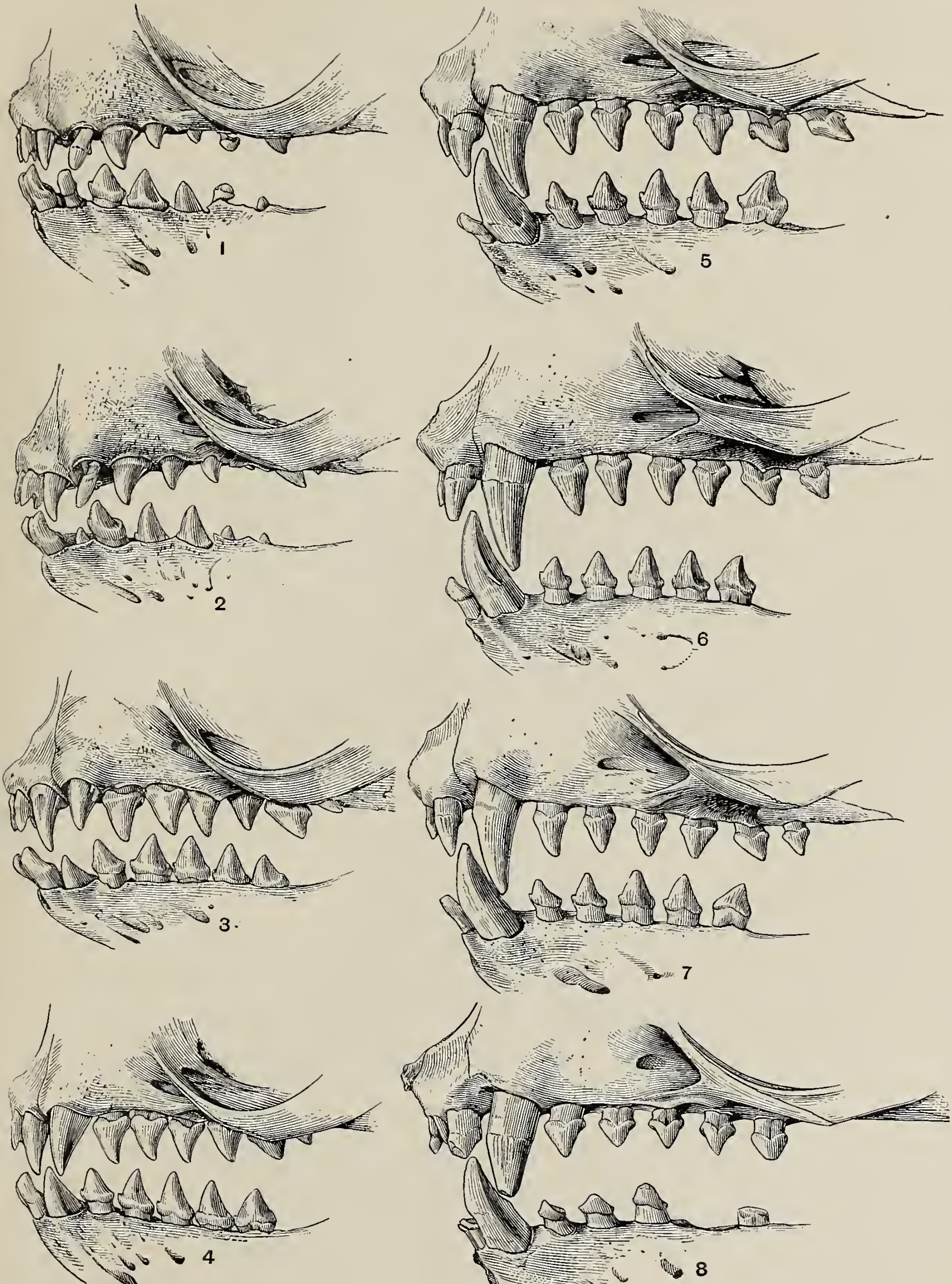
Fig. 1. The ventral aspect of the brain of the fur seal, *Callorhinus ursinus*, showing in addition to the fissures the cranial nerves and the cerebellum. On each side of the latter is a depression into which fits the petrosal portion of the temporal bone.
2. The dorsal aspect of the brain, showing the cerebellum largely concealed by the cerebrum.
3. The left lateral aspect of the cerebrum.
4. The right lateral aspect of the cerebrum.
5. The mesal aspect of the right hemicerebrum.
6. The mesal aspect of the left hemicerebrum.

EXPLANATION OF PLATE VI.

Fig. 1. The ventral aspect of the brain of the hair seal, *Phoca vitulina*, slightly modified from Tiedemann's figure.
2 The dorsal aspect of the cerebrum of *Phoca vitulina*, after Tiedemann.
3. The left lateral aspect of the cerebrum.
4. The right lateral aspect of the cerebrum.
5. The mesal aspect of the right hemicerebrum.
6. The mesal aspect of the left hemicerebrum.

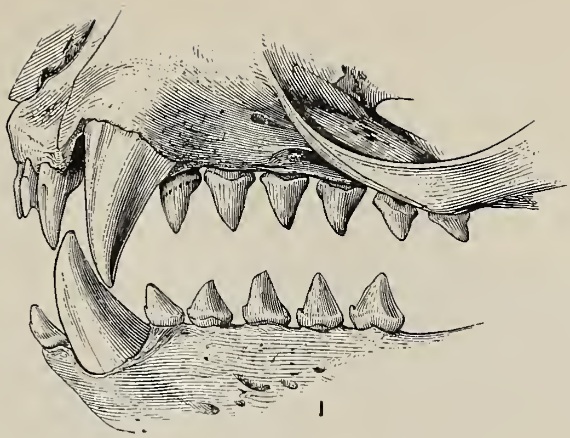
EXPLANATION OF PLATE VII.

Fig. 1. The left lateral aspect of the cerebrum of the sea lion, *Zalophus californianus*.
2. The right lateral aspect of the cerebrum of *Zalophus*.
3. The mesal aspect of the right hemicerebrum.
4. The mesal aspect of the left hemicerebrum.
5. The left lateral aspect of the cerebrum of *Ursus thibetianus*.
6. The mesal aspect of the right hemicerebrum of *Ursus*.
7. Dissection of the left hemicerebrum of *Callorhinus*, showing the lateral ventricle with a very rudimentary postcornu.
8. Dissection of the left hemicerebrum of *Phoca vitulina*, showing the presence of the calcar and large postcornu in the lateral ventricle.



DENTITION OF FUR SEAL, NATURAL SIZE.

1–4, pups, 5–8, females.



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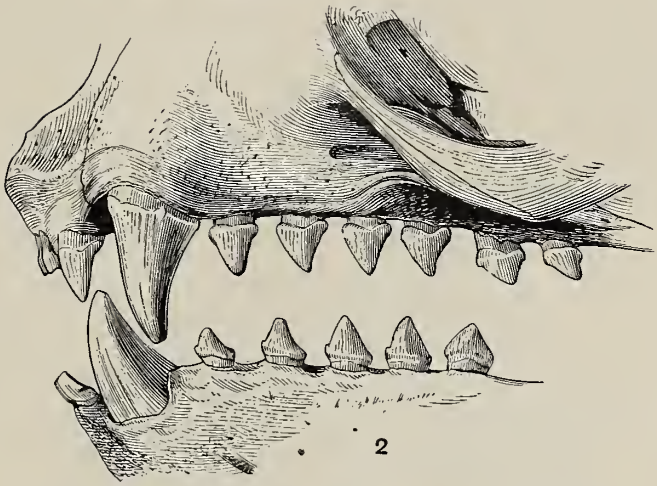
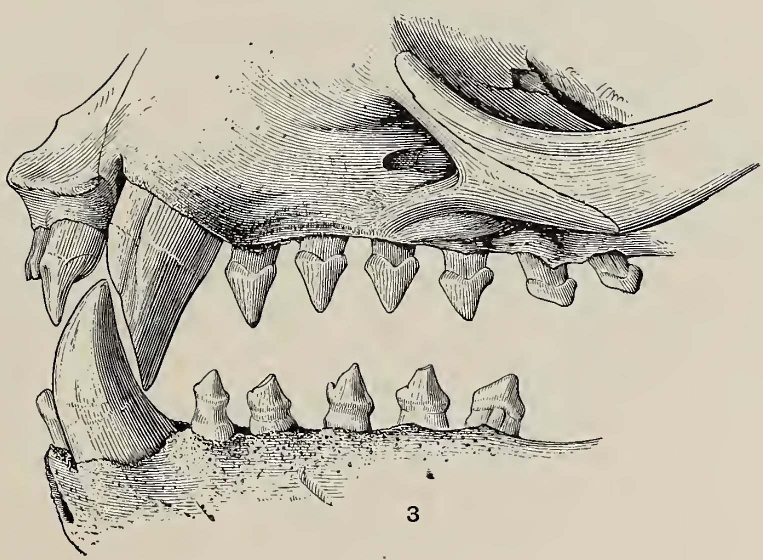


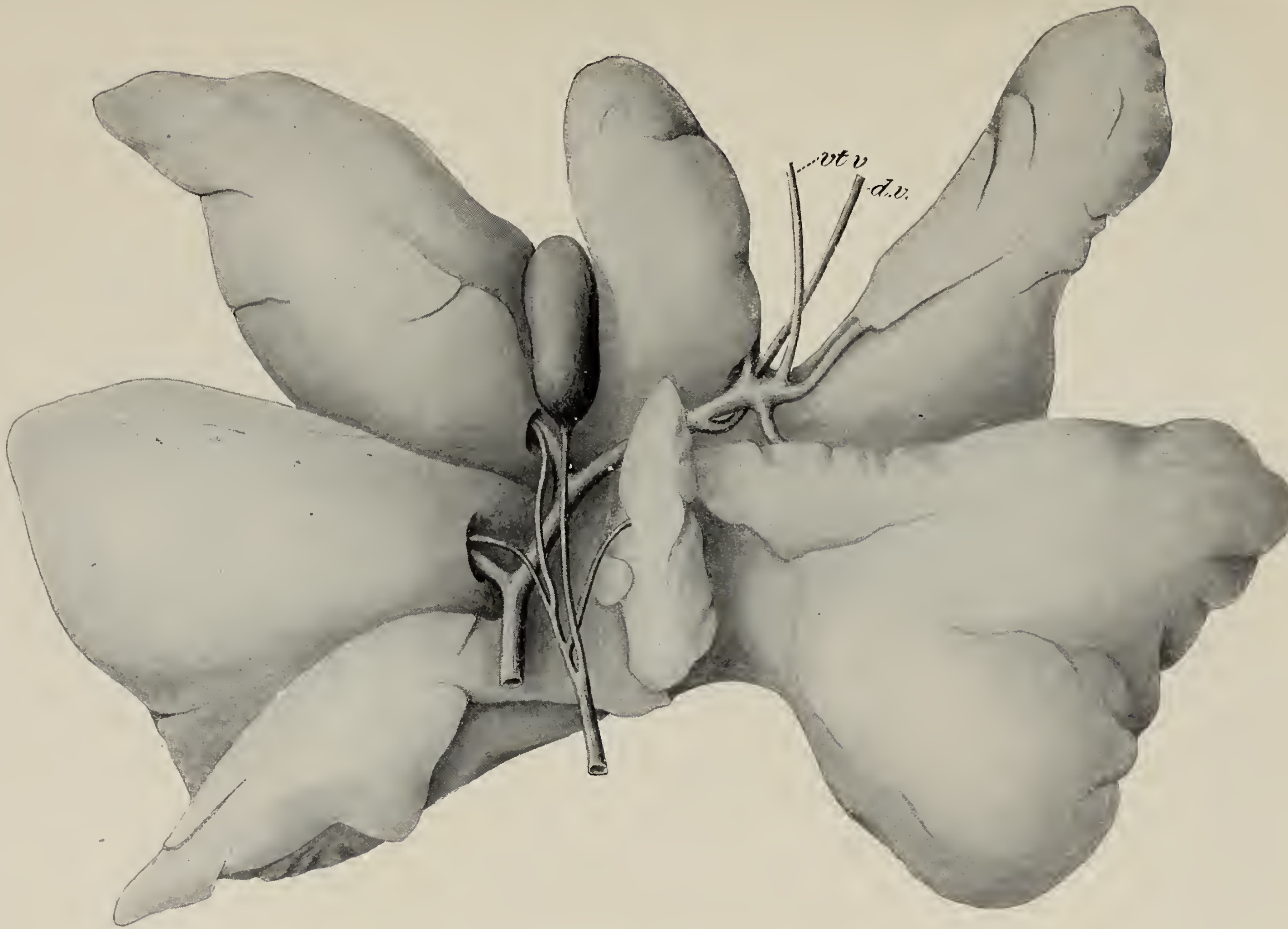
2



3

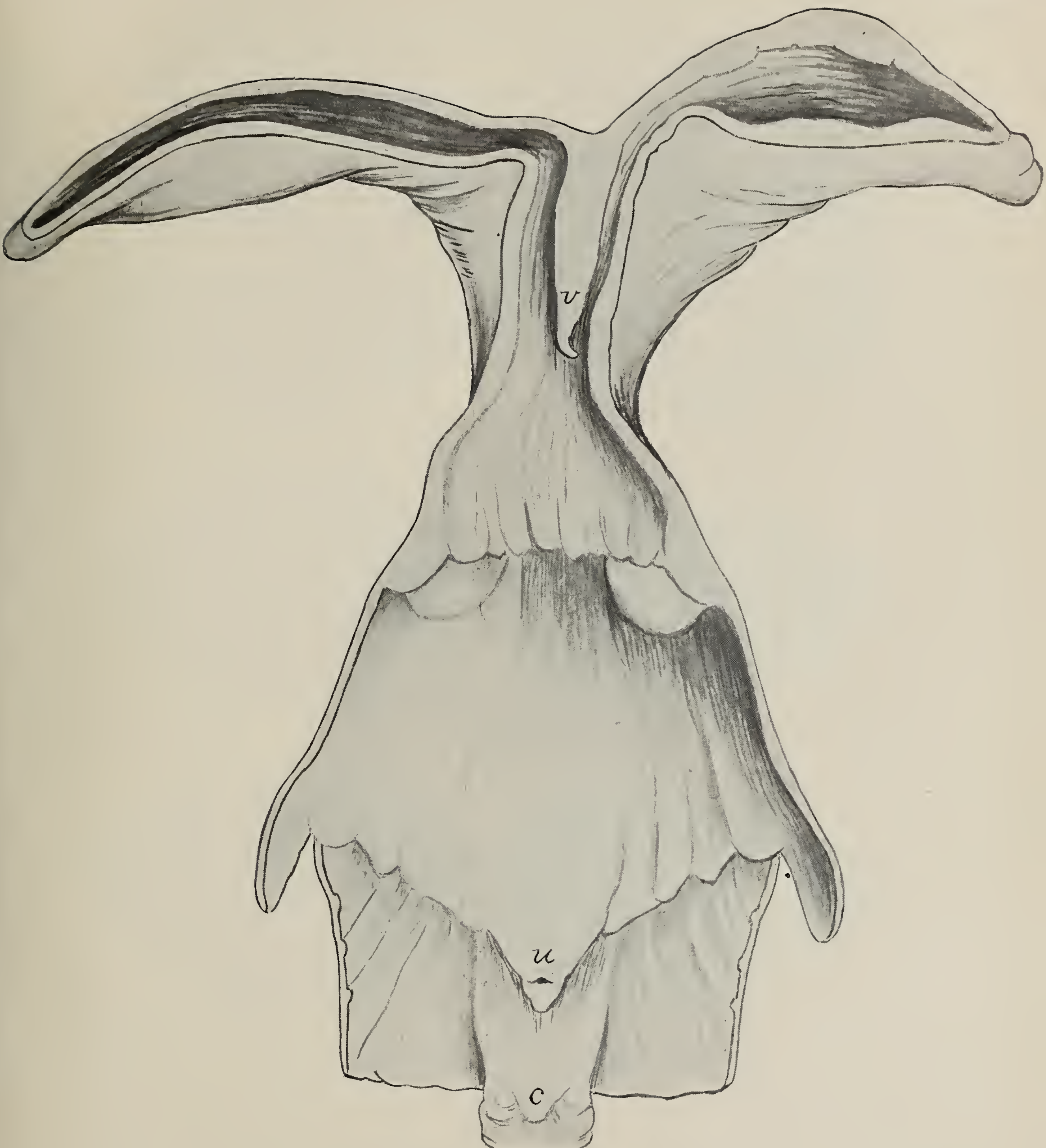
DENTITION OF FUR SEAL, NATURAL SIZE

Males.

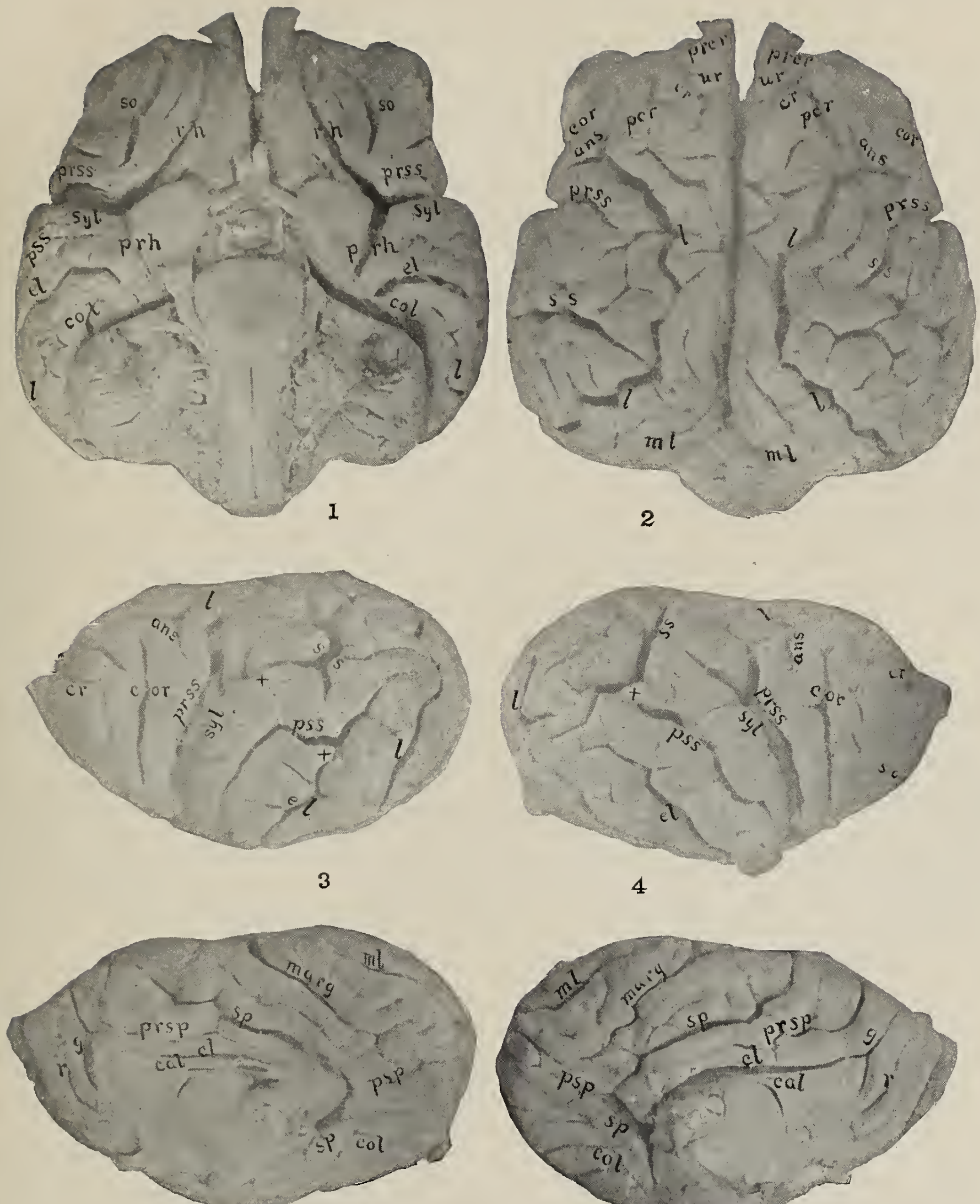


LIVER OF SEAL PUP, NATURAL SIZE.

vt. v., vitelline vein. *d v.*, ductus venosus.



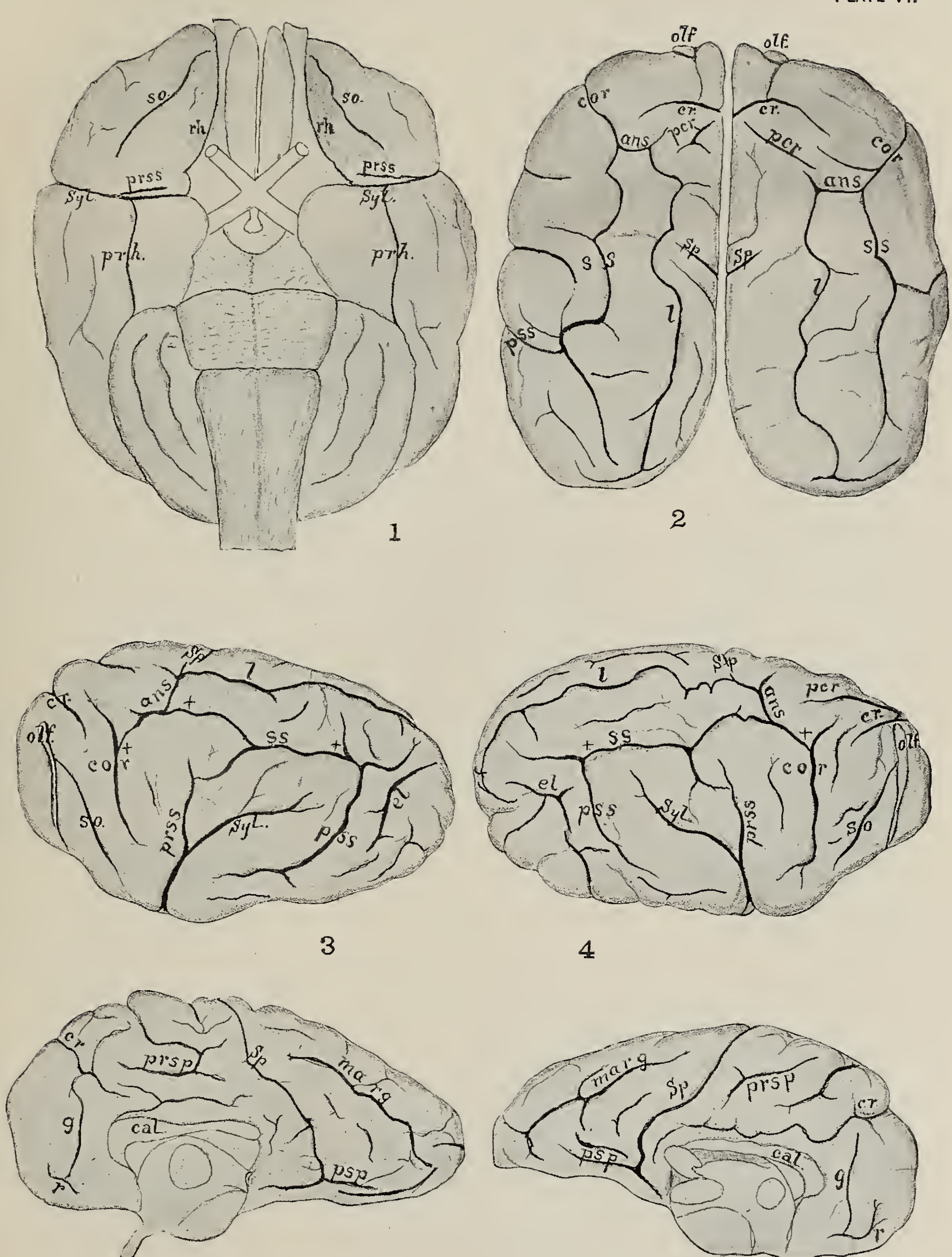
UTERUS AND VAGINA OPENED FROM THE DORSAL SIDE, NATURAL SIZE.



BRAIN OF FUR SEAL, *Callorhinus ursinus*, REDUCED.

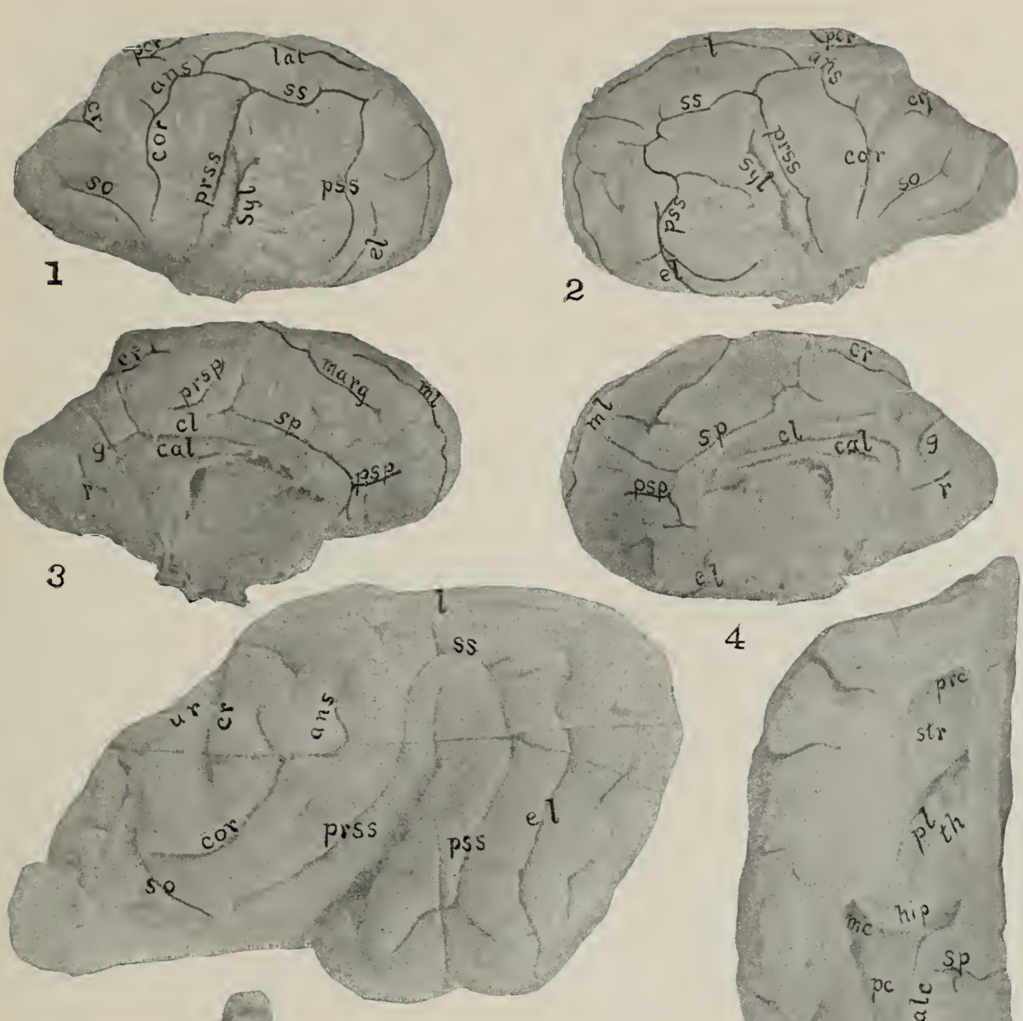
For explanation see page 41.

PLATE VI.



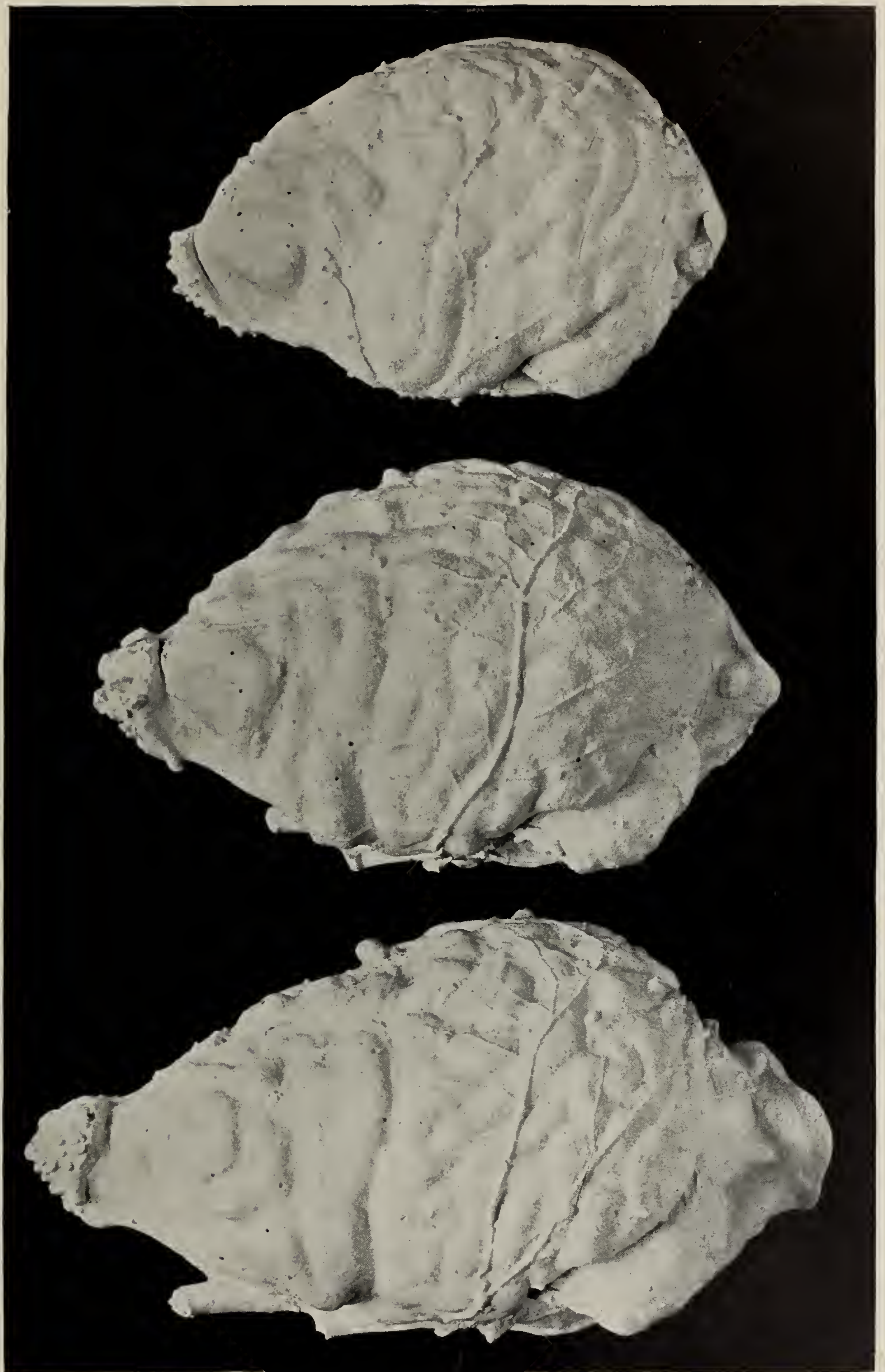
BRAIN OF HAIR SEAL, *Phoca vitulina*, REDUCED.

For explanation see page 41.



BRAINS OF SEALS AND BEARS, REDUCED.

For explanation see page 41.



CASTS OF CRANIAL CAVITIES OF FUR SEAL, NATURAL SIZE.

1. Young pup. 2. Adult female.. 3. Old male.

III.—THE BREEDING HABITS OF THE PRIBILOF FUR SEAL.

By Frederic A. Lucas.

The more evident features in the breeding of the seals have been so often described that, save for the sake of completeness, it might seem unnecessary to repeat them here. The truth, however, has of late years been so overlaid and interwoven with errors and falsehoods that it is practically impossible for one who has not made a special study of the subject to separate the one from the other. So far back as 1839 Bishop Veniaminof published a very good description of the habits of the seals on their breeding grounds, and that account, after the elimination of one or two very excusable errors, is as true to-day as when it was written. In 1882 Elliott well described the breeding habits of the seals, but about the same time the publication of Allen's work on North American Pinnipeds gave wide circulation to the many errors contained in the account of Captain Bryant.

Shortly after the ice has left the islands, late in April or early in May, the first bulls make their appearance, and after loitering about the rookeries haul out and take their stations for the season. The bulk of the males, however, do not put in an appearance until later, but by the 1st of June the majority have taken positions on the breeding grounds, although their numbers gradually increase for some time longer through the entry of bulls which force their way in and establish harems. The bulls appear to take up the places occupied the previous year, for in many cases bulls were seen in 1897 in localities where they had been noted in 1896, though there are, of course, many exceptions to this rule. There is much less fighting at this time than we had been led to expect, and the males pass much of their time in sleeping while awaiting the arrival of the cows. These begin to straggle in early in June, and although the majority of cows have come on land and brought forth their young by the 10th of July, yet they continue to arrive up to the middle of August, or even later, a newly born pup having been seen on August 27, 1896.[1]

[1] The exact dates on which these various occurrences took place in 1896 are as follows:

First bull arrived	Apr. 13
First killable seals arrived	May 11
First cow seen on North rookery, St. George	June 8
First cows, five, seen on reef	June 12
First pups seen on reef	June 14
Newly born pup on North rookery, St. George	Aug. 16
Last newly born pup seen on St. Paul	Aug. 27
Apparently gravid cow seen on Staraya Artel	Aug. 17
Last copulation, between young bull and 2-year-old cow, Tolstoi	Aug. 27

From July 1 to July 15 or 20 may be called the height of the rookery season, when the harems are at their fullest and the bulls are most active in keeping the cows within bounds. During this time there is little visible change, and even a count of the cows may show little or no difference between two days, although a systematic count made day after day will show fluctuations.[1] That there is a steady though imperceptible going and coming of cows is revealed by the fact that a count of the pups shows them to be twice as numerous as the cows that are on the rookery grounds at any one time, although for a while the arrivals about balance the departures, giving the rookeries an appearance of stability that they really do not possess.

About the 1st of August comes the period of rookery expansion, when the rigid discipline of the harems is relaxed. The cows, now nearly all impregnated, are allowed to come and go as they please, and the entire mass of seals draws back from the water's edge, making it possible to pass between the seals and the water without creating much disturbance. This spreading of the rookery limits is apparently due to the movements of the young, who work out of the harems and assemble in bands back of the breeding places, podding, as it is termed. The nursing cows returning from the sea naturally seek for their pups, and this in turn brings the cows back of their original positions, the whole body of seals being thus brought from 50 to 200 yards, or even more, inland. A certain amount of this expansion is also due to the influx of 2-year-old cows which make their appearance in the main after the 1st of August and are eagerly appropriated by the bulls, particularly by the waiting bulls.

Fighting among the bulls continues throughout the rookery season, not only between the proprietors of adjacent harems, but more particularly between the bulls with cows and those without, and among the idle bulls. The fur seal is ever ready to construe any movement on the part of a neighbor as a threatened attack, and quite as ready to meet him half way, although there is much threatening that results in nothing and many brief encounters that end in a vicious bite or two, serious enough, in fact, but of comparatively little moment to a bull seal. Two bulls will rush savagely at one another, and just before meeting throw themselves flat on their breasts and simply puff two or three times at each other like small locomotives. The most severe combats take place while the harems are forming, or later on, as just stated, between the lord of a harem and some idle bull who has made up his mind to dispossess his fortunate relative. These fights are sometimes long protracted and the bulls get badly bitten about the back, shoulders, and fore flippers, the back of the arm being a favorite place of attack. The several fights which were brought to a finish were concluded by the bulls coming up to each other, chest to chest, and pushing with all their might, the bull which was forced backward yielding and rushing for the water, to the great disturbance of that section of his rookery.

While, as previously stated, the main features in the life of the fur seals have been long known, of late years many questions, once looked upon as of purely scientific interest, have become of great practical importance, rendering a more detailed and exact knowledge of the life history of the fur seal not only desirable, but necessary.

[1] Judging from Dr. Stejneger's remarks, the weather seems to have much less influence on the seals on the Pribilofs than it does on the Commander Islands, for no such general depletion of the rookeries takes place on a bright, warm day on the former islands as he notices several times on the Commanders.

Among such questions are the ages at which the males and females begin and cease to breed, the frequency of births, the alleged frequent occurrence of "barren cows," the necessary proportion of the two sexes, and their natural proportions at birth. Much of this information, and particularly that which depends on the study of the reproductive system, could not have been secured in the better days of the Pribilofs without killing many females and creating great disturbance on the rookeries. The great destruction of the females at sea and the consequent thinning out of the rookeries has rendered it possible to get about the breeding grounds more readily than formerly, while by obtaining from pelagic sealers the bodies of skinned seals extensive series of females of all ages were secured for examination.[1]

Mr. C. H. Townsend, to whom belongs the credit of having inaugurated this important line of work,[2] with its incontrovertible evidence, collected and examined the ovaries of 106 seals in 1895, and during the present season (1896) we procured 75 more, while these were supplemented by others obtained from pups and females of various ages killed for examination. From this material data were obtained which rendered it possible to substitute facts for probabilities and to refute some of the wild assertions that had found their way into print.

As stated by Elliott, the testes of the young male are inguinal, descending into the scrotum toward the end of the second or commencement of the third year;[3] and Mr. Andrew Halkett has found living spermatozoa in a 3-year-old male. The males are thus occasionally capable of procreation at the age of 3, but they are rarely able to enter the rookeries before the age of 6, while the majority of bulls on the breeding grounds are 7 years old and upward. The failure of the young bulls to enter the rookeries is not due to any lack of desire, but simply because they have not attained their full growth and are not large and strong enough to fight their way in; and here again "natural selection" works to the advantage of the fur-seal race by permitting only the full-grown, vigorous males to possess harems. Many of the younger bulls obtain cows and get their first experiences in the art of running a harem after the rookeries have expanded and the young females have made their appearance, and it is very amusing to see these youngsters endeavoring to assume the airs and manners of veterans. At this time, too, the idle bulls, which were unable to obtain cows earlier in the season, secure a cow or two, either young or old, and establish small and temporary harems—temporary because there are no young to cause the cow to return after she has again taken to the water.

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[1] In this connection I would like to express my obligations to Capt. W. H. Roberts, as well as to the officers of the *Rush*, for the cordial assistance rendered in securing material and for the interest taken in the work. It is not a pleasant, and often no easy, task to transfer several boat loads of greasy, bleeding seal carcasses from the decks of a sealing schooner to the revenue cutter, but the work was most cheerfully done, and the material thus secured was invaluable.

[2] Mr. Townsend made a commencement of this work in 1892, but it was not prosecuted vigorously until 1895.

[3] A curious feature in the seals is the voluntary or involuntary withdrawal of the testes from the scrotum. From the study of a few individuals it seemed probable that, as in squirrels and many other animals, the testes were completely retracted at the end of the season; but more extended observations by Mr. Clark and myself showed that while this was to some extent true, much depended on the position of the animal, and also that they seemed to be under the animal's control. When a seal lies on his back, the testes are pressed backward and appear; when he rolls over and starts to walk away, they are wholly or partially withdrawn, thus furnishing a safeguard against injury when the animal is running about over rocky ground. See also page 18.

The young females come on the rookeries for the first time after the harems of adults have broken up, and there is more or less admixture of seals of all ages. They are not in the harems in June or early in July, and in 1896 they were first seen on St. Paul July 27, and on St. George July 28, their appearance on the two islands being thus practically simultaneous. As to the age of these cows and the fact that this was their first appearance on the rookeries there can be no question; the yearlings and 2-year-olds are readily known by their size, while to settle the point beyond dispute, two young cows were shot and examined on July 28, both proving to be 2-year-old virgin females. From the last of July until about the end of August these 2-year-old cows were numerous.

The congested condition of the blood vessels and the presence in both ovaries of Graafian follicles in various stages of development show that in young females coming to the rookery for the first time both branches of the uterus are functional, and impregnation may occur in either. The young are borne alternately on either side, and if, for example, the first pup is developed in the right branch of the uterus, the second will be borne in the left, first one ovary then the other being functional. The reason for this alternation is that the time between delivery and coming in heat is so short that there is not sufficient time for that branch of the uterus in which the young was developed to resume its normal condition, this operation probably requiring six weeks. All this was very well demonstrated by Mr. Townsend in his report for 1895, and his statements have been corroborated in every particular. The difference in size between the ovaries, and particularly between the branches of the uterus, is usually perceptible, not only to the eye, but to the touch, until late in August or early in September, although by that time specimens will be met with in which the impregnated branch has commenced to swell while the other has nearly or quite resumed its normal size. After the maturing and impregnation of an ovum the other Graafian follicles appear to be absorbed, since in ovaries examined in September where the corpus luteum was well advanced the Graafian follicles were small.

There is not the slightest evidence to support the theory advanced by Dr. Slunin that the seal breeds biennially, for all evidence tends to show that from the third year onward throughout life the female brings forth a pup annually.

It is commonly stated that the females come in heat within 48 hours and that the period of gestation is about 360 days, but more accurate information is needed on these points, and I am inclined to doubt the correctness of the above statements, or at least am unwilling to accept them as a general law. From data obtained in 1897, given in full at the end of this chapter, it would seem that from three to six days elapse between the birth of the pup and the coming in heat of the cow. In 1895, the season being late, Mr. Townsend made the following observations on the condition of the harems June 25 and 26: "The harems in course of formation along the beaches were as yet very small, the average number of females in each being five. About one-fourth of the females were nursing new-born pups, the others being conspicuously gravid. Some sections of rocky ground were still covered with snow, and a number of new-born young with the red placentæ still attached were lying upon the snow. Occasional females were noticed arriving from the sea, but none were seen leaving. There were no signs of any then coming into heat." If the interval between delivery and coming in heat is so short as generally supposed, it would seem that some of these females should have evinced some signs of desire. Moreover, if the period of gestation were uniformly 360 or even 350 days, since the 2-year-old females do not make their appearance on the rookeries until the last part of July, it would finally come to pass that all the young would be born late in July, which is not the case. The known facts are that the majority of pups are born between July 1 and July 15, but quite a number of births take place after that date, occasional births occurring up to September 1. A small, black pup was, however, killed on Kitovi, on October 16, which was in good condition and weighed only 14½ pounds. This could, at the most, have been only a month old, very likely not even that, and must have been born in September. A large number of these small, late pups were seen on the various rookeries in October, so that scattering births certainly occur as late as the first week in September. On account of these late births, and the date at which the 2-year-old virgin cows make their appearance on the rookeries, there can be little doubt that the first period of gestation is shorter than the succeeding ones. Were this not so we would find a larger percentage of births late in the season, and it would be impossible to account for the retrogression of births toward the early part of June and July. Mr. Clark, who has devoted some time to this question, writes as follows:

The height of the season falls about the 10th or 15th of July, and it is reasonable to suppose that the number of cows then visible and the increased number of births about that time are due to the influx of the 3-year-old cows which come to bring forth their first young. These 3-year-old cows were impregnated about August 1 of the preceding year. If we suppose that the first period of gestation is 350 days, this would bring the time of delivery about July 15. If the interval between delivery and impregnation is about five days, the period of gestation remaining the same, the second birth would fall about July 5, the third June 25, the fourth June 15, the fifth June 5, which is impossible, or at least a sixth would be, for no births are recorded before June 10.

If, however, we consider the second and succeeding periods of gestation to be about 355 days, the interval between birth and impregnation remaining the same, the births would fall as follows: Second, July 10; third, July 5; fourth, July 1; fifth, June 25, etc., the eighth falling on June 10. The cow would then be 10 years old, probably still in bearing condition; but there is every reason to suppose that the period of interval between delivery and impregnation is less than five days. This figure, as well as the one representing the period of gestation, has simply been taken arbitrarily for purposes of illustration. With shorter intervals, say of three or even two days, the number of births necessary to cover the interval in which births can occur would be increased.

This is purely a theoretical discussion of this matter. The data regarding the period of gestation and the interval between delivery and impregnation are wanting, and it would require several seasons of painstaking observations to supply them. But we have definite information regarding the time at which the virgins are first served. We also know that the great mass of pups are born before or about the middle of July, and we know that pups are born as early as June 10 to 12. That a cow which was originally impregnated about August 1 can eventually bring forth a pup in early June can only be accounted for by supposing a retrogression of the time of birth, for it must be the oldest cows that bear their pups in early June.

In order to definitely settle the matter careful observations of the younger cows are needed, although the investigation is fraught with much difficulty.

Mr. Clark, who witnessed the birth of several pups, writes:

In bringing forth her young the cow seems to take no thought as to her place. One pup was observed to be born on a slanting rock down which it slipped as soon as released. The mother reached down and lifted it up to her side only to have it slide down again. She repeatedly lifted the pup back, and finally changed her position. Another cow was seen with her new-born pup on a narrow shelf which was scarcely large enough for herself, and from which the pair were in constant danger of falling off. The pup must have been born there, but how is a mystery.

The pup is born with the head first, though one birth was this season witnessed on St. Paul where the hind flippers came first. Delivery seems easy. The cow shows but little evidence of pain, though before delivery she shows more or less uneasiness, changing her position frequently, getting up and lying down as sheep do. In the case of three births witnessed a copious discharge of water preceded delivery. The cow shows no disposition to lick or otherwise dry her pup. She fondles and calls over it, smelling of it, and will lift it out of the way of danger, taking it by the skin of the back as a cat would her kitten. Soon after delivery the mother draws the pup toward her breast as if to have it suck, and it is not long before the pup is able to do so. In the case of one birth witnessed the cow by swinging about immediately separated the pup from the placenta, which was not delivered within half an hour after the birth of the pup. That there is difficulty in breaking the umbilical cord in some cases is evidenced by the fact that one pup was found imprisoned in the rocks attached by an unusually thick cord to a rotting placenta. The pup, though a week or more old, had not moved from its place; its flippers were white and it was unable to use them when released. It had probably not moved from its place since birth. Another pup, strong and healthy, was seen walking about with the dried placenta attached to it by a very thick cord which greatly impeded its movements.

While the female is sexually mature at the age of 2, the uterus and ovaries do not attain their full development until some time later, the difference in size between the ovaries of the 2-year-olds and those of the older females, though slight, being quite noticeable. There is, however, a considerable amount of individual variation in the size of these organs not dependent on age, and it sometimes happens that the ovaries of a breeding female are smaller than those of a 2-year-old. The following measurements, taken from carefully preserved alcoholic specimens, may be taken as giving the average size of the ovaries: Two months, 10 by 13 mm.; one year, 15 by 17 mm.; two years, 22 by 25 mm.; adults, 23 by 25 and 25 by 28 mm.

As the development of the fetus is extremely slow while the cow is nursing, the embryo is consequently so minute during August and September as to escape detection, unless carefully looked for under favorable circumstances and with the most approved appliances. The question as to whether or not a female has been impregnated therefore depends on the condition of the ovary, and it might naturally be asked what reason there is to suppose that a scar on the ovary is not merely due to the rupture of a Graafian follicle. In answer to this it may be said that of the 146 ovaries of adult nursing females, examined by Mr. Townsend and myself, all bore a single old scar on the ovary corresponding to that branch of the uterus in which delivery had last taken place. In 78 specimens examined by Mr. Townsend in 1895 there was an unquestionably fresh scar on 68, and on reexamination 7 of the 10 doubtful cases proved to have been impregnated. The exact condition of the remaining 3 will never be known, as they were not preserved, but they, too, may have been impregnated. The 68 specimens collected in 1896, with one exception, bore a recent scar on the ovary functional for the season, although in these instances the fact was not apparent on a first examination.[1] In specimens obtained early in September, the corpus luteum and corresponding branch of the uterus had increased in size, showing clearly that impregnation had taken place, and since in no case did an ovary bear more than one scar it is not assuming too much to say that in the fur seal ovulation is practically synonymous with impregnation. That this should be so is not surprising when it is considered that a female, after entering a harem, is held there by the bull until he is satisfied that she may properly be allowed to leave; that back of the harem and along the water front are idle bulls waiting for stray females, and that finally when the harem system is relaxed there is an influx of young bulls who before this time could not enter the rookeries, and who would be likely to discover if any female were still unimpregnated. In the possible event of a female escaping impregnation when the first Graafian follicle reached maturity the next advanced follicle would ripen, and as

[1] In all doubtful cases the specimen was preserved and subsequently examined in company with Dr. William Gray, of the Army Medical Museum.

no less than eight to twenty follicles in various stages of development are to be found in an ovary the chance of a female ultimately leaving the rookery unimpregnated is very small. It is evident also from the actions of the old bulls, a certain percentage of whom return in September to their places on the breeding grounds after feeding, that should any cow fail to be served in June, July, or August she would find service even in September. Microscopic examinations made by Dr. J. J. Carroll put this beyond doubt. Sections made from the testes of a bull killed August 26, which had recently withdrawn from the rookery, contained no spermatozoa, while sections made from a bull killed October 17, contained spermatozoa in great numbers. In the old bulls the testes are more or less withdrawn from the scrotum at the close of the breeding season, simultaneously with the withdrawal of the bull from the rookery, and his demeanor is completely changed. From being alert and aggressive he becomes quiet and timid. Instead of perpetually quarreling with his neighbors, bullying the bachelors and savagely resenting the intrusion of man, he lies down to sleep with seals of all ages, and flees precipitately from the sight or smell of a man.

That such belated service sometimes occurs is borne out by the fact that several hundred small black pups were noted in October on the rookeries of St. Paul. One of these, killed on October 18, was found in good condition and with stomach full of milk. It weighed 14½ pounds. An unborn fetus, taken from a cow on Zapadni Reef August 14, weighed 11 pounds, and the experimental pup, taken from Tolstoi rookery on August 1, supposed to be about a month old, weighed 12 pounds. A gray pup, killed at the same time as the small black one, weighed 29 pounds, and two weeks before a similar pup had been killed on the same rookery which weighed 33⅝ pounds. The little pup could not have been much over a month old, and therefore must have been born in September.

As a result of the examination of 146 ovaries of adult cows it can safely be said that there is nothing whatever to corroborate Dr. Slunin's statement that it is possible to determine from the appearance of the ovaries how many young have been borne by a cow. In no case were two scars present on an ovary, to say nothing of there being a greater number, and while in a single instance there seemed to be two scars on one ovary a section showed that the appearance was merely superficial and not due to the rupture of an ovum. The scar of impregnation, corpus luteum, develops very slowly and slowly disappears, a cross section of the ovary revealing its presence long after all traces have disappeared from the surface. Dr. Slunin, it is stated, examined the ovaries in alcohol, and he probably mistook the slight depressions caused by the shrinkage of the Graafian follicles for scars. A section of the nonfunctional ovary shows it to be a fine-grained, homogeneous mass with no developing follicle, while the ovary which is for the season functional may have as many as eight Graafian follicles in various stages of development.

Careful search was made for "barren cows;" 3 females found with the bachelors were killed for examination, and the ovaries of all females taken during 1896, 82 in number, young and old, were carefully studied, but in every case save one the females were found to be fertile, and in the majority of cases pregnant. The single exception was an adult cow, probably 5 years old, in which the genito-urinary system had failed to develop, the ovaries and uterus being no larger than in a yearling.[1] The

[1] This animal was killed on St. Paul while I was absent on St. George, and was examined by Dr. Otto Voss, the resident physician, and by Dr. Jordan.

right ovary contained a single small Graafian follicle, but there was no sign of impregnation or of capacity for impregnation, neither ovary showing any traces of a scar or of the presence of a corpus luteum. The results of this examination are recorded as follows in the diary:

On August 1 a barren cow was found in a pod of bachelors on the parade ground on Reef rookery. From an examination of the teeth and skull she was found to be an adult cow, probably about 5 years of age. She was above medium length but slender, and of rather less than medium weight. The throat was very dark brown in color, rusty below as well as above. She was killed for purposes of study. On examination the mammæ were found to be fairly large and to have undergone pathological fatty degeneration. The glandular structure was obliterated. The ovaries were found to be small, about one-fourth the size of those of the virgin 2-year old cows recently examined. The fallopian tubes and uterus were similarly atrophied. The right ovary contained a small Graafian follicle and egg. The germinal spot was visible in the egg and not impregnated. There was evident no sign of impregnation or of capacity for impregnation. No signs of corpus luteum or scars of previous impregnations were visible. The opening of the bladder was so small as to require a probe to find it. There was no trace of hyperæmia, the tissues being pale and bloodless.

This is the sole recorded instance of a cow positively known to be barren. That female seals should occasionally be barren is not surprising, but that any number are habitually so, either from lack of bulls or any other cause, is wholly unsupported by any evidence and directly opposed to all known facts. That cows not in milk may be taken at sea or elsewhere is self-evident from the fact that 11,000 dead pups were found before August 15, but that these cows or any part of them are barren or unimpregnated can only be determined by an examination of the ovaries, while, from the number of recorded observations, the presumption is that although dry they are pregnant. Therefore statements that have been made to the effect that the females taken at sea, when over 2 years of age, were largely barren cows or nonbreeding females are either deliberate falsehoods or the result of crass ignorance of evident facts. Not only are these statements wholly unsupported by facts, but a most astonishing feature about them is that they have been made by men who were not only incapable of telling from examination whether or not a female was barren, but who actually never made a single examination to ascertain the truth of their assertions.

When the power of procreation ceases is unknown, but there is every reason to believe that ordinarily it lasts throughout life. No bulls were seen so old that they did not possess or strive to possess harems, while the very oldest female obtained was nursing and, but for a pelagic sealer, would have borne a pup in 1897. Here we have only the unsatisfactory corroborative evidence to be derived from domesticated animals, but we know that many of these breed throughout life, in spite of the fact that as they live under artificial conditions they attain a much greater age than they would in a state of nature, where the old and feeble are soon eliminated. So if an animal breeds during its entire lifetime in a state of domestication, it is pretty safe to affirm that it would do so in a state of nature, while from the rarity of unpaired males or females among wild animals during the breeding season it is a pretty safe inference that they breed throughout life. Many horses breed as long as they live, and while mares often cease to bear at the age of 22, the celebrated mare Primrose bore her twentieth foal at the age of 28. The supposition that the female fur seal bears throughout life receives strong support from the examination of a female sea lion (*Eumetopias*) killed for the purpose of obtaining, if possible, related evidence on this point. The animal, as shown by the condition of the skull and the skeleton generally, was extremely old, and yet, like the fur seal previously mentioned, had borne a pup in the spring and was prepared to bear another in the spring of 1897. An old hair seal, *Phoca largha*, taken at Marunichen, was also fertile, and it may be said that so far no female seal so old that she has ceased to breed has been taken.

The age to which fur seals attain is still problematical, and until careful experiments have been made it can only be stated approximately. The females have a complete dentition at the age of 2, but the canines of the males are not full-grown until the age of 5. The moustache is black in the young and whitens with time. Any female with moustache entirely white can safely be placed as older than 4 years, and any male as older than 5. Beyond that it is difficult to say more than that a seal is old or very old, so much may be affirmed from the condition of the true molars, but as to the exact number of years there are no data. Mere size is no criterion, for the variation in this respect is so great that a small animal may be much older than one of greater bulk. Neither is the wear of the teeth a sure guide, unless checked by some other character, for the younger of two animals may have the more abraded teeth, although from the general appearance of the teeth, and especially the amount of absorption they have undergone, it is safe to say that the individual is adult, middle-aged, or old. The various parts of the skeleton must be used with caution, since some portions seem much older than others, and unless a person has had experience, he would be sure to think the humeri belonged to a much older animal than the vertebræ. Although the larger size and slower maturity of the bulls incline one to the belief that they reach a greater age than the females, it is fair to say that no skull of a bull whose teeth would indicate an age so great as that of some females obtained has come under my notice. But, coupled with this, is the fact that the procuring of bodies from the pelagic sealers has made it possible to secure a much larger proportion of adult females than of adult males, so that while something like 75 skulls of females, mostly adult, were available, there were not more than 25 skulls of old males.

There is, however, another possible reason for the lack of very old bulls. As stated in the chapter on mortality, the death rate among females is probably very high, but it is also probable that the causes by which the death rate is influenced act evenly throughout life, and the struggle for existence among females is mainly with natural conditions. The males not only fight against surrounding conditions, but with one another, and this last factor must act more and more severely with advancing age, until the time comes when an old bull is driven out by some younger, stronger rival, and retires from the rookery grounds only to die. This, of course, is pure theory, but it accounts for the fact that among the male skulls picked up in various localities there were none that appearred so old as some of the females. This does not necessarily mean that the males do not attain a greater age than the females, for as these last, as shown by the dentition and age at which they are sexually mature, reach maturity sooner than the males, they naturally grow old sooner as well.

The question of the proper proportion of males to females is purely problematical, and the only data obtainable for comparison are such as can be derived from domesticated animals, and as these are living under more or less artificial conditions such data must be used with caution. With sheep 1 ram is deemed sufficient for at least 50 ewes, and with cattle 1 bull to 20 or 25 cows on a range, or 1 to 50 where they do not run at large. When running at large a single stallion is sufficient for from 20 to 40 mares, but when under control the number may be much larger, well on toward a hundred. Among fowls, of what may be called the more natural breeds, having an ample range, 1 cock suffices for 30 hens. So that, using domesticated animals as a basis for comparison, we may say that 1 male to 30 females is well within the safety limit. But these animals are naturally only polygamous to a comparatively small extent, and the discrepancy in size between the sexes is slight, while the fur seal is polygamous to a great degree by nature, the males are at least four times the bulk of the females, and the necessary proportions of males to females is evidently much smaller. Elliott figures 18 breeding females in a harem, and says that on the rookery there are 15 to 20 females to 1 male, a number in practical accord with the average derived from counting a very large number of harems, and this, with the doubling now known to be needed, brings the number of cows up to 36 or 40.[1] Moreover, in 1896 the proportion of idle bulls was very great, there being 2,996 waiting bulls and 5,009 bulls with harems, so that in consequence the harems may be considered as comprising the minimum number of cows. While 18 is an average number of cows present in a harem at the height of the season, the proportion of cows to a bull varies immensely, much depending on the location of the bull and his ability to hold his station against all comers. During the season of 1896 there were many bulls which were able to secure but a single cow, and many others which had only 3 or 4, while some possessed as many as 50, and one, the greatest polygamist of them all, had no less than 135 rounded up at one time. This old fellow stood at the head of a broad gully and at the foot of a slope on North rookery, St. George, and from his position he was able to intercept all cows which sought to haul out on the hillside above, while from his strength and prowess he was able to fight off the bulls back of him. The number of cows was, however, too great for him to control throughout the season, and later on the waiting bulls in the vicinity and those with smaller harems took possession of part of the seraglio. A similar immense harem was formed on Gorbatch early in the season of 1897 by a bull who commanded the passage leading from a section of the beach to the slope above, and this, too, later on resolved itself into a number of smaller harems.

The landing of the cows is to a great degree influenced by the character of the shore, shelving rocks, gullies running conveniently inland, or little openings among large bowlders, determining the spots where the females will come on shore. Thus, a readily accessible gully on the eastern end of the amphitheater of Kitovi is the natural inlet to that portion of the rookery, and up this come the cows to form the harems, while on the western side access is over sloping rocks. Once two or three cows have located themselves, others follow the gregarious instincts of the seals, thus leading to disproportionately large harems in favored localities.[2]

Thus the condition of the harems is largely influenced by, if it does not depend entirely on, the lay of the land. Also, where a rookery can be more or less indefinitely extended inland, as back of Polovina, or on the hillside at Staraya Artel and Zapadni, there is room for all idle bulls to accumulate at the rear; where a rookery is so hemmed in by a cliff as to be incapable of extension backward there are few

[1] In 1895 Mr. True counted on Kitovi, between July 8 and 10, 2,640 cows in 153 harems, an average of a little over 17 to a harem. In 1896 Dr. Stejneger and myself, on July 13, counted on the same ground 3,152 cows in 182 harems, again a little over 17 to a harem. In 1895 on the southern part of Tolstoi there were on July 11, 1,624 cows in 107 harems, and in 1896, on July 14, 1,498 cows in 108 harems, or respectively about 15 and 14 to a harem. On the above-mentioned rookeries, and particularly on Tolstoi, it is possible to count the individuals with great accuracy.

[2] For note on the landing of cows see Part II, p. 523 and after.

idle bulls, since all the cows are appropriated by the two or three lines of bulls between the water and the cliff. The small size of many harems is thus due to their being located in the inner portion of the rookery, where the bulls are unable to obtain many cows, or where they obtain them by capture. Where the harems are small the bulls appear to be less active and quarrelsome than where they are large, as if they fully understood that it is less trouble to manage a small family than a large one. This, however, may be a misinterpretation of the facts in the case, for the smallness of the harem may have been due to the inability of the bull, on account of lack of fighting qualities, to secure a large number of cows.

If 35 cows is the minimum average for a harem, 50 or 60 would be what might be called a good working proportion, and so long as the harems do not, on the average, exceed this, there is no reason to suppose that the number of bulls is too small. The small proportion of bulls actually necessary for the continuance of the fur-seal herd is indicated by the conditions on Bering Island, where for many years every male over a year old which could be secured has been promptly killed. Not only is there a complete absence of idle bulls, but on the South rookery there are at most only 6 bulls to 500 to 600 cows, the exact number of the latter being unknown. Notwithstanding this small number of adult males, there is no evidence that, with the aid of the younger males, it is not quite sufficient for breeding purposes, since there is no apparent dearth of pups.

This is not brought forward as an argument in favor of such close killing, which under ordinary circumstances would be wholly unjustifiable, but to show how few bulls are actually needed. The justification for this close killing is found in the existence of pelagic sealing, which spares nothing, and renders it proper and desirable to secure every available male seal on land, so as to leave as few as possible to be killed at sea. The difficulty of so exterminating the males that the seal herd would not recuperate if left to itself is well shown by the history of Robben Island,[1] which ever since 1854 has suffered from the most reckless slaughter, every effort having been made time and again to secure every individual seal on the island. And yet, again and again, after brief periods of rest, the seals have been found in greater or less numbers, and even in 1896, after forty years of slaughter, there were about 1,000 seals of all kinds left, and it was possible to secure 260 skins.

Robben Island is also a good illustration of what would happen were it possible to put an end to pelagic sealing, for if seals continue to exist in any numbers when their sole protection is preservation from being killed on land, it is easy to see how they would increase if not taken at sea.

The size of the harems and the number of surplus bulls is a safe guide to the condition of the rookeries for breeding purposes, the increase or decrease of the total number of seals being naturally quite another thing, although the two should be carefully compared with one another. If the number of surplus bulls is large, and the size of the harems small, either the rookeries are shrinking or the number of bulls increasing, and immediate steps should be taken to ascertain which is the case, in order to decide whether more seals may be advantageously killed, or whether there is an unsuspected number of deaths among the cows. The total disappearance of the idle, waiting, or reserve bulls, as they have been variously called, would be a warning of the most emphatic nature to immediately lessen the number to be killed,

[1] See Stejneger, The Russian Fur Seal Islands, pp. 54–58.

for since the seal herd is for a great portion of the year quite beyond the control of man it will always be necessary to allow a liberal margin of bulls for breeding purposes.

As to the proportion of the sexes at birth, the result of several counts, made at various times and in various localities, shows that the number of males born appears to be slightly in excess of the number of females. In 1872, during the killing of pups for food, Mr. Elliott found that 855 out of 1,670 young were males, while other parties counting at the same time, though possibly with less care, found 3,945 males out of 7,330 pups.

In 1896, 750 pups were examined for sex, and 388 proved to be males, a number in substantial accord with the results obtained by other observers. These results will show a little more closely if put in tabular form:

	Total	Females.	Males.	Excess of males.
Counted by Elliott	1,670	815	855	40
Counted by others	7,330	3,395	3,945	550
Counted by commission	750	362	388	26
Total	9,750	4,572	5,188	616

The following table shows the age and condition of female seals taken in Bering Sea during the month of August and the early part of September:

[Examined by C. H. Townsend between August 11 and August 21, 1895.]

Yearlings	14
Two years old	12
Over 2 years—all nursing	78
Total	104
Pregnant 2-year-olds	5
Unimpregnated 2-year-olds	7
Pregnant nursing females[1]	75
Unimpregnated nursing females	3
Total	104

Age and condition of female seals examined in 1896.

Examined August 10 and 11:	
Two years old	3
Over 2 years old	43
Nursing, with milk abundant	35
Little or no milk	8
Pregnant	45
Examined September 3:	
Two years old	1
Over 2 years old	25
Nursing, with milk abundant	15
Not nursing, no milk	5
Probably not nursing, little milk	6
Pregnant	26

[1] These figures differ slightly from those given in Mr. Townsend's report for 1895, pp. 42–45, because reexamination shows that some marked questionable were pregnant.

Combining these tables, we have a total of 176 female seals taken during 1895 and 1896 between August 10 and September 3, which may be considered as fairly representing the age and condition of seals taken at sea. Of these 176, there were 14 yearlings, 16 2-year-olds, and 146 over 2 years old. All over 2 years old had brought forth young the season they were taken, and 151 of those 2 years old and upward were pregnant. The total number of seals examined whose condition was at all uncertain was 11, and 7 of these were 2-year-olds examined before August 22, and these might have been impregnated later in the season. Moreover, in 9 of the doubtful cases the ovaries were not preserved, or examination under more favorable circumstances might have lessened even this number, for the corpus luteum does not show so clearly in fresh specimens as in those which have been hardened in alcohol. The exact condition of some of the specimens taken during 1896 was questionable when the ovary was fresh, while later examination showed that, with one exception, all the doubtful cases were pregnant. These tables show very clearly what has been so well stated by Mr. Townsend—that the majority of females at sea are both nursing and pregnant, so that the killing of one female is practically the loss of three seals, and pelagic sealing not only is the burning of the candle at both ends, but in the middle as well.

On Pl. XI are shown a number of ovaries bisected to show the appearance of the scar of recent impregnation (corpus luteum) and the vanishing scar (corpus albicans) of former impregnation. The scar resulting from the simple rupture of a Graafian follicle soon disappears, but when impregnation has taken place the scar continues to develop for some time, and does not disappear until some little time after delivery. Old scars were plainly visible, after immersion in alcohol, on the ovaries of seals killed in September, although delivery must have taken place a month or six weeks previously.

NOTES BEARING ON BREEDING HABITS.

The first instance of copulation seen occurred on Tolstoi sand flat June 22. The harem contained a single cow, with a pup apparently 2 or 3 days old. Nothing is known about the arrival of the cow or the birth of the pup, but neither was present on the 16th when Tolstoi was first visited.

The second copulation was witnessed at 3.30, June 23, on Lukanin, in a harem of five cows. This harem was formed during the night of the 19th, three cows being present in it at 8.30 on the morning of the 20th. As the harem lay at a distance from observation points, no record of the birth of pups can be given.

The third copulation occurred on Lukanin in a harem containing nineteen cows. The harem was formed with one cow on the 18th, first seen at 9 a. m. Her pup was born between 8 and 9 a. m. the following day. The other cows were added to the harem on the 20th at 10.30, and a fourth at about the same hour the following day. Two additional pups were born to the harem at 3 p. m. on the 21st. The time of copulation was 9 o'clock, June 26.

The fourth copulation was witnessed in the harem which has the cow that has been present since the 12th without a pup. A second cow joined this harem on the 21st at 10 o'clock, and her pup was born at noon the following day. There are now five cows in the harem, but three are recent arrivals. The time of copulation was 9.30 o'clock in the evening of the 27th.

The fifth copulation was observed by Mr. Adams in a harem founded with a single cow on the 21st. She was alone until the 23d, and on the 25th had three companions. No records of births for this harem are available. The time of copulation was at 10.15 a. m. on the 27th.

The sixth instance was observed at 5 p. m. on the 28th by Mr. Adams in a harem founded with a single cow on the 18th at 9 a. m Its history, so far as known, is given under the third instance.

A seventh case of copulation was witnessed by Mr. Adams at 4.30 p. m. of the 29th in the same harem as above noted in the third and sixth instances.

The eighth case of copulation also occured in this same harem. The time was 9.30 p. m. of the 29th.

The ninth case reported by Mr. Adams occurred at 3.05 p. m. of the 29th in a harem formed with a single cow on the 21st. The harem was not favorably situated for observation, and grew rapidly, having thirteen cows on the 25th. No records of births are available.

A tenth case of copulation was observed by Mr. Adams at 5.30 p. m. of the 30th in the harem noted under the fifth instance.

SUMMARY OF OBSERVATIONS ON ARRIVALS, BIRTHS, ETC.

The first cow seen on St. Paul, Lukanin rookery, at 4 o'clock, June 12; not seen on the afternoon of the preceding day; has not had a pup to date, June 22.

Two cows first seen on the amphitheater of Kitovi at 4.15 on June 14; of these one was seen to give birth to a pup at 3.30 on the afternoon of the 15th; the second cow gave birth to her pup at 3 o'clock on the 17th.

A cow first seen at 4 o'clock, June 12, on Lukanin rookery, was seen to have a second cow with her on the 17th, at 8 o'clock; both cows had then pups.

Two cows were first seen on the evening of June 15, at 9 o'clock; one of them had a pup at 8.30, June 17; it was not present at 5 o'clock on the 16th. The second cow could not be traced, owing to the fact that other cows were added to the harem before a second pup was born.

On Lukanin rookery at 8 o'clock on the morning of June 17 a cow with her pup was seen; the pup was evidently not many hours old; neither cow nor pup was present at 5 the preceding evening.

On Gorbatch a cow not present at 5 o'clock on the 16th was seen at 1.45 by Mr. Adams with her pup.

A cow was first seen at 9 o'clock a. m. of the 18th; she had no pup at 9 p. m. of the 19th, but at 10.03 of the 20th she had a pup with her.

A cow was seen to land at 3.30 on the 18th, and her pup was seen to be born at 3 o'clock on the 20th.

A cow landed at 2 o'clock on the 19th, and her pup was born between 4.30 and 8 o'clock on the 20th.

A cow was first seen at 9 a. m. on the 18th; she was seen with a pup at 9.45 on the following morning.

A cow was first seen on the 18th at 9 a. m.; she had a pup at the same hour the following day.

A cow was seen to land at 1.45 on the 17th on Gorbatch rookery; her pup was born between 11 and 3 o'clock of the 20th.

Many other cows were noted on landing, but became confused through additions to the harems before their pups were born. In cases of the cows mentioned the identification was clear.

A cow landed between 3 and 9 p. m. on the 20th, and her pup was born between 5 and 8.30 the afternoon of the 21st.

A cow arrived at 3.30 the 20th and bore her pup at 11 o'clock on the morning of the 21st.

A cow arrived on the 19th at 9.30 a. m. and bore her pup at 4.15 of the 22d.

EXPLANATION OF PLATE XI.

1. Uterus and ovaries of an old fur seal, ventral aspect. A triangular section has been removed from the wall of the uterus to show its complete division into two portions. Delivery has taken place in the left branch (shown on right side), and the scar of recent impregnation is visible in the right ovary (at left of plate).

2, 3. Ovaries of a 2-year-old female, showing corpus luteum in left ovary. Degenerate Graafian follicles appear in both ovaries.

4, 5. Ovaries of old female, showing corpus albicans in left ovary, 4, and corpus luteum and degenerate follicles in right ovary, 5.

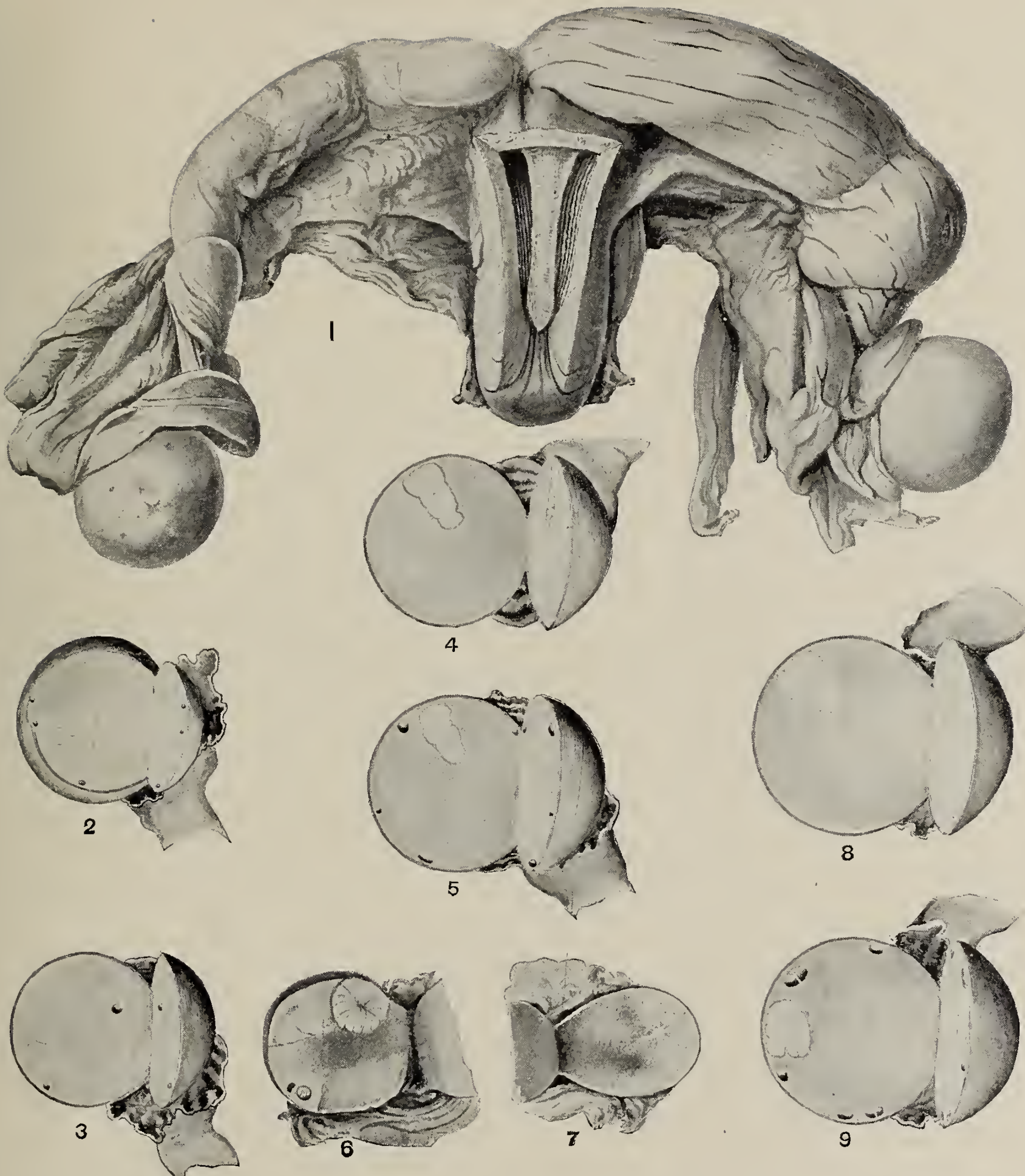
6, 7. Ovaries of an old female, showing corpus luteum in left ovary, 6, and almost absorbed corpus albicans in right ovary, 7.

8, 9. Ovaries of an old female, showing corpus albicans in left ovary, 8, and corpus luteum and numerous Graafian follicles in right ovary, 9.

All figures of natural size. Nos. 1, 6, and 7, by Dr. J. C. McConnell; 2, 3, 4, 5, 8, and 9, by A. H. Baldwin, from alcoholic specimens.

A TYPICAL HAREM, "HAREM 25" ON GORBATCH.

MASSED HAREMS AND IDLE BULLS ON TOLSTOI.



UTERUS AND OVARIES OF FUR SEAL.

For explanation see page 57.

IV.—THE FOOD OF THE NORTHERN FUR SEALS.

By Frederic A. Lucas.

Our knowledge of the food of the fur seal is based almost entirely upon data and material collected by Mr. C. H. Townsend, although Mr. A. B. Alexander and Dr. C. Hart Merriam have made contributions to the subject, and while there have been some statements as to what the seals ate, and some theorizing as to the amount of fish destroyed by the seal herd and its effect on the Alaskan fisheries, these statements and theories have rested on no basis of observed facts. As Mr. Martin N. Johnson remarked at a hearing before the Committee on Ways and Means, "You can only determine what they (the seals) eat by an examination of their stomachs," and with the exceptions noted above, comparatively little of this work has been done. The material collected by Messrs. Townsend and Alexander has been reexamined in order to ascertain not only the species, but, in the majority of cases, the number of individuals of each species eaten. One result of this examination has been to show that the fishes recorded as cod were invariably pollock, the exact determination being previously impossible owing to the lack of material. In this connection I would like to express my obligations to Mr. Barton A. Bean for assistance in identifying the fishes, and to Prof. A. E. Verrill for identifying the cephalopods.

Up to the time that the pups leave the islands they subsist entirely on milk, and while small quantities of other things are found in their stomachs, these are swallowed for the same reason which causes the older seals to swallow similar objects, and there is not the least iota of evidence to indicate that before November pups derive the slightest sustenance from anything save their mother's milk.

In view of the size of the pups at this time this may seem surprising, but the largest gray pups were found starved to death, while the examination of a number killed for the express purpose of determining whether or not they fed on anything save milk showed conclusively that they did not. Seaweed, small crustaceans and tunicates are found in infinitesimal quantities, but these are not taken for food any more than are the fragments of shells and the pebbles which are so often present, and no one has ever claimed that bits of succulent lava were eaten for the nourishment they contained.

During the fall of 1896 a number of pups were killed in order to determine if possible the time of weaning and to ascertain whether or not the pups fed on anything save milk. While a few of the stomachs contained crustaceans, in only one case were they present in sufficient numbers to indicate that they had been taken as food. In this single instance, a gray pup taken on October 5, the stomach contained remains of 150 amphipods, but as the pup was dying from starvation it is evident that he was deriving little or no subsistence from this source. The following record by Mr. Clark shows the number and condition of the pups examined:

August 29: Pup killed on Lukanin; stomach contained only milk.

September 11: Male pup accidentally smothered on Kitovi; stomach empty.

September 22: Two male pups taken on rocks at the warehouse; both stomachs contained milk only.

September 26: Two large, well-nourished pups, one male and one female, found freshly dead from drowning on Lukanin Beach; stomach of female empty; male full of milk only.

September 28: Pup with deformed nose killed at Zapadni; stomach contained milk only.

September 30: Large black pup accidentally killed by falling over a cliff; stomach contained milk only.

October 1: Large gray female pup killed on Gorbatch; stomach contained milk and two small crustaceans.

October 5: Starving gray pup in dying condition on the reef killed; stomach contained a few crustaceans and several shreds of seaweed.

October 6: Two pups killed on Tolstoi; milk only found in their stomachs.

October 11: Two large gray male pups killed on Gorbatch; stomachs empty.

October 13: Two pups, male and female, killed on Lukanin; stomach of male empty; of female contained milk only.

Two large gray pups killed on Kitovi; stomach of one full of milk; of the other empty, except for one small tunicate.

October 14: Three pups killed on Kitovi. (1) A starving pup, stomach containing one soft-shelled crab; (2) a very small pup, stomach full of milk; (3) a large gray pup, stomach empty.

All stomachs examined contained pebbles.

October 20: Gray pup shot in water of Zolotoi, playing with seaweed; stomach full of milk; excrement in rectum and intestines like that seen on beach.

Not only does the young fur seal feed exclusively on milk, but it feeds on the milk of one cow, and that cow its mother, for the fur seal never knowingly nurses any pup save her own, and although a hungry pup may steal a few mouthfuls of milk from a sleeping cow, it will be promptly detected and cast out. While the female seal apparently cares little for her own offspring, she cares still less for that of another, and any strange pup is repulsed with a snap that plainly indicates the cow's feelings.

That the mother unerringly recognizes her own offspring can not for a moment be doubted by anyone who has watched the behavior of the females on the rookeries, and while very young pups may respond to the call of a strange cow they respond in vain. The cow will accept only her own pup, which, as among other animals, is recognized by scent, and will hunt for half an hour and nose over scores of young seals to find her own. Even after the right pup is found and recognized it is smelt of from time to time, as if the mother were afraid that she had made some mistake and wished to be reassured.[1]

[1] The following note will show what chance a pup has of nursing any cow save its mother:

"Reef, September 1. I see a little starving pup below me. He is moving about, calling out, and nosing about the breasts of sleeping cows. He has tried three, and been driven off with a growl and snap from the waking cow. He wanders some distance; comes up to a sleeping cow whose pup is either nursing or asleep with his nose at the nipple. The starveling takes hold and evidently nurses for some seconds; but the cow, as before, wakes and snaps at him with unwonted vigor. Her own pup has been asleep. Evidently she had been misled by the fact of his having recently been sucking. The starveling gives up and lies down." (G. A. Clark.)

It is hardly necessary to write these things for naturalists, but so much nonsense has been published concerning the food of pups, the possibility of their subsisting on crustaceans and kelp, and the probability of pups whose mothers were killed at sea being nursed by other cows that it is desirable to emphasize these points.[1]

The young seals are apparently weaned in November, at about the time they depart for the South, and after leaving they are doubtless forced to shift for themselves, and must learn to capture squid and fish or starve. It is not unlikely that losses at this period from failure to obtain food add largely to the roll of those who are missing the ensuing spring.

From the time he is weaned, onward, the food of the fur seal during a great portion of the year and over a large part of its range can only be surmised from observations of stomachs obtained in Bering Sea and the Gulf of Alaska. These indicate that the fur seal does not procure its food at any great depth, but that it feeds mainly on squid and such fishes as swim near the surface. In Bering Sea during August and September the pollock (*Theragra chalcogramma*) forms the staple article of food, a squid (*Gonatus amoenus*) coming next in importance, while some salmon and a few species of small fishes are also eaten. One of these last, although devoured in large numbers, and therefore abundant in many localities, is apparently new and is described on page 440 under the name of seal fish.

Mr. A. B. Alexander observes that the "material which has been found in the stomachs of seals taken in different parts of Bering Sea indicates that only a small percentage is composed of fish which inhabit deep water. It is only reasonable to suppose that when seals are in shallow water they feed on both bottom fish and those near the surface."[2]

Surface fishes, and especially squid, seem to be the natural food of the seal. In the stomachs that have been examined a variety of material was found, such as pieces of Alaskan pollock, salmon, and other fishes, but it has also been observed that in localities where squid are plentiful very little other food may be looked for. I am informed by hunters that on the coast of Japan and off the Commander Islands squid occur in great abundance, and that it is not an uncommon sight to see a half dozen or more seals together feeding on the tentacles of an octopus floating on the surface. Sealers find squid plentiful off the island of Kadiak, and in that locality they have often been found in large quantities in the stomachs of seals.

Outside of Bering Sea the food changes somewhat. The pollock grows rare to the southward, while salmon, herring, and rockfish become abundant. Doubtless these and other available fishes are eaten in numbers. We have no reason to suppose that the seal prefers the flesh of any one species to another.

Captain Todd says the food of seals taken near the mainland (northwest coast) consists largely of salmon, and that this is true of the Japan and Copper Island sealing

[1] In that treasury of misinformation, the Proceedings of the Paris Tribunal, is the following piece of testimony, introduced to show the probability of cows nursing strange pups, and although the Paris Tribunal is a thing of the past, this gem deserves to be preserved:

Q. "Is it common and easy to make ewes suckle other ewes' lambs?

"Yes. It can be effected by putting the skin of the ewe's dead lamb on the lamb she is desired to adopt, or by holding her and getting the lamb to suck her for a few days."

Very easy, indeed! The inferential spectacle of seal pups wandering over the rookeries dressed up in their brothers' cast-off clothes, or of half a dozen Aleuts holding a cow seal for a day or two while two or three other natives applied the pup, appeals vividly to the imagination.

[2] There is, however, no evidence of this except in the rare presence of cottoids noted beyond.

grounds, and Captain Magneson of the schooner *Walter Earle* reports that seals taken on August 25, 1894 (latitude 56° 13′ N., longitude 172° 44′), had been feeding on salmon.

The statements of sealers must, however, be taken with some allowance, as they are apt to jump at conclusions instead of reaching them by careful observation; and the mere fact that seals and salmon were found in the same locality would, to many, be proof conclusive that the one fed on the other. Dr. Stejneger's observations, quoted farther on, are to some extent opposed to those of Captain Todd, and show that in the immediate vicinity of the Commander Islands the seals have no visible effect on the fisheries. Mr. Barrett-Hamilton has very kindly allowed me to examine the specimens of seal food obtained by him on the Asiatic side, and from these it would appear that the seals feed on pretty much the same species there as they do in the eastern part of Bering Sea. A specimen from Robben Island contained bones of salmon (*Oncorhynchus*) and beaks of the ever-present squid (*Gonatus amoenus*), one specimen from the Commander Islands consisted solely of bones of the pollock (*Theragra chalcogramma*), one solely of beaks of squid, and a third of squid and pollock.

From data obtained by Dr. C. Hart Merriam it appears that a large portion of the food of seals found in the North Pacific, from 60 to 80 miles from shore, between latitude 56° 45′ and latitude 58° 58′, in April, consists of red rockfish (*Sebastodes*), and an almost equally large portion of squid (*Gonatus amoenus*), salmon and small fishes being also eaten to some extent.

No codfish (save in a single instance), halibut, or dogfish, is known to have been found in the stomachs of seals, and these species probably swim at too great depths to be taken, all facts in the way of stomach contents indicating that the seals invariably feed near the surface. Cod, halibut, and sculpin are abundant about the Pribilofs, but with the exceptions noted in the table of food, none of these have been found in the stomachs of seals, or in the spewings on the rookeries. While bones of cod have been in several instances recorded as part of the food of seals, reexamination has shown that in every instance the bones were those of pollock. Superficially the vertebræ of a large pollock resemble those of a small cod, and this had led observers who had no material at hand for comparison to set down cod as one of the fishes eaten by seals. The sculpturing of the vertebræ is, however, unlike in the cod and pollock, while other parts of the skeleton, the otoliths and portions of the gill covers, are so entirely different in the two that no confusion is possible. There is no evidence to show that the seal ever destroys more fishes than he eats, or eats one portion of a fish in preference to another, reports of hundreds of fishes being seen with the nape or throat bitten out requiring to be supported by proof to show that the seal was the guilty party. Nor is there anything to show that one species of fish is preferred to another. All is fish that comes to the fur seal's net, and the species which happens to be the most readily taken is the one which is most abundantly eaten.

Even dead fish may be eaten, for Mr. A. B. Alexander records having seen seals eating salmon which had been dead for several days, and on one occasion the head of a *Macrurus*, a deep-sea fish, dredged by the *Albatross*, was found later on in the stomach of a fur seal. Concerning the dead salmon Mr. Alexander writes as follows:

In June, 1894, the *Albatross* was lying in Dutch Harbor, Unalaska, and for several days I had been collecting, obtaining among other things a large number of salmon. After the ship's company had been supplied there was a considerable number left, which were placed in boxes, to be taken to

St. George and distributed among the natives. On arriving at St. George the sea was too rough to make a landing, and we were compelled to remain on board. Several days passed, and, in the meantime, the salmon were not improving with age. The usual number of seals were playing about the ship, and Mr. J. Stanley-Brown suggested that we feed them with the salmon. The first salmon had no sooner struck the water than it was grabbed by a seal and devoured. This, of course, attracted other seals, and soon quite a number were on the lookout for something to eat. Some six or eight salmon were thrown overboard, all of which were eaten.

And yet two seals which were taken to Woodward's Gardens, San Francisco, refused to eat, and starved.

Neither, so far as is shown by the stomach contents, does the seal feed on crabs or other crustaceans,[1] although these probably form a large portion of the diet of its cousin, the sea lion *Eumetopias.* But two stomachs of this animal have come under my notice, and they both contained fragments of the common crab of the Pribilofs and bones of sculpins, both indicating that the sea lion is a bottom feeder. It was, however, suspected that crabs must form a large part of the sea lion's food from the peculiar chalky nature of the excrement about the hauling grounds of these animals.

The hair seal found about the Pribilofs feeds to a considerable extent on the Octopus (*Octopus punctatus*), and to some extent on crabs, but in only one case has the remains of the octopus been found in a fur seal.

That the fur seal has a good, healthy appetite, and when he does eat amply makes up for his long fasts, may be inferred from the fact that bones of 5 good-sized pollock were found in one stomach and remains of 41 small pollock, about 6 inches long, in another, while a third individual had eaten 139 of the little sealfish. The Alaskan pollock certainly has a hard life in Bering Sea being preyed upon by the seal above and the cod below, and if any creature has cause to rejoice over the destructive work of the pelagic sealer that creature is the pollock.

In regard to squids, one male seal had, as indicated by the beaks, devoured at least 155, while a female had made way with no less than 210. It must be borne in mind, however, that this does not mean that all these were eaten at one time, for a study of the stomach contents shows that food is eaten and the hard parts regurgitated continually and irregularly, for while, as noted above, bones representing five pollock were taken from one stomach, by no means all the bones were present, and in other cases the stomach contained bones of several fishes in very different stages of digestion, indicating plainly that they had been eaten at different times.

The stomach contents of a seal taken on September 3, near latitude 57° 20′ N., longitude 172° 45′ W., illustrate this point very well, and also give some hint of the distance traveled by feeding seals. These contents consisted of some vertebræ of a salmon, much digested, the beaks of two squids, and the fresher remains of three small pollock. The salmon had doubtless been taken somewhere in the vicinity of the Aleutian Islands, the squid between those islands and the locality where the seal was taken, and the pollock in the immediate vicinity of the spot where the seal was killed.

In regard to the frequency with which the seals feed, little can be said, owing to the impossibility of keeping track of any given seal. It is known that the bulls come on shore late in May or early in June, and that they remain on the rookeries

[1] Of course these may be eaten by fur seals, but there is not the least bit of evidence to show that such is the case, and since no remains are found in the stomachs of bachelors or on the rookeries, there is, as yet, no reason to say that fur seals eat crabs.

until some time in August, few appearing on the hauling grounds before the 10th, while they are not numerous until toward the end of the month. They certainly fast from two to three months, and then, instead of going to sea to feed, haul out on some sandy spot and take a nap of a week or ten days. Even at the end of the long fast the bulls are fatter than one would expect, as was shown by the condition of two killed on August 26. Some differences of opinion exist concerning the bachelors, some thinking that they fast during a great part of the summer, others believing that they eat frequently during their stay at the islands. The truth probably lies somewhere between these two extremes, and my own belief is that while the bachelors feed occasionally, they by no means feed so often as the females. The bachelors are noticeably numerous on the hauling grounds during July and a considerable part of August, and it is not until after the middle of August that their numbers thin out decidedly. This would indicate that they are not absent from the islands, but, on the other hand, we know that seals are coming and going on the hauling grounds, or it would not be possible to obtain several lots of killable seals from one locality.

That the stomachs of the bachelors examined on the killing grounds are almost invariably empty, save for the presence of pebbles or very rarely of traces of fish or squid, is negative evidence, as it might be construed to mean either that the seals were not feeding or that they had digested their food before coming on land. What little evidence there is, however, seems to sustain the latter supposition, although also indicating that bachelors feed but seldom in July. Of the hundred stomachs opened by Professor Thompson and myself in the various killing grounds between July 15 and August 7 not one contained a trace of food, and not over four or five contained any pebbles.

In 1895 Mr. True examined the stomachs of over two hundred bachelors and in only one specimen found fish bones, these being much decomposed, indicating that they had been swallowed some time before. Another stomach contained shells and pebbles, and a third a few pebbles only.

Of 118 specimens examined by Dr. Merriam on August 1 and 3, 1891, 93 were empty and 20 contained pebbles or beach-worn shells. Four contained beaks of squids, 2 bones of a cod,[1] and 1 a large Isopod crustacean. Thus only 7 stomachs out of over 400 contained any trace of food, certainly a very small proportion.

Since we neither know how often a fur seal eats, nor how much he averages for a meal, all so-called "estimates" of the amount of fish eaten must be considered as pure guesswork, the more that we do not have even the unsatisfactory data derived from seals kept in captivity to aid us in comparison. I am told by Mr. W. A. Conklin that California sea lions (*Zalophus californianus*), averaging 150 pounds each, keep fat and sleek on 7½ pounds of fish per diem, although they would, if permitted, eat 10 pounds. These figures, however, throw little light on the problem, not only because the sea lions were living in captivity and under artificial conditions, but because we know that fur seals feed intermittently and there is nothing to show whether or not they eat enough when they feed to make up for their fasts.

Owing to the demands made upon them by the growing pups, the nursing females undoubtedly eat at much more frequent intervals than the other categories of seals, being forced to go to sea for food when the males are on or about the islands, and this is one of the reasons why the majority of seals taken by pelagic sealers are females.

[1] I venture to doubt this identification, believing the bones to have been those of a pollock.

The most frequent feeding grounds, as indicated by the logs of pelagic sealers, lie from 75 to 150 miles to the southward and eastward and to the northward and westward of the Pribilofs, some little distance outside the 100-fathom line, or where the bottom of the sea dips abruptly downward from 500 to 5,000 feet. Few seals are taken or recorded in the comparatively shallow waters to the north and east of the seal islands, and although there are some indications that a portion of the herd frequents this region during the summer, yet the map giving the distribution of the seals in August and September is practically a map of the feeding grounds.

An examination of the chart will show that there seems to be a direct relation between the 100-fathom line and the localities where the seals obtain food, but the conditions affecting the feeding grounds can only be learned from a long and careful study of the depth and temperature of the water and set of the currents, since these are the prime factors in determining the presence and distribution of the minute plants and animals, which may be called food units, and on which all higher animal life ultimately depends.

As the principal feeding grounds, large as they are, seem to lie within certain more or less definite boundaries, it follows that in going to feed the traveling seals do not radiate from the islands like the sticks of a fan, but go and come in parallel lines or lanes. Still, it should be borne in mind that our knowledge of these points depends on the catch of sealers on certain known dates, and the movements of the sealing fleet are largely determined by the catch of a few vessels, since if A and B know that C is taking seals they and others do not like to leave the vicinity, leaving a probability for a possibility.

From the condition of the contents of the stomachs it is apparent that everything is swallowed entire, a pollock 18 inches long being bolted, head and all. This is evident from the fact that the bones of the head are always present when the quantity of bones is large, but they may be regurgitated, together with the other bones of the anterior portion of the body, leaving only the tail vertebræ.

The indications are that digestion is extremely rapid, since even on the feeding grounds it is almost impossible to obtain stomach contents sufficiently well preserved to admit of identification from external characters. Hard parts—such as fish bones, the beaks and crystalline lenses of the eyes of squids—are regurgitated something after the manner in which the skin and bones of mice are ejected by birds of prey. In this manner the seals also eject the small pebbles and other hard substances, such as shells and bones, which they swallow for problematical purposes; and it is by this method that the sea lion must get rid of the stones, sometimes of large size, which it swallows in considerable quantities. There are plenty of theories as to why these things are swallowed by seals, the most reasonable of which is that they are to aid digestion by grinding up such substances as fish bones and the hard parts of crabs. But while this seems plausible enough when applied to the sea lion, which eats many crabs and swallows quantities of stones, some weighing 2 or 3 pounds, it fails with the fur seal, as this animal is not known to feed upon crustacea, and the pebbles found in its stomach are of small size and not mixed with food. The stomachs of nursing pups are quite as liable to contain pebbles as are those of adult seals, but in this case they are probably swallowed instinctively. On August 26 a pup was seen meandering about Lukanin, stopping now and then to pick up a pebble; and on the same date a pup, full of milk, was killed in the water whose stomach contained 13 large and 26 small pebbles, the total weight of which was 62.299 grams (2.2 ounces). M. Grebnitski has suggested that the pebbles are swallowed in catching cephalopods, but this is evidently incorrect for several reasons. The squid preyed upon by the fur seal is a deep-water species and does not cling to pebbles, being found near the surface; the pebbles and beaks of squid are not found together, and the pebbles occur in the pups who are eating nothing but milk. The most honest thing to say is that we really don't know why seals swallow hard substances.

From observations made by Mr. Clark during the season of 1896, he concludes that seals remain in the water until the food in their stomachs is digested, and that this accounts not only for the fact that seals taken on land are invariably empty, but for the presence of the band of swimming seals in front of every rookery. It would also explain why females are never seen to come directly in from the sea, but emerge from the fringe of idle seals along the shore, although this seems rather due to indirectness of character, since we never saw a seal going directly out to sea, although constantly watching for it.

Although excrement is always to be met with on rookeries and hauling grounds,[1] it is by no means commensurate with the number of seals, while Mr. Clark in September and October noticed large quantities of fecal matter strewn along the shore in localities where the pups were sporting in the water.

Bones of fishes or remains of squids are also very seldom found on land on the Pribilofs, indicating that these, too, are rejected in the water, while they are much more common on the Commander Islands where the feeding grounds are not so far from the rookeries as on the American Islands.

Although we know little of the food of the fur seal south of the Aleutian Islands, something may be inferred from the character of its food in Bering Sea. Since the seal feeds near the surface, none of the bottom-haunting fishes such as the cod and halibut, nor their enemies, can be influenced by it, except so far as their food supply may be affected by the destruction of pollock, and it is highly improbable that the cod fishery of Bering Sea could have been in any way affected by the fur seal. Surface-swimming species, like the salmon, might possibly be destroyed in appreciable numbers were the fur seal abundant, but as no previous effect has been reported, although it is fair to say that no study of the subject was made in the past, the verdict for the present must be—not proven.

In regard to the bearing of the seals upon fisheries, Dr. Stejneger's remarks concerning Bering Island are very much to the point. He says:[2]

> Three species of salmon (*Oncorhynchus*) abound in all the rivers on Bering Island and the fur seals are not observed to feed upon them at the mouths of these rivers; but the fact that the largest salmon river of the island, the Saranna River, is situated less than 7 miles from the largest rookery, without the seals coming over there to feed upon the enormous number of salmon ascending that river, is proof conclusive. * * * The annual catch in that river alone varies between 20,000 and 100,000 salmon.
>
> As for the codfish, it is only necessary to state that they are common right off the great North Rookery of Bering Island. On September 16, 1895, we were anchored in 10 fathoms of water, less than a mile from Sivutchi Kamen, and within hearing of the roar from the rookery. A single cod line over the side of the steamer for a couple of hours brought up three-fourths of a barrel of codfish.

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[1] That, as has been stated, anyone ever searched for excrement and did not find it indicates very poor powers of observation or of veracity.

[2] The Russian Fur Seal Islands, p. 70.

If the seals do not affect the fisheries of so small a place as Bering Island, it is not likely that they will do so elsewhere.

Finally, since the seal feeds on squid and fishes which are found near the surface in comparatively deep water, and invariably seeks its food at some distance from land, it is evident that a closed zone of 60 miles about the islands can give but a small measure of protection.

It has been suggested that the migration of the seals from the islands is influenced by the departure and movements of migratory fishes on which they feed. There are, however, no migratory fishes in Bering Sea, and it is not likely that the movements of the seals in the North Pacific is in any important way modified by the movements of such fishes as the salmon in its movement toward the rivers for purposes of spawning. These fishes do not go far out in the sea, and, while the seals feed upon them when they can be had, there is no reason to suppose that the seals go out of their way to follow such fishes. The general direction and extent of the fur seals' migration are directed by its homing instinct. The movement of the herd from day to day is probably in a measure dependent upon the food supply, the seals tarrying to feed where food is abundant and moving on when it becomes scarce. The departure of the seals from the islands is not due to the departure of the fishes on which it feeds in summer, but simply due to the coming on of the severe weather of winter. The fur seals of the southern islands do not migrate, and the climatic conditions obviate the necessity of their doing so.

The following species are actually known to be eaten as food by the fur seal:

Squid, *Gonatus amœnus.*
Octopus, *Octopus sp.*
Pollock, *Theragra chalcogramma.*
Seal-fish, *Therobromus callorhini.*
Rockfish, *Sebastodes alutus.*
Salmon, *Oncorhynchus kisutch.*
Lamprey, *Entosphenus tridentatus.*
Cod, *Gadus macrocephalus.*
Wolf-fish, *Anarichas lepturus.*
Stickleback,[1] *Gasterosteus cataphractus.*
Sculpin.[1]
Unknown.

The following shows the total amount of food eaten by 36 seals during the month of April in the Gulf of Alaska:

Squid	726
Rockfish	20
Salmon	2
Pollock	2
Sundry	12
Total	762

[1] There is a slight doubt in regard to these fishes, as they may have been swallowed out of curiosity. This is the more probable since the sculpins, which were identified from odd bones, were small individuals and not the large species so common in Bering Sea.

The following shows the results of the examination of the stomachs of 273 seals taken in Bering Sea during the months of August and September, and indicates the number of seals which had eaten a given species:

Pollock	165	Cod	1
Squid	163	Wolf fish	1
Seal fish	84	Octopus	1
Salmon	18	Unknown	2
Lamprey	6		
Cottoid	5	Total	446

The following is the total amount of food known to have been eaten by 100 seals during the months of August and September in Bering Sea:

Small seal fish	568
Squid	324
Pollock	251
Salmon	10
Sundry	10
Total	1,163

The various combinations of species made by the same 100 seals are shown as follows, which may be called the seals' bill of fare:

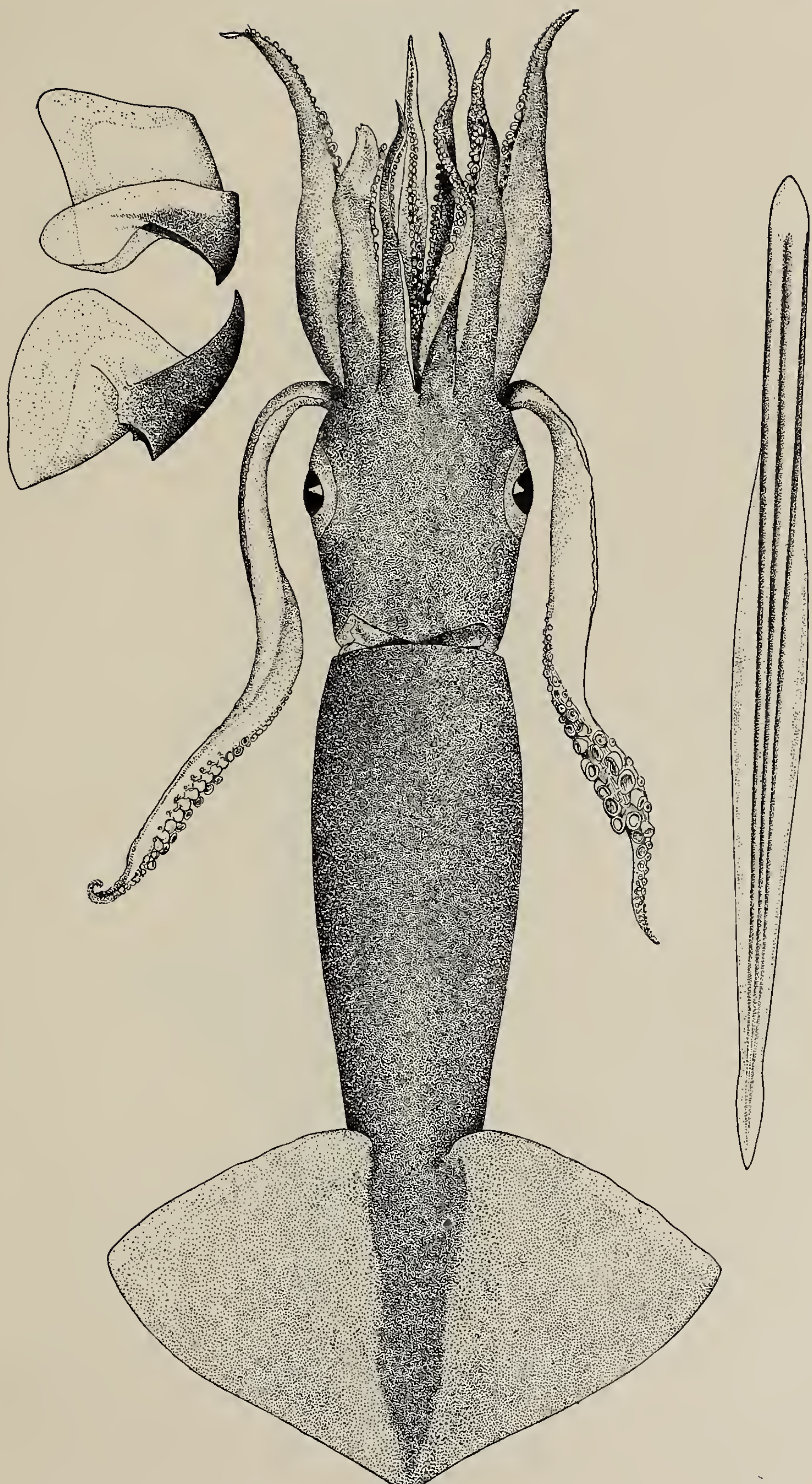
Pollock only	41	Pollock, squid, and seal fish	11
Squid only	2	Pollock, squid, and lamprey	4
Salmon only	1	Pollock, squid, and salmon	1
Seal fish only	1	Pollock, salmon, and seal fish	1
Pollock and squid	22	Pollock, squid, and octopus	1
Pollock and salmon	3	Squid and seal fish	6
Pollock and seal fish	3	Squid, seal fish, and salmon	1
Pollock and cod	1		
Pollock and wolf fish	1	Total	100

The following objects, certainly not taken for food, have been found in the stomachs of seals, young and old:

Ascidians.
Hermit crab, *Eupagurus brandti.*[1]
Idotea ochotensis.
Anonyx nugax.
Dead shells of *Buccinum.*
Dead barnacles, in fragments.
Dead gastropods, in fragments.
Opercula of *Litorina.*
Bones of pup seal.
Pebbles of lava.
Fragments of kelp.
Buckshot, a single example.

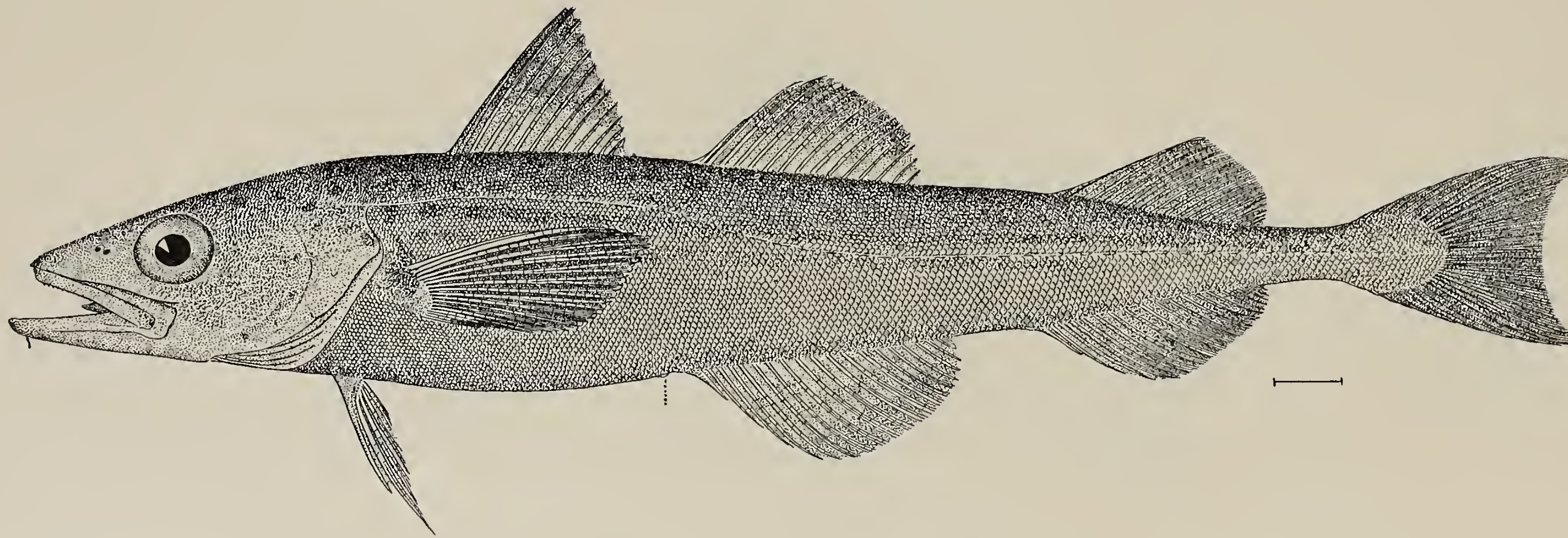
It is evident that these things are not swallowed haphazard, but are selected with considerable care from among the articles strewn along the shore, and that a preference is exhibited for rounded objects. This is shown by the fact that, as a rule, only articles of one kind are found in one stomach, although seals do not discriminate between fragments of barnacles and fragments of gastropods. Moreover, pebbles of serpentine and chalcedony are now and then found on the hauling grounds under conditions indicating that they were brought there by seals, while the pup seen gathering pebbles on Lukanin did so with great care, by no means taking the first that came to hand. The most striking example of this discriminative selection is, perhaps, shown by the pup which had swallowed a buckshot, while the chance of finding such a thing must be, at a guess, about one in a million.

[1] Probably taken with the dead shells of *Buccinum.*



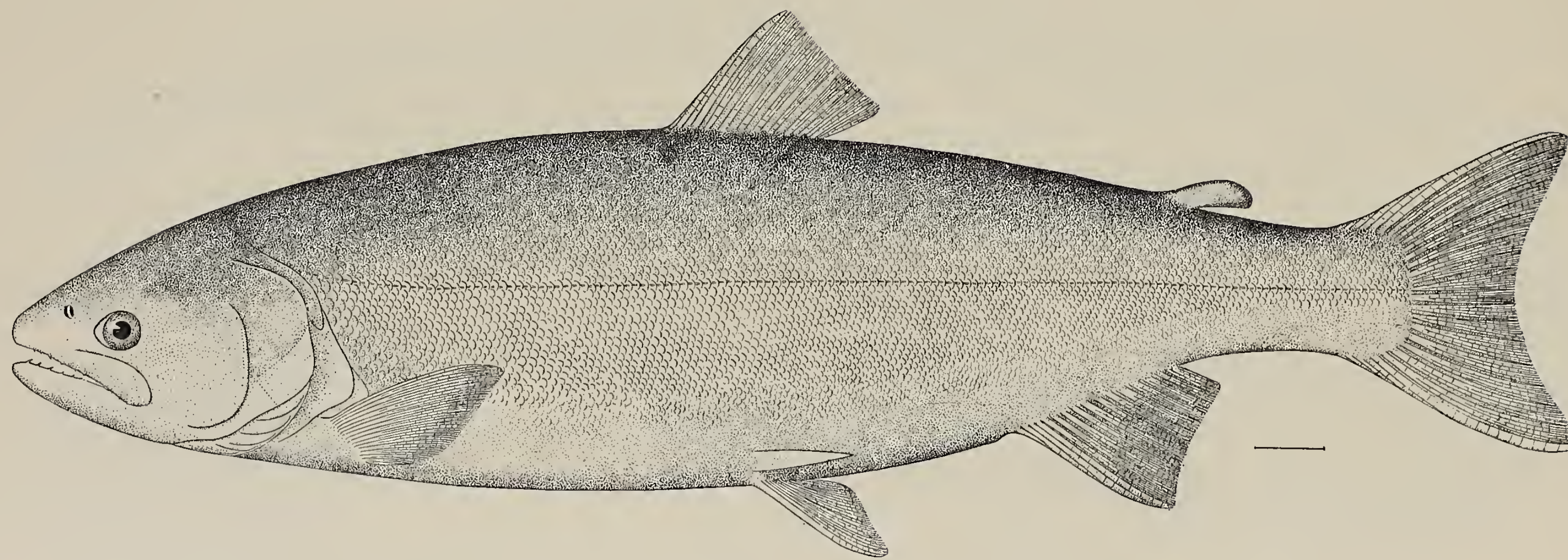
SQUID, *Gonatus amœnus.*

Plate XIII.



THE ALASKAN POLLACK, *Theragra chalcogramma.*

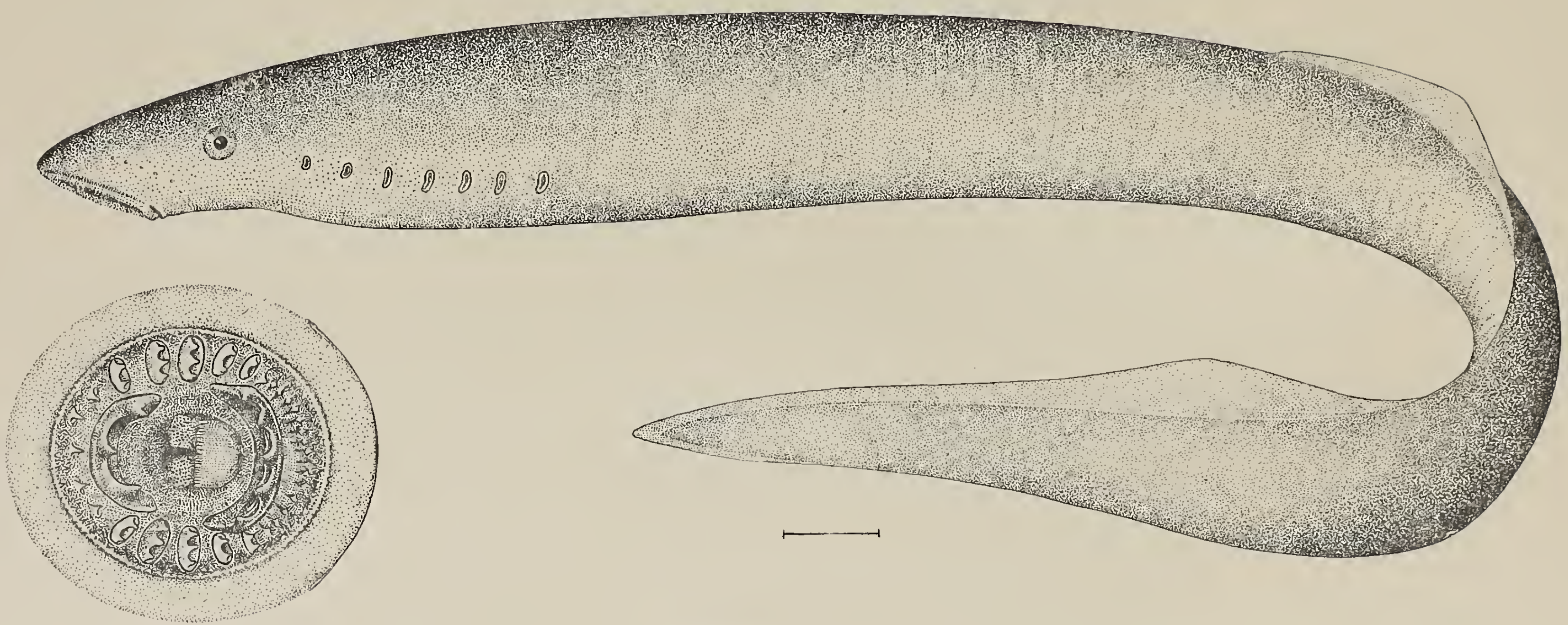
From a drawing by H. L. Todd.



THE SILVER SALMON, *Oncorhynchus kisutch.*

From a drawing by H. L. Todd.

PLATE XV.



LAMPREY, *Entosphenus tridentatus.*

From a drawing by A. H. Baldwin.

V.—MENTAL TRAITS OF THE PRIBILOF FUR SEAL.

By Frederic A. Lucas.

Fifteen years ago, when my acquaintance with the fur seal was solely through the medium of books, I wrote: "Animals which witness the killing of their young with indifference, do not try to escape from danger themselves, and tranquilly remain in a locality where hundreds of their kind are daily slaughtered do not seem remarkable for their intelligence." To-day, after a careful study of the behavior of the seal in the field, there seems to be no reason to retract anything of this. The fur seal is a creature of strong instincts, but little intelligence. The mechanical functions of life are performed to perfection, but it is seldom guilty of an act requiring reason.

By intellect or intelligence in this sense is meant the power to choose among different possible courses of action. The external influences and internal impulses produce certain impressions on the nervous system of the animal. By the automatic instinct the response which follows is directly related to the cause, and there is no choice among responses. So much influence, so much rebound. By the operations of instinct each individual, in given conditions, will act just as any other individual will. Intellect, however, implies individuality. One animal will choose to do this, another that, adapting action to the special needs or circumstances. A fur seal will do what his ancestors have had to do to perfection. If he is led to do anything else he is dazed and stupid. For these reasons our experiments in better methods of culling killable seals by sending the herd through a wooden chute were not successful. The most experienced bulls would beat their noses against a door closed before them if one before them had been seen to pass through it. That one door was shut and another opened is beyond their comprehension.

When not engaged in the performance of the more mechanical functions of life the conduct of the fur seal is marked by a most exasperating indirectness, and in many ways they remind one of Kipling's description of the Banda Log, starting to do one thing and ending by doing another. A seal coming ashore to nurse her pup will tarry by the wayside to doze and scratch, calling at intervals for the young one, often taking half an hour to progress a hundred yards or so. This is not because cows will not allow pups to nurse them when wet, for pups were seen nursing cows just from the water, but because the fur seal is indirect by nature. Just so in no instance was a seal observed to go directly out to sea to feed or directly to return. Day after day seals were seen to enter the water; day after day they were seen to come out of it; but in each case the individual was lost in or emerged from the mass of seals sporting along the margin of the rookery.[1]

[1] Mr. Clark, as noted elsewhere, considers this to be due to the fact that seals remain in the water until food has digested; but while this would account for the lingering of returning seals, it would not account for their delay in going.

The fact that the fur seal acts by instinct and not by reason makes it possible for man to use the fur-seal herd to his own advantage, and to treat it much as he would a herd of cattle, with the advantageous exception that he is neither obliged to feed, water, nor look after its welfare. Its instincts, however, sharpened by long years of natural selection, and augmented by the cumulative effects of heredity, in most ways supply the place of reason and are an offset for its natural stupidity.

Among the strongest of these instincts is the homing instinct, which yearly leads the seals back to the rookeries and directs them to the feeding grounds, and so strong has this instinct become by long cultivation that, as with the great auk, nothing short of extermination will drive the seals from their rookeries.[1]

The seals return to the rookery grounds of the Pribilof Islands, not because they have the least idea that they will there find protection, but simply because their homing instinct leads them to do so. They have returned just as regularly and persistently to Robben Island and to their Antarctic breeding grounds, where every seal, big and little, is relentlessly slain. Their "bump of locality" is greater than their reasoning power. Conversely, the female seals, which are never disturbed, are just as much afraid of man as are the bachelors, whose ranks are thinned by annual slaughter. The experience of a score of years has not taught them that so far as man is concerned they are quite safe when on shore.

Just so this instinct of locality, coupled with gregariousness, brings the seals released from a killing back to the hauling grounds, when a more intelligent or distrustful creature would forsake the place entirely. The same causes, plus the instinctive desire to get somewhere near the rookeries, bring the bachelors to the vicinity of the breeding grounds. Time was when the rookeries were so large and occupied the water front to such an extent that access to the territory at the rear was restricted and vast numbers of seals were forced to haul elsewhere. The earliest maps of the islands show that then, as now, breeding and hauling grounds were contiguous, although then the number of bachelors was so vast that only a small portion of them could approach the frontier of the breeding grounds, and a very close approach is prevented by the picket line of waiting bulls.

The gregarious nature of the seals is extremely strong, not only leading them to herd together, but, like sheep, to follow one another blindly, regardless of where they may be going, seeking safety or hurrying to the killing gang without the slightest hesitancy. One morning on Zoltoi bluffs a seal, startled by the approach of a party on the way to the reef, plunged over the edge of the bluff to the rocks, 15 or 20 feet

[1] In many ways the case of the fur seal resembles that of the great auk; both, when discovered, were animals of limited distribution, confined to small, uninhabited islands, and both evinced the utmost tenacity in clinging to their breeding grounds. One might suppose from much that has been written that there was some occult reason why the fur seal was found only on the Pribilof Islands, out of all those that skirt the Alaskan coast, and that those islets alone had the necessary conditions of climate to suit the fur seal. As a matter of fact there is nothing mysterious in the matter, for the seal, like the great auk, was probably exterminated by prehistoric man in every place that was accessible.

The fur seal family is one of great adaptability, and its members thrive not only in the cold and wet of high latitudes, but under the burning sun of the Tropics; climate has little effect, provided the species can breed in peace. But a creature which comes on shore to breed and passes a quarter to a third of its life on land is particularly liable to the attacks of man, and uncivilized man is no more careful to protect breeding animals than his civilized relatives.

below. The neighboring seals immediately started to follow, and before the natives could turn them back several had gone headlong after their leader, heedless of the fact that the way was open in another direction.

Nothing, perhaps, shows the low grade of the seal's intellect and the inability to think for themselves so well as their behavior during the drives and on the killing grounds, and it was a constant source of wonderment to see 500 or 1,000 seals shuffling along, guided and controlled by at the most five men.

It is not docility which keeps the long procession together, but gregariousness, and the fear of being left behind. A single yearling may delay a killing for five minutes, snapping, snarling, and charging at the skinners and killers, but on the drive the idea of escape never occurs to a seal, for all his energies are devoted to keeping up with the others. On August 26 two old bulls were killed for specimens, and in order to save the labor of "backing" their skins and skeletons to the village, the entire lot then on Zoltoi Bluffs were driven by Judge Crowley and the ever-ready Jake, with a little assistance from myself. There were 50 old bulls, 50 half bulls, and 100 bachelors of assorted sizes, and it was an astonishing sight to see all these huge brutes fleeing from three men, when any one bull could have driven the drivers, and would have done so a month previously. But a month previous the breeding instinct was predominant to the exclusion of all others, and not only was fear banished, but hunger and fatigue were unheeded.

The gregarious nature of the seals was curiously illustrated by their disposition about Hutchinsons Hill, in August, or after the rookeries had expanded and the seals retired far from the water. While there was ample room for ten times the number of seals present to sprawl out in comfort, they were gathered into numerous dense masses with wide stretches of bare ground in which the Burgomaster gulls walked up and down, picking at the eyes of dead pups.

The smell of blood, particularly of that of their own species, inspires fear or anger in most animals, since they associate its presence with danger to themselves or others, but with the fur seals it seems to do neither, and the animals turned loose from a killing will trample over the bodies of the slain and pause to rest 50 or 100 yards away, with their flippers wet with the blood of their comrades.[1] It frequently happened while dissecting pups on the rookeries[2] that the bulls, after all was quiet, approached very closely, sometimes a little too close for comfort, and on one or two occasions dissected pup carcasses were thrown at them, both to drive the bulls away and to see what the effect would be. In no instance did the body of a pup have any more effect than a pebble or a bit of wood, the bull sniffed at the one just as he did at the other, but so long as the blood was not his own it was a matter of little consequence.

Even had the blood come from himself it is doubtful if the bull's behavior would have been different, for not one of Cooper's Indians could be more indifferent to pain than the whole tribe of fur seals—bulls, cows, and pups. The bulls give and receive the most savage bites without flinching, and cows do not show the least sign of pain when pulled about and torn by their lords and masters, and on no occasion was any

[1] It is quite likely that this is due to the incessant fighting among males and mauling of the females by the bulls, wounds being so numerous and blood so freely spilled that the seals are accustomed to it.

[2] It must be borne in mind that this was after the breaking up of the harems, when seals of all kinds were more or less intermingled, and many bulls were roaming around looking for odd cows.

animal seen to lick a wound. In one of the rookery battles a bull seized another by his neck and held him for at least a full minute, while the bitten bull looked complacently heavenward without as much as moving, until he suddenly countered on his adversary and grasped him by the throat. Not only do seals appear to be indifferent to pain, but, provided an object is motionless, they seem quite as indifferent to disagreeable sights and equally unpleasant smells. They walk over and about the dead and decaying carcasses on the rookeries and lie down to sleep among them without giving them the least attention, caring so little that a cow was seen dozing peacefully with her head all but pillowed on the bloated body of a pup.

The stolid behavior of the seals on the killing grounds has been remarked by Elliott, and pitiful tales of their mad fright, being crazed by the sight of their slaughtered companions, and frantic efforts to escape are utter rubbish. The behavior of the first seal turned loose determines the behavior of the rest of the herd. If he hurries, the others hurry, and each one eggs on the other; if he stops to rest, all subsequently rejected stop to rest.

There is no doubt that the seals are frightened when driven up to the clubbers, but they have just as much fear of the boy who is guarding one side of a group of 1,000 seals as they have of the men who are about to knock them or their companions on the head. Their fear is instinctive and irrational, and is not due to any reasoning process or any dread of what is to come. It is largely caused by the discomfort of being crowded together. So little true fear do these beasts possess that the seals in a pod before the killers will snap at each other just the same as if they were being crowded by their neighbors in the hauling grounds. So far from being crazed with fright, when turned loose they are as liable as not to stop within 50 yards of the killing and there rest and scratch for half an hour, complacently watching the others being clubbed to death.

The seal is not intelligent enough to be superstitious, as is the case with the dog and horse; the source of his fear must be real and tangible, and he never imagines an enemy in stick or stone or other motionless object, unless it stands up above the sky line and suggests a man. The only possible exception to this is when he is wakened from a sound sleep, when, like other unreasoning creatures, his first idea is to run. On such occasions a veritable stampede may occur if a number of seals are together, for the scuffling of one rouses the other, and each urges his neighbor on to fly. Mr. Clark noticed a most curious incident on Gorbatch, where a stampede was imminent because a few seals near the water, aroused by the breaking of an unusually large wave, started up in alarm and in turn communicated their fright to the surrounding herd.

If love of offspring be indicative of intelligence the fur seal may be considered as very low in the intellectual scale, for it is not probable that among the higher vertebrates there is another which evinces so little affection for its young and is so heedless of its welfare. During our visits to the rookeries there were naturally many cases in which mother and pup were startled by our approach, and in every instance save one the alarm shown by the cow was evidently for herself and not for her offspring, since she never stopped to defend her young one, but sought safety in flight, leaving the pup to care for itself as best it might. Similarly when a rookery is stampeded by the exit of a vanquished bull, or when, later in the season, a band of seals is frightened from any cause it is a case of *sauve qui peut*, every seal for himself or herself, no matter what happens to the next one.

The mother takes little or no interest in her offspring, unless it be immediately after birth, and here my own experience is limited. The cows are said to lift the newly born pups out of uncomfortable or dangerous places, but the few seen during the summer of 1896 seemed to evince little regard for the welfare of their offspring, and if a pup with the placenta still attached became caught in the rocks the mother simply looked at it and left it to do the best it could.

A curious instance of lack of care and lack of intelligence was noted by Mr. Clark, who found a pup whose abnormally large umbilical cord had caught among the rocks and held him fast. It had never occurred to the cow to bite through the cord and release her offspring, although the size of the pup indicated that it had been there some time. On the other hand, the condition of the young seal showed that it had been well fed, for nursing comes by instinct and calls for no display of reason. When the umbilical cord was severed the pup staggered away, almost unable to walk through having had no previous experience in that line.

The cows do pay some attention to their pups while nursing, and will often search long and carefully for their own, nosing among the pods of sleeping pups; but here again it must be remembered that the discomfort caused by the distension of the udder is a stimulating cause, and that the cow's motive is not entirely unselfish. But, again, a female will content herself with simple bleating for the pup, and if he does not come will climb on a stone and go to sleep with the utmost tranquillity. Now and then, however, one sees a touch of human nature among the seals, as when a cow deliberately bit two pups for the apparent reason that her own offspring did not respond promptly to her call, and when a defeated bull consoled himself by biting a cow. The comfort of the pup is of little moment to the cow; her own comfort is a much more important matter, and she will lie in the water where the youngster is submerged by every heavy sea, or on a stone where the pup can scarcely reach her, without the least concern. A cow just in from sea came to the head of "the slide," followed by a very hungry pup, and then climbed on a high stone and lay down. The pup tried in vain to follow, for, standing on his hind flippers, his nose reached only to the top of the rock, and there he stood bleating for something to eat. The mother looked over the edge as much as to say, "I'm sorry for you, but really I can do nothing," and then lay down again. She did, a little later, descend from her perch, but not finding a place to suit, returned in five minutes, and at the end of half an hour was dozing comfortably, while the pup still stood on his hind legs expostulating in vain.

As for the cow taking sufficient interest in her offspring to teach it to swim, or in any way to care for itself, this is the sheerest nonsense. The seals are firm believers in the doctrine of *laissez faire*, enforcing their principles with tooth and flipper. Every seal looks after itself, and death promptly overtakes the hindmost.

At first glance the sea lion might seem less intelligent than the fur seal; but in all mental attributes the latter compares unfavorably with his big relative, who is social and affectionate in its disposition, and wary by nature. The sea lions breed earlier in the season than the fur seal, so it was not our privilege to witness their behavior at this time; but in August bulls, cows, and pups haul out together in perfect amity, although the young males seem to keep somewhat by themselves, and there appeared to be none of the snapping at one another which is so characteristic of the fur seals.

The females appear to take an affectionate interest in their offspring, and even when weaned the pups haul out beside their mothers and accompany them from place to place, and in one instance a pup was seen resting on the shoulders of a female while she swam a short distance. When meeting, old and young frequently rub noses, and occasionally the mother talks to the young by swaying her head up and down and at the same time slightly from side to side. Just what this signifies it is difficult for us to understand, but it evidently means something to the pup. When alarmed the sea lions cluster together, as they also do for purposes of sport, for they are fond of playing in the water, diving or lying on one side, splashing with the exposed flipper, much after the manner of a sportive humpback whale. If frightened from a hauling ground, the sea lions are slow in returning, swimming back and forth, surveying the ground and sniffing the air for the presence of suspected danger. They also express their disapproval of intrusions by loud growling, and if one is shot the immediate members of the herd become much excited and, although keeping at a safe distance, swim about, and by their conduct and roars clearly express their fear and anger. All in all, though at first sight appearances are against him, the sea lion is intellectually much above the fur seal.

The great redeeming feature of the fur seal's character is its playfulness when young, for few animals seem to enjoy life so well as the rollicking pups and young bachelors. But here again it is necessary to curb our imagination, and to remember that while the young seals undoubtedly do derive a certain amount of enjoyment from their sports, very much of what strikes us as mere play is in reality dawning instinct. The sporting of seal pups foreshadows the time when their very lives will depend on the ability to capture food for themselves, and the playful wrestling contests in which they perpetually engage are mere hints of future fierce battles among bulls. Yearlings do not round up harems of pups with the reasoning care that a child bestows on her dolls, but because centuries of heredity have caused this instinct to be developed long before it serves any practical purpose. And this acting by instinct is the keynote of the seal's character; the mind, like the body, has been molded by natural selection acting on the mass, so that one seal behaves like another and knows just as much as another, and no more. It is a creature of instincts and not guided to any great extent by reason. As it has done in the past so it will do in the future. Its habits, being formed by the slow process of natural selection, can change but slowly, hence the fur seal is not likely to alter its habits, or to adapt itself to changes in surrounding conditions. It may be exterminated, but it will not leave its breeding grounds, and the last seal will come calmly on shore to be knocked in the head.

VI.—THE CAUSES OF MORTALITY AMONG SEALS.

By Frederic A. Lucas.

Those who have read the testimony submitted to the Paris tribunal must have been struck with the great diversity of statements regarding the death rate among seals, and particularly among young seals, for it was positively asserted and quite as positively denied that numbers of seal pups died annually prior to the 1st of August. In view of these conflicting statements it was obviously of great importance to ascertain not only the number of pups which died before the commencement of pelagic sealing, but the causes which led to their death. Every effort was therefore made to obtain information on these points, and this portion of the report may be said to represent the results of the observations of all members of the various commissions. A count was made of the dead pups as early in August as circumstances would admit, while autopsies, recorded further on, were performed on as many bodies as were sufficiently well preserved to allow of its being done.

It is not pretended that there may not be many more diseases among seals and many more causes for their death than are herein set forth, but the intent of this chapter is to show what we actually know about these matters. There has been entirely too much theory and entirely too little observation and record of facts in treating of the fur seal, and it is mere idle speculation to say from what diseases they might or might not die. It seems to have been generally considered that the death rate among pup seals was low, the chief destruction being caused by surf and killer whales. Photographs taken by Mr. Macoun in 1891 and 1892 (see Pl. XVI), however, showed that on some portions of Tolstoi and Polovina there were certainly large numbers of dead pups far above the surf mark which had perished long before the middle of August and before the effects of pelagic sealing could be felt. It therefore became an interesting question whether or not there was any reason why the deaths on these rookeries should be more numerous than elsewhere.

Up to the 1st of August it was not only impossible to enter the breeding grounds, but impossible to approach them very closely, not so much from the danger of stampeding the rookeries as from the danger of being stampeded by angry bulls. By August 8 the rookeries had opened out somewhat, the seals having largely drawn back from the water, and on that date the dead pups on Kitovi, Lukanin, and the Reef were counted. It was no easy matter to enter a rookery even on that date, and it required much skill in dodging active and angry bulls and a cautious collecting of bodies with long gaffs to make the count complete and to gather any subjects fit for dissection. While the result of this count was surprising, 1,264 dead pups being found in 1896 on the three rookeries named, the counts of Polovina, made on August 10, and of Tolstoi, made on August 12, were still more startling, revealing as they did the presence of 635 dead on the one and 1,895 on the other, the level sands of Tolstoi being so strewn with bodies as to suggest a battle field after some hotly contested encounter. See Plate XVII.

The first very evident fact regarding these dead seals was that the vast majority had been a long time dead, some bodies being swollen and distorted, while the flattened, hairless condition of others bore testimony not only to the length of time they had been dead, but to their ruthless trampling beneath scores of shuffling feet. The early date at which many had died was apparent from the numerous instances in which the umbilical cord was still attached to the body, indicating that the little fellows had been killed shortly after birth. The length of time that most had been dead was also well shown by the small proportion available for dissection, for, although every effort was made to obtain as large a number as possible, only 103 were obtained on St. Paul in 1896 between August 6 and August 14, and not one of the 735 pups found dead on St. George was dissectible.

The next very obvious fact was the large number of bodies lying on level, unobstructed patches of ground where, earlier in the season, the breeding seals had been densely massed, and where, as on Tolstoi, Zapadni, and Polovina, there had been much fighting and confusion. Rocky slopes were comparatively free from dead, and there were fewer still on rookeries composed of water-worn bowlders, as are the Lagoon and Zapadni Reef.

The direct relations between the character of the ground, the numbers of breeding seals, and the number of dead pups, and the fact that many of the more recently dead were bruised,[1] seemed to point to the trampling of the larger seals, and especially of the bulls, as the cause of death. This inference was apparently sustained by the invariable verification of predictions, based on a careful study of the first rookery visited, as to the rookeries or parts of rookeries on which dead pups would be found most numerous, and in the preliminary report of 1896 it was stated that deaths among young pups were almost solely due to trampling.

However, in dissecting the pup penned up and allowed to starve, a few small nematodes were found in the small intestine, and as this young seal was nursing, and in consequence they could not have been obtained from fish, the parasites were preserved, and, with other specimens, submitted to Dr. C. W. Stiles for examination. Dr. Stiles indentified the nematodes as belonging to the genus *Uncinaria*, and in his report stated that under proper conditions this worm might play an important rôle in the mortality of the pups.[2]

Being aware of the possible presence of a dangerous parasite, on the visit of the commission in 1897 a careful search was made for this nematode, with the result that it was found to be present in great abundance, completely realizing the state-

[1] It may be said that the number of pups bearing bruises and obviously trampled on was greater in 1896 than in 1897, for the reason that there were more seals in the former year and they were more densely massed, so that there was a greater chance for a pup to be stepped on.

[2] In Professor Thompson's report on his mission to Bering Sea in 1897, page 8, he says: "During last winter Dr. Stiles, a well-known American helminthologist, reasoning from the very high mortality of the pups on sandy as compared with that on the rocky areas, suggested to the American commissioners that a cause of the mortality might be found in a parasitic worm of the genus *Uncinaria* (*Dochmius*), which passes a portion of its life history in sand. * * *" This was written before the conference of November, 1897, and before hearing the report of the writer on *Uncinaria*, and is wholly erroneous, the facts being as given above.

ments made by Dr. Stiles and eliminating trampling as an important source of death to any but very young pups. The first pup secured for dissection was obtained from Lukanin rookery on July 24, although noted as dead on July 22. No part of this rookery was crowded, and the dead seal lay on a sandy spot, strewn with bowlders, not fár from several harems. On dissection the pup proved to be fat and well nourished, the stomach containing a quantity of milk. There were no bruises and no signs of disease save a slight discoloration of the median part of the small intestine, which might well have been caused by decomposition. The intestine was, however, slightly nodular or swollen in spots throughout this discolored area, and on cutting open these nodes the mucous membrane was found to be broken down and the swollen part filled with mucus and blood. Moreover, in each swelling there were many *Uncinaria*, the total number in the 3 feet of intestine affected being large, and the wall of the intestine being marked by numerous cyst-like spots, where the parasites had been attached. The flesh was pale, and but little blood, and this thin and watery, present in the heart and large vessels, the indications being clear that death had resulted from loss of blood and general anæmia produced by the attacks of *Uncinaria*.

From this time onward, owing to the opening out of the rookeries, it became gradually more and more easy to obtain specimens for examination, and between July 25 and September 4 some 345 pups were dissected, revealing the existence of *Uncinaria* in all favorable localities, and showing that this parasite was by far the most important factor in the death rate among pups. After my departure on August 20, the work of dissection was carried on actively by Messrs. R. E. Snodgrass and A. W. Greeley, of Stanford University, who prosecuted the work up to September 4, the date of their departure.

From our combined observations it would seem that the disease is at its height from July 15 or 20 to August 20, and that it ceases about the 1st of September.

While we failed to recognize *Uncinaria* as the cause of death in 1896, yet after August 22 of that year only two pups were found that had not certainly starved to death. In the light of subsequent work it is evident that one of these was a case of death resulting from inflammation caused by *Uncinaria*, and it is probable that the other was from the same cause. Both were from the worst infected localities on St. Paul, one being from Polovina, the other from Tolstoi. In 1897 Messrs. Snodgrass and Greeley found two cases of death from *Uncinaria* after September 1, but the summer of 1897 was warmer and drier than that of 1896, and as equally careful search was made in both years for other sources of death than starvation it is possible that for climatic reasons the ravages of the parasite were continued to a later date in 1897 than in the previous year.

Since but two pups out of many scores are known to have died from *Uncinaria* in 1896 after August 22, and but 15 out of 106 actually dissected after August 20 are known to have died from *Uncinaria* in 1897, it is assuming too much to say that any considerable number of pups dying after September 1 have perished from that cause.[1]

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[1] Professor Thompson, Report on His Mission to Bering Sea in 1897, p. 8, writes: "And, furthermore, the existence of this cause of death gives us the right, though in what measure we do not know, to deduct to a very considerable extent from the number of pups that die in the latter part of the season when we seek to estimate the loss due to starvation as a result of pelagic slaughter of the cows. It was shown last year that one-half the mortality of pups occurred before pelagic sealing

It must be remembered, too, that the proportion of 15 to 91 is abnormally high from the fact that in securing specimens for dissection hundreds of obviously starved pups were passed by and others secured when possible.

Up to the middle of August the number of deaths from *Uncinaria* exceeds that from all other known natural causes combined, and while many young seals probably recover from attacks of the parasite, it would seem that in a large proportion of cases the disease is sufficiently severe to cause death.

In the absence of the necessary data, we can say nothing as to the proportion of infected young which recover, and the data could only be obtained by the somewhat expensive method of killing and examining at least one hundred healthy individuals from some such locality as Tolstoi sand flat. Such an examination should begin after August 15 and be continued up to or into September, and the results of the dissections, compared with the number of pups found dead from *Uncinaria*, would afford some clue as to the proportion which are attacked and recover. The best we can do at present is to glean what we can from the tables of mortality, and here we find that of the 24 which died from violence, sundry or unknown causes, 4 contained *Uncinaria*, although 1 contained but a single example. Out of 177 starved pups, 14 contained *Uncinaria* in numbers too small to be fatal, although these starved pups throw little light on the problem, since, as pointed out elsewhere, the starving animals are the least liable to be infected. We can merely say that of 201 pups which died from various causes, but mainly from starvation, 18 contained small numbers of the parasite. These figures do not include the deaths on St. George, which is almost free from *Uncinaria*, and for that reason was not considered.

While many apparently strong and healthy pups suffer from *Uncinaria*, those dangerously attacked may usually be recognized by their sleepy appearance, the eyes being dull and partly closed; by the unkempt appearance of the coat, and by their lack of vigor. When it is possible to obtain and handle these animals they are found to lack the spirit and bad temper of healthy animals, to allow themselves to be handled and to apparently enjoy being rubbed. One of the effects of the disease seems to be to make the pups restless and to cause them to wander away from the rookery limits, sometimes to very considerable distances, and it is probable that young seals observed in 1896 and recorded as stragglers were afflicted with a fatal attack of *Uncinaria*.

The blood of animals suffering from *Uncinaria* is small in quantity, deficient in red corpuscles, thin and watery, and in extreme cases will not coagulate. The flesh is anæmic, so much so in typical examples that the cause of death is revealed at the first stroke of the knife; the lungs are pale, the kidneys particularly so. At the same time, while the animals are somewhat flabby, they have every appearance of being well nourished, and unless death has resulted from a combination of *Uncinaria* and starvation the bodies are enveloped in a thick coat of blubber, death coming so quickly that there is not time to get thin. Thus the pups which have died from *Uncinaria*

could exert its influence, but we do not know at what period, if at any period of infancy, the parasite ceases to be fatal to the pup. The presumption is certainly strong that to this epidemic cause is due a very considerable proportion of that moiety of deaths which do not constitute but only include the loss from pelagic sealing." The presumption, or, rather, the evidence, is opposed to this "presumption," and even were it true it does not alter the fact that every pup seal whose mother is killed inevitably starves. The argument is that because there is a high natural death rate therefore it does no harm to add to it.

can always be told from those which have died from starvation, and the intermediate cases when death has resulted from starvation following an attack of the parasite are also readily recognizable.

The pups which have died from *Uncinaria* alone are invariably fat, and their flesh is anæmic and yellowish; those which have succumbed to starvation alone show no trace of fat and their flesh is dark and purplish. Those in which starvation has followed an attack of the parasite exhibit more or less of an intermediate condition, more or less fat being present, according to the extent of the infection. Thus if the infection is extensive the animal will succumb quickly to the added starvation and some little fat will be present, while if the infection be light subsequent starvation will act slowly and only traces of fat will be present. Other things being equal, the condition of the kidneys affords very good evidence of the cause of death, since they are shrunken and congested in the starved animals; anæmic and rather soft in those which have died from *Uncinaria*, and in an intermediate state in cases of *Uncinaria* combined with starvation.

The original place of the attack is at or near the median portion of the small intestine, although in one severe case the *Uncinaria* reached to within 3 feet of the pylorus. The infection may occupy but 3 or 4 feet of the intestine, while in the worst case examined all save the uppermost 7 feet were more or less infected with the parasite, and in the later stages, as noted by Mr. Snodgrass, even the upper part of the large intestine may be involved, although this happens rarely.

In typical cases the diseased part is marked by slight nodular swellings, in other cases it is more uniformly distended along the bad part, while in other cases the intestine is thick, less elastic than in health, and abnormally pale. In still other cases, where death is due to inflammation caused by the presence of *Uncinaria*, and is not directly due to their attacks, the intestine is slightly inflamed. The majority of deaths are directly due to loss of blood; next in number are the instances where the animal has apparently withstood the attack, but the intestine has lost its power to assimilate food which passes through it undigested. These are the cases where the intestine is thick and pale and examination reveals the presence of numerous small cyst-like spots where the parasites were attached. Deaths from inflammation set up by the *Uncinaria* are the least numerous of all.

I am indebted to Mr. Snodgrass for the following notes on the condition of intestines of pups infected by *Uncinaria*, and on the development of the eggs.

The small intestine of a pup that has died of *Uncinaria* is, when the pup is recently dead, enlarged and of a whitish color. The walls are swollen and easily torn. Usually about the posterior third only is affected. At irregular but short intervals, the affected part is distended by oval enlargements. The walls of these places are usually no more swollen than the walls elsewhere. The enlargement is due to the collection of a dark, reddish-brown, or a reddish (due to blood) colored mass of mucus in the intestine. The worms are present only in the distended places, generally numbering from one to ten or twelve in each, and are very evidently the cause of the collection of mucus and blood. In pups that have just died, each *Uncinaria* is attached by one end within a small pit on the wall of the intestine.

Only the upper end of the large intestine is ever affected, worms having been found only in a very few cases lower down than about the first 6 or 7 inches, and generally the most of them are crowded into a much smaller place near the anterior end. In one case a few were found scattered along to near the posterior end, and several other worms have been found back of the middle. Since the middle of August cases were very common in which no worms were present in the small intestine, although all appearances strongly indicated that they had been there, but in which a large number were crowded into the upper end of the large intestine. The affected part of the large intestine is modified in the same way as that of the small, except that the small swellings are absent, the entire affected region being greatly enlarged and very tense.

Sometimes the walls of both small and large intestines contain small, whitish, granular bodies imbedded in them. These are not egg pockets, but diseased places.

The two sexes of the *Uncinaria* are easily distinguished by the difference in size and by the terminal organs of the male. The male is shorter and slenderer than the female, being about 9 millimeters long, and has the posterior end provided with two opposing sets of three large, inwardly curved, claw-like appendages. The female is about 14 millimeters long, and the posterior end of the body is conical, with a short tubular prolongation.

A large number of females were examined with a microscope during the time from August 20 to September 4. Only one of them contained no eggs. The others all contained a great number—more than a hundred in those counted. When the worms kill a pup, they kill themselves also. The females expel some of their eggs into the intestines during the life of the pup, and then pass to the exterior in the fæces. Numerous eggs may be found in the contents of both intestines by use of a microscope. These are generally in the process of division, consisting of eight or ten cells. Many are undivided, however. The eggs in the female worms are in the same condition. In a dead pup the unlaid eggs greatly exceed in number the laid eggs present in the intestine at the time of death. Therefore, by the killing of the pup, the worms kill a large proportion of their own eggs, unless the latter develop in the dead pup. Some eggs were examined from a rotting pup that must have been dead at least four weeks. A few were apparently decomposing, but the rest were in various stages of division. Many of the latter were placed in a drop of water on a glass slide and floated in a tight jar of water to prevent desiccation, in order to learn whether they would develop further or not. A hurried leaving of the island prevented the results being known.

The embryos of *Uncinaria* are undoubtedly taken into the stomachs when nursing, being brushed up from and with the sand by the fur of the female seals, and then swallowed by the young. This supposition is corroborated by the fact previously stated that few starved or starving seals contain any *Uncinaria*, the worst affected being the best nourished, many having died immediately after having eaten a hearty meal.

Out of 29 pups which had died from *Uncinaria* the stomach was full in 14 cases, partially full in 9, and empty only in 6, and it has been suggested by Dr. T. M. Wood that death may follow immediately after a full meal as a result of the effort of the enfeebled system to digest it.

The *Uncinaria* are practically confined to those rookeries where there is more or less sand, and it must be remembered in this connection that many localities where the ground is so plentifully strewn with rocks as to deserve the term of bowlder areas contain an abundance of sand among the rocks. This is partially the case on the Reef, Gorbatch, and Northeast Point, all localities where *Uncinaria* abound, although the headquarters of the pest seems to be on the sands of Tolstoi, Zapadni and Polovina coming next.

It is interesting to note that level, sandy areas thickly crowded with seals, on which deaths from trampling would be most likely to occur, are also the areas most favorable to the propagation of *Uncinaria* and their transmission to the young seals.

The sandy areas are not only favorable for the retention and development of the embryos of *Uncinaria*, but favorable to their transmission to the pups, for the reason that the females in lying on or moving over the sand get more or less of it in their coats, and a part of this is swallowed by the nursing pups. So much is sometimes swallowed as to give the milk a slightly grayish cast, the milk being so thick that sand does not settle in it.

On rocky ground the embryos are readily blown or washed off, while on bowlder beaches, such as the Lagoon and Zapadni Reef, the embryos are still more readily washed away, while many fall among the crevices of the rocks at the outset and are lost. There is thus much less chance of the embryos being present to adhere to the coats of the female seals, while on rough ground the seals are also unable to pack as closely together as on flat places. The relation between the character of the ground and *Uncinaria* may be shown by the comparison of one rookery with another or by the comparison of the deaths on St. George with those on St. Paul. For example, we did not find a single case of *Uncinaria* on Lagoon rookery, which is composed of rounded bowlders, while on Tolstoi Sand Flat 52 out of 109 pups examined contained *Uncinaria*, and there were 44 deaths from that cause alone. On comparing Big Zapadni with Zapadni Reef we find that on the first-named tract, which comprises much sand, 16 out of 25 deaths were from *Uncinaria* and parasites were present in 3 other cases, while on Zapadni Reef, which consists largely of bowlders, but 2 out of 12 deaths were due to *Uncinaria*, and these 2 occurred at the eastern end, where the bowlders are interspersed with sand.

Taking the death rate of the two islands as a whole, the number of dead pups found on St. George in 1896 was only 735, while on St. Paul it reached the astonishing number of 10,309, this great difference being solely due to the character of the breeding grounds. On St. George the rookeries are located almost exclusively on bowlder beaches or on solid rock, seldom, in their now depleted condition, comprising any extent of sand. On St. Paul, on the contrary, a large portion of the seals occupy ground that is either sandy or consists of sand interspersed with bowlders. This rocky character of the rookery ground on St. George and its practical freedom from *Uncinaria* is probably the reason why this island has afforded a greater number of skins in proportion to the size of the hauling grounds than has St. Paul.

As the damage done by *Uncinaria* bears a direct relation to the character of the ground and the number of seals present, the losses from this cause in past times must have been enormous, although in most places there is little apparent evidence of past destruction. Still, when one stands on the slope above the eastern end of Tolstoi and looks at the sands below they seem gray with the whitening bones of thousands of pups, thus mapping out territory occupied when the rookeries were in their prime, part of which has been vacant for at least eight years.

These seals, dead from *Uncinaria*, are those seen by the British commissioners in 1891 and 1892, and also by Colonel Murray in the latter year, and they are the dead seen on Zapadni and Polovina scattered along the edges of the breeding grounds.

That this great mortality has gone on year after year practically unnoticed is not so remarkable as it might seem. At the time the deaths are most numerous it is quite out of the question to enter the rookeries, and most of the dead are hidden from view by the dense masses of breeding seals, while naturally the more abundant the seals, as in years gone by, the more difficult would it be to examine the breeding grounds. During the period of rookery expansion, when the rookeries are largely clear, they are avoided in order not to disturb the seals which have drawn back over the adjacent territory, and after the breeding season is over no attention seems to have been paid to the rookery grounds; hence year after year thousands of pups have died and no one has been any the wiser. And unless one has actually gone over a rookery foot by foot and counted every dead seal, he will fail to realize the numbers present.

Thus, on the deadly sands of Tolstoi, where during the rookery season of 1896 there appeared to be not over 120 bodies, a complete count showed 1,493, while on the flat portion of Polovina, where 584 dead pups were found, Professor Thompson and myself on July 23 could see only 8.

Then, too, in many places the bodies of the dead rapidly disintegrate and disappear. Gulls begin the scavenger work, flies and foxes continue it, and rain and wind sweep up what remains; or in the denser portion of the rookery grounds the grinding of hundreds of flippers and the drifting sand soon remove all traces of the dead, and in a few months a scattered bone or two, which will serve as playthings for next year's pups, is all that remains to tell the tale. So quickly do the bodies disappear when the conditions are favorable that by October 10, 1896, not 10 per cent of the dead counted during the first half of August could be recognized.

Now and then, however, some traces of the former destruction of pups comes to light, as in 1896, when a dry October gale swept over St. Paul, removing the sand in places to a considerable depth, laying bare the bones of numberless pups, long buried in the sand flat of Tolstoi. Here, where a short time before only a bone or two was visible, fragments of 336 skulls were counted in a space of 39 by 42 feet, while the area adjoining the present terminus of the rookery showed even more.[1]

In one of the gullies at Zapadni there were 27 skulls, or rather fragments representing that number, in one little pile, but here they had washed together from various places above, and the local mortality, although great, was not so bad as it might at first appear.

As previously noted, the plague of *Uncinaria* ceases about the end of August, and its cessation appears to bear a direct relation to the habits of the pups, who by that time pass more or less of their time in the water, where the fæces are for the most part voided. The embryos of *Uncinaria* therefore pass into the water and perish instead of falling on the ground, where they may readily be taken up by the seals.

The rains of fall and the intense cold of winter must kill any *Uncinaria* which may linger in the sand, and we do not yet know how the rookeries become reinfected in the spring, although it is very probable that the older seals are to some extent troubled with the parasite, and that it is through their agency that the disease is started anew. This, however, is merely surmise, for the examination of a number of bachelors and old bulls failed to reveal the presence of any *Uncinaria*. The rapid digestion of the older seals and, above all, the fact that their food is obtained in the water and at great distances from land are factors of safety for them.

Next to *Uncinaria* the most frequent cause of death among young seals is starvation, and while the ratio shown in the number dissected may not be found in the total number of deaths, there is some reason to suspect that such may be the case; and, in any event, starvation is an important source of loss. If we use the figures obtained by Mr. Snodgrass from an examination of 75 young seals on St. George, and apply them to the total number of pups found dead in August, 1896, we would have 617 of the 735 deaths on St. George due to starvation, a death rate of 30.8 per 1,000, according to the estimates of the number of female seals on St. George in 1896. As starvation is the cause of the vast majority of deaths on St. George, it is fair to assume that this is not far from the normal ratio. Applying this ratio to the 123,000 females estimated to have been on St. Paul in 1896 would give 3,800 pups as having died from starvation

[1] Recorded by Mr. Clark.

in 1896, and it is to be noted that this is not far from the number indicated by the percentage of starved pups among those examined in 1896 and 1897. The percentage of deaths from starvation was a little higher in 1897 than in 1896, and this is precisely what would happen if we are correct in supposing that the starvation is principally, or at least largely, due to the rough treatment of cows by the bulls, and their subsequent death at sea.

Between July 25 and August 15 the proportion of starved pups to those dead from other causes is, among those examined, as 5 to 8; between August 15 and September 5 it is as 2 to 1, owing to the influence of pelagic sealing. In 1896 no young seals were found after August 22 which had died from any cause save starvation; in 1897 but 2 were found dead of *Uncinaria* after September 1, while of 23 young containing *Uncinaria*, examined after August 25, 8 had died from starvation following an attack of the parasite.

It will do no harm to repeat that there is no difficulty in distinguishing between pups which have died from *Uncinaria* only and those in which an attack of *Uncinaria*, not necessarily fatal in itself, has been followed by starvation. As the seal is weakened by the drain upon its blood produced by the parasite, it naturally follows that an animal thus afflicted will succumb to starvation in a much shorter time than if in a perfectly normal condition. It thus happens that those young seals which have died from the combined effects of *Uncinaria* and starvation retain more or less fat, while those that have perished from starvation alone are emaciated to the last degree.

Therefore, although we failed to recognize the ravages of *Uncinaria* in 1896, yet in no single instance did we consider as starved a single pup that had died from *Uncinaria*, and Professor Thompson's surmise to that effect is without any foundation.[1]

As to the exact causes of this starvation of the young we are somewhat in the dark, although we get some hints in the observations of Mr. Clark in 1897, which show that in some cases the seals are stolen from their original harems, and thus separated from their young, who in many instances are unable or fail to follow their mothers. Also, a number of females very likely perish at sea from the rough handling they have received on shore, while others probably stay away so long feeding and sleeping that the young perish of hunger before they return. This supposition derives support from the fact that on two occasions lean and apparently famishing pups were seen to respond eagerly to the calls of cows just in from the sea, showing from the avidity with which they nursed that they were in a starving condition.

A few pups are bound to starve from the deaths of their mothers, which are killed by rough treatment on the rookery grounds, but this number is comparatively insignificant and, moreover, most of the cows are killed too early in the season for their pups to be dissectible by August 10, and after all known sources of starvation have been considered we are bound to say that deaths from this cause before August 1 are more numerous than, with our present information, we can definitely account for. However, let the loss from starvation under natural conditions be what it may, this loss is comparatively small, while the fact remains that every pup whose mother is killed at sea inevitably starves to death.

Deaths from drowning are not so numerous as might be expected from the habits of young seals and from what has been written of the "deadly surf nip," but after visiting the rookeries during and after several gales it becomes evident that, under

[1] Thompson, Report on His Mission to Bering Sea in 1897, p. 8.

ordinary circumstances, comparatively few are lost by drowning. Until the pups have learned to swim well they are careful not to venture beyond their depth,[1] and after they have learned it takes a pretty heavy surf to drown them, even before they have mastered the art of diving beneath the crest of a wave. A pup will come in on a wave and go sprawling up the beach over the shingle and among the rocks in a perfect smother of foam, and then, instead of thanking Providence for his escape, turn about and swim out into the sea to repeat the performance.[2] Certainly some do drown, especially when startled into jumping from a cliff into a heavy surf, and the habit of crawling under the bowlders leads to the destruction of others when the sea comes up with the tide and catches pups in places whence they are unable to extricate themselves; but, after all, the number lost from these causes is small. In this connection it is worth noting that the percentage of drowned pups was higher in 1896 than in 1897, and this is in accord with the difference between the weather during the two seasons, the summer of 1897 having been unusually quiet, so that up to August 15 there was no surf sufficiently heavy to sweep incautious pups off the rocks. While at St. George, on August 3 and 4, 1896, we experienced a fresh gale from the southwest, which sent a heavy surf tumbling directly in on Zapadni. As the bowlder beach at the foot of the cliffs was fairly swarming with pups just beginning to play in the water, it was a good opportunity to see what damage, if any, would be wrought by an ordinary gale. A visit to the rookery, however, failed to reveal the presence of a single drowned pup, although the locality where the young seals were massed beneath the bluff was critically scanned with field glasses and a careful search was made along the beach. The pups, as in other cases noted, had simply withdrawn from the water's edge, beyond the breaker's reach, and were perfectly safe.

Freshly drowned pups were found on Tolstoi shortly after this gale (August 7), and later on drowned pups were obtained from Lower Zapadni and Gorbatch, but on these rookeries the sea struck obliquely, and it would seem that this is more dangerous than when it sets squarely on shore. In the latter case, a pup if swept off by one wave might be cast back by the next, but when the sea strikes diagonally it creates a strong surface current, that would carry an unlucky pup out and down the beach to some place where the waves come directly in and there the lifeless body would be cast ashore.

Many a pup has been considered as having drowned, when in reality he had been dead for days, perhaps weeks, before washing off the rookery, to form one of a so-called "windrow of drowned pups" at some point farther up the beach. After the gale of August 3 the sandy beach at Tolstoi was strewn with the bodies of long-dead pups,[3] while the gale of August 17 cast no less than 30 bodies on Zoltoi sands, nearly a quarter of a mile north of Gorbatch rookery. A superficial observation of these bodies might easily have created the belief that they had been drowned, when a closer scrutiny would have shown that all had long been dead; that many were in an advanced stage of decomposition, and that some had the umbilical cord still attached. (See Pl. XIX.)

[1] On several occasions in August, while visiting the rookeries when a heavy surf was running and before the pups had learned to swim, they were seen to gather in a crowd along the edge of the water, evidently hestitating between the devils and the deep sea.

[2] In September and October pups were always to be seen sporting in the surf, even when it was infinitely heavier than at any time in August.

[3] There were 232 of them, not one of which had drowned; those which had perished from this cause being found among the bowlders of the rookery proper farther to the west.

The danger of taking anything for granted is well shown by the fact that when the commission first visited Northeast Point in July the bodies of 10 seal pups and 25 sea-lion pups were found washed up on the beach to the south of Sea Lion Neck. As it had blown a gale from the northeast ten days before, and the surf had beaten directly on this part of the island, death from drowning seemed so obvious, that no autopsies were made, although it was casually noted that the sea-lion pups were lean.

In the light of subsequent observations it is plain that Mr. Redpath was correct in stating that these animals were dead long before they washed off the "Neck." With this unfortunate exception, in no instance was it taken for granted that a pup was drowned simply because such appeared to be the case.

While the number of dead pups which remains after eliminating those dead from *Uncinaria*, the starved and the drowned is comparatively small, yet, in the aggregate, it must amount to some hundreds, and helps to swell the long list of those which die before they are 6 months old. Various accidents and diseases contribute to the death roll, and there must be many causes of death besides those noted.

While the trampling of the young seals by the old does not play the important role ascribed to it in 1896, it nevertheless enters into the causes of death, and probably did so more extensively in former days when seals were much more numerous and the rookeries much more crowded. Judging by the number of very young pups with part of the umbilical cord still attached which die within the harem limits before the middle of July, there is a considerable percentage of newly or recently born pups which meet their death by being stepped on. These could scarcely have met their death from *Uncinaria*, since the time that they have been nursing seems hardly sufficient for them to have become infected so badly as to cause death.

That there is a certain amount of loss owing to the pups being trampled under foot or struck by some bull rushing about the rookeries is undeniable. Six pups were found in 1896 whose death could be ascribed to no other cause, while as many more were badly bruised, and in 1897, when a larger number of pups were examined, 10 deaths were due to blows and several more were obviously injured.

It is also possible for a pup to receive fatal injuries without any trace of them appearing on the body. On August 8, 1896, while counting the dead on the reef, two pups were seen to be knocked over by a bull and left gasping on the ground. One, a robust individual, so far recovered from his injuries that he was allowed to take his chance of total recovery; the end of the other, a small animal, paralyzed and dying, was hastened by a scalpel thrust in the medulla, but a careful examination made of the body failed to reveal any visible signs of the deadly blow that had been received.

The long, rubbery flipper of the fur seal is, in fact, an improvement on the sand bag of the footpad, and while the edge of the flipper is capable of delivering as hard a blow as a cudgel, the flat part may stretch a pup lifeless on the sand, and leave no trace behind. So small, indeed, may be the external evidence of a heavy blow that one pup from Gorbatch, which bore so slight a contusion on the neck that the cause of death was questionable, was found to have the base of the skull fractured. Had the skull not been saved and cleaned, this individual would have passed into the list of cause of death not obvious, for the fracture was invisible until the muscles were removed and the skull completely cleaned by the industrious amphipods.

The possibilities of a blow from the flipper of a bull, were well shown in one instance where the stroke had been so tremendous, and dealt so squarely on the top of the head, that the skull was literally split, the frontal and parietal bones being driven apart along the line of suture. Another pup whose skull was fractured may have been struck by a flipper, but, as it was also bitten, was more probably dashed against a rock.

To one who has watched the rookeries and seen an excited bull rushing about in a crowd of females and pups the surprising thing is that deaths from bruises are not more frequent. During the height of the season the bulls are ever on the alert, keeping a sharp lookout, not only on the idle bulls which lie about the rookeries, but on their neighbors as well, who, when their harems are small, are quite ready to borrow a cow or two from a more fortunate companion. Considerable commotion, too, may be caused by a bull heading off some cow which may evince a desire to go to the water before the bull thinks she should. The worst disturbance, however, is created and most damage done when the proprietor of a harem is driven off by some aggressive rival, for the defeated bull makes for the sea, overturning cows and dashing the pups right and left in his mad rush for safety. Other cows, taking the alarm, also scurry for the water in spite of the efforts of their bulls to round them up, and a hundred or more, leaving their pups behind, will plunge headlong into the sea. On July 16, 1896, such an incident was twice witnessed at Northeast Point in a comparatively short space of time, and while the desertion is only temporary, the cows returning to their respective harems as soon as quiet is restored, yet much damage may be thus caused.

While deaths from specific diseases are probably comparatively few, yet undoubtedly more exist than are herein noted, while more careful work might have transferred some of the unknown list to other categories. Still it is often difficult, frequently impossible, to ascertain the cause of an animal's death even where the preliminary symptoms are known and the autopsy made under the most favorable circumstances. In the present instances the specimens were gathered as best they might from half an hour to two weeks after death had occurred, and the work of dissection was performed in the field, sometimes with a block of lava for a dissecting table, sometimes on the sand, often with an audience of interested bulls who evinced a strong desire to take part in the proceedings.

Still, in making the autopsies nothing was taken for granted, not even in cases of evidently starved pups, while all bodies found in situations where they might have been drowned were carefully examined to ascertain whether or not this were really the case. Care was also taken not to confuse marks made by the pecking of gulls with contusions, for such injuries about the eyes and frontal region, when inflicted shortly before or after death, may readily be mistaken for the actual cause of death. In two instances, where the cause of death was not obvious and time permitted, the brain was examined, but in neither case did it exhibit any congestion or other lesion to account for death.

Absence of fat, or of subcutaneous fat, may not mean as much as it should to those unacquainted with seals; in reality, it is practically synonymous with starvation, and if a seal lacks fat beneath the skin it is useless to look for it elsewhere. Fat is the seal's heavy undershirt, by which he is protected from cold, and when this is gone the seal is gone, too.

In order, too, that there might be no question as to the evidences of starvation, an active, healthy female pup found among the bachelors was placed by itself, its condition at various times noted, and an autopsy made after death. In order to have the same conditions that are found on the rookeries, the body was allowed to lie out of doors, exposed to the weather, for two days before it was dissected. The results of the autopsy agreed exactly with the diagnosis of starvation in man, as well as with the appearances of the organs in other pups whose death was ascribed to starvation. When first taken, on August 1, the pup weighed 12 pounds; at the time of death, on August 15, the weight was reduced to 9 pounds. The appearance of the organs was as follows: Lungs small, flaccid, deeply congested; comparatively little blood in heart, and no clot; liver small, thin, and very dark; gall bladder full; much dark bile secretion in intestines, forming the "tarry feces" so characteristic of starvation; kidneys small and dark; both branches of uterus congested.

It may be said, too, that a blind pup was killed on Zapadni by choking and crushing, much as might have occurred had the little one been sat upon by a bull, or trampled beneath a score of stampeding cows, and that the lungs showed the characteristic congestion found in the lungs of evidently trampled bodies, although, as was often the case in them, there was little external evidence of what had happened.

As the autopsies were, as stated, made and recorded in the field, it was not practicable to go into particulars; and where, for example, the lungs were congested, that fact alone was stated without describing their appearance in detail, although there is a great difference between the flaccid, purple congestion of a starved lung and the fuller, redder look of a lung congested from trampling or smothering, still another variety of congestion resulting from drowning. But while this is not noted in the autopsies, it was taken into consideration in deciding on the cause of death.

The rarity of pulmonary diseases is shown by the fact that only one seal was thus affected, this being a case of catarrhal pneumonia,[1] found on Big Zapadni. That such should be the case is not, however, to be wondered at, for it would indeed be surprising to find animals whose lives are passed in the water, or on cold rocks in a raw, foggy atmosphere, suffering from pulmonary complaints. In this respect, as in all others, "natural selection" tends to improve the race of fur seals by eliminating the weak or sickly, for Nature harshly and promptly removes all individuals which lag behind in the race for life. The old seals, however, are much given to sneezing when on shore, although the cause of this is unknown.

The most common source of trouble among the little seals, although common only by comparison, is inflammation of the bowels, seemingly brought about by constipation, the large intestine being packed to distention with green fecal matter, with resultant inflammation. Three instances of this trouble were found on St. Paul, and as many on St. George, in 1897. Mr. Snodgrass, who made the autopsies on the latter island, notes that in two instances the umbilical cord and a portion of the placenta were still attached, the region about the umbilicus being particularly inflamed. As in these instances the state of the intestines was similar to those in which the umbilical cord had disappeared, it seems likely that its presence simply aggravated the disease and had no part in producing it.

Another case of inflammation of the bowels, noted in 1896, may have been brought about by a blow or by a fall from the rocks, and the same may be said of the single case of inflammation of the kidneys, as the region over these organs is particularly liable to be struck by the flipper of some old seal.

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[1] So diagnosed by Dr. Wm. Gray, of the Army Medical Museum, who prepared several sections from one of the lungs.

Falling from cliffs may seem a rather singular source of death to anyone not familiar with the conditions about the rookeries and with the habits of the pups, although to one acquainted with them it is not surprising. Young seals are much like children; they delight in exploring little caves and creeping into out-of-the-way nooks and crannies, a trait which leads to some of the losses from drowning. They also scramble along narrow ledges on the bluffs back of the rookery grounds, especially if there be some miniature cave in which they can curl up and sleep, and in these explorations it occasionally happens that even their clinging, rubbery feet slip and a pup falls from 10 to 40 feet onto the sharp rocks below. In fact it was the sight of the little seals thus scrambling about the bluffs of North Rookery, St. George, that first suggested the thought that some might be killed in this manner, and a little later two bodies were seen lying among the rocks in places inaccessible from below. The result of such a fall was shown by the autopsy of the only one thus killed which could be recovered, the others having fallen among the breeding seals, where their bodies could not be reached. Even when they do not fall far enough to be killed, pups may fall into crevices among the rocks whence escape is impossible, and in these natural death traps perish miserably from starvation. Such a trap, consisting of a narrow crevice at the base of a long, steeply sloping rock, was noted on Kitovi when counting dead pups in 1897. The bodies of several little seals were taken from this one cranny, whose steep sides prevented escape, while the sloping rock above formed a most admirable chute down which the pups slid to their death. A still more curious case was that of a young seal found penned beneath a rock by drifting sand, this having accumulated to such an extent that escape was impossible, and only room enough was left to enable the pup to breathe, the aperture being quite too small to allow the body to pass.

The number of pups thus caught among rocks and starved, while not large, is yet greater than one would have suspected, since 7 pups and 1 cow were rescued when counting the starved pups, and, of course, any cause of death, however small, helps swell the total mortality. Now and then rocks fall on the pups instead of pups falling on the rocks, and at Polovina two young seals were seen lying beneath blocks of stone which had dropped from the face of the cliff. It is rather surprising that this does not occur more frequently; but while the rocks are cracked and shattered, rock-falls rarely occur except in early spring before the seals have arrived. Deaths from this source are probably more frequent on Copper Island than on the Pribilofs, owing to the fact that the rookeries in many cases lie at the base of overhanging cliffs, and, although accurate observations of the rookeries are difficult from the manner in which they are guarded, Mr. Barrett-Hamilton noticed in one spot a bull and two cows crushed beneath fallen rocks.

The following note is taken from Dr. Stejneger's report on the Russian Seal Islands, published in 1896. He says, page 45, footnote:

> So steep are the rocky walls behind the Copper Island rookeries, and so close do the seals lie to them, that falling masses of earth and rocks have occasionally caused the death of many of the animals. Thus it is recorded (Otchet. Ross Amer. M. Komp. Za., 1849, p. 23) that on the 16th of October, 1849, during an earthquake, a rocky wall fell down, burying a rookery on Copper Island. Another earth slide on one of the Glinka rookeries in 1893 similarly resulted in the killing of many seals.

The death of a pup seen on the hillside at Upper Zapadni, jammed beneath a bowlder, was in all probability due primarily to some rampant bull or fleeing bachelor, for even on level ground a hurrying seal will overturn a good-sized stone, while on a slope a rock of a hundredweight might easily be set in motion, and roll into a pod of sleeping pups with fatal effect. A practical example of the ease with which pups may be killed in just this way was seen while making the final count of Tolstoi, when a bowlder, dislodged by moving seals, rolled into a "pod" of pups, killing two of them and bruising others.

Among the causes of death not given in the table is the biting and mauling of recently born pups by the cows, and the maltreatment of older ones by salacious bachelors. A pup obtained on Copper Island by Mr. Barrett-Hamilton had, according to the diagnosis of the surgeon of H. B. M. S. *Spartan*, died from erysipelas induced by a bite on the head, and on Northeast Point two pups were seen with suppurating wounds on the back whose ultimate recovery seemed somewhat problematical. Several young pups were seen bearing fresh and ugly scars of recent bites, and during a visit to Kitovi on July 13 Dr. Stejneger and myself witnessed the following ill treatment of a very young pup: "A recently born pup was very badly pulled about by the cows. At one time it was pulled by three cows at once, one having hold of its head, another of a hind flipper, and the third by the skin of the side. It was pulled back and forth in this manner for some time, but when last seen was alive."

There was no apparent reason for this brutal treatment save the vicious nature of the animals, which snap at one another on small provocation. Later in the season, when the harems have broken up, bachelors also worry the pups for pure devilment, just as big boys torment little ones, some of the youngsters being pretty roughly handled, and some found whose death could be ascribed to no other cause. A large male pup, badly bitten, was seen on the reef, the external oblique muscle being cut through and the skin torn off half the right side of the abdomen, the flap trailing on the ground. Although alive and active, such a wound must eventually have resulted in death, and the animal was killed. No case of sunstroke was observed, and none has probably ever occurred, although seals might be killed by the sun just as they might be killed by lightning. The symptoms ascribed to "sunstroke," "nervous jerking of the limbs, followed by convulsions and death," are the symptoms of the later stages of starvation, and were seen and noted by Dr. Jordan, Mr. Townsend, and Mr. Clark.[1]

To sum up the evidence accumulated during the summers of 1897 and 1898, it may be said that under natural conditions the vast majority of deaths among young fur seals are due to the parasitic worm *Uncinaria*, whose ravages have probably borne a direct ratio to the number of seals and condition of the rookeries. Next comes starvation from causes at present not definitely known, and then follow small losses from various diseases and accidents. A few of the newly born are accidentally trampled under foot, a few are killed by their vicious relatives, and some perish from other causes, so that all in all the total number of deaths before the young leave the island of St. Paul is not far from 10 per cent of the number born, St. George with its freedom from *Uncinaria* faring much better. What follows after the migrating thousands

[1] Two of these are recorded in the Journal as follows: "A little pup lies gasping, with spasms like hiccough for each breath. She is killed. A small female pup, very lean. The right lung congested, hardly crepitating; left lung normal; other organs likewise. Stomach wholly empty. Lower part of small intestine full of greenish fecal matter. Absolutely no fat.

"A large female pup, greatly emaciated, was found lying gasping and jerking with spasms. Another case of sunstroke, so called. It has passed a quantity of dark matter, like coal tar (a sure sign of starvation), and its lower intestines were full of the same fluid. The organs were in a normal condition. Not a trace of fat."

have left the islands and started on their first trip southward we do not know, but we do know that a very large proportion of those that set out never return, and the most probable suggestion is that they perish of starvation from failure to catch the necessary food, being abruptly weaned and forced to shift for themselves before they have had an opportunity to learn the art of fishing.

Little can be said regarding the deaths among adult seals except those which occur on the rookery grounds and are the direct outcome of fights among the bulls or ill treatment of females by the males. As a rule these happen early in the season, for not one of the 129 cows and 28 bulls found on the breeding grounds in 1896 was sufficiently well preserved to permit of an autopsy. In all probability comparatively few bulls perish directly on the rookeries, the 28 bodies found being those of such as were killed outright or so desperately mauled that retreat was impossible. But many a vanquished bull escapes only to die and many another dies after the season is over, lying down to sleep his last sleep on the slopes about Middle Hill, where the bones of many an old veteran lie bleaching on the sands. The shore of English Bay, from Tolstoi to beyond Middle Hill, is indeed an ancient cemetery, not only for thousands of pups and scores of bulls, but for many a sea lion and an occasional sea otter [1] as well. A 5-year old male, found dead on Zoltoi sands, affords a hint of the manner in which many a rookery dispute must terminate, especially when a young bull ventures, or a bachelor blunders, inside the line of breeding seals; bitten about the flippers, bruised about the neck, this ejected youngster had taken to the sea only to exchange one mode of death for another, escaping from the jaws of an irate bull only to perish by drowning. But if most of the bulls which are killed during the breeding season die outside the rookeries the reverse is probably true of the cows, whose deaths either result from the efforts of the bulls to prevent them from leaving the harems, or from the attempts of the bulls to appropriate cows belonging to their neighbors. In either case the cows are liable to undergo rough treatment, and although they receive the most savage bites without flinching, many undoubtedly die of their wounds. Ordinarily a bull merely expostulates with a cow in very vigorous seal language, but now and then he will lose his temper, and with a rapid stroke cut a gash in the female's neck or shoulder, or make his teeth meet in her back.[2] Or, occasionally a nervous bull will seize some hesitating cow by the back and with a toss of his head hurl her 10 feet away, usually without serious injury, but now and then with fatal results. Such a case was seen on the reef in 1897, where a female lying on her back among the bowlders was found to have her skull as neatly fractured as if it had been done with a club, a bite in the small of the back intimating rather plainly that the perpetrator of the deed was an ugly-tempered bull.

While such things may happen at any time, they usually occur in the early part of the season, and are most frequent where the harems are small and the idle bulls, which are so fruitful a source of disturbance, most numerous. This in 1896 was the state of affairs toward the southwestern portion of Northeast Point, where the quarreling and clamor were incessant. Many of the cows, and some of the pups as well, were badly scarred, one cow being specially noticeable from the fact that a patch of skin 6 inches

[1] Bones of the sea otter are now very seldom found here, as they have mostly been collected.

[2] A good example of such an occurrence was witnessed during the first visit to St. George, Zapadni, when an ill-tempered bull with but one cow cut a gash 6 inches long in her neck with a single quick snap, while on Lukanin, in 1897, a vicious bull literally tore one of the newly arrived cows to pieces.

square was missing from her back. Such an injury as this last may have been inflicted in the attempt of some envious bull to appropriate his neighbor's wives by dashing into a harem, seizing a cow by the skin of her back and carrying her off bodily, a performance eminently calculated to create respect for the bull's strength and agility.

Naturally such a Sabine outrage as this does not go unheeded by the bull whose cow has been taken, but his pursuit of the offender is hampered by the fact that he dares not leave his harem too far behind lest in trying to save one wife he lose others.

One enterprising bull was seen to come out of the water, grasp the nearest cow by the neck, plunge back and swim away with his prize to a spot some 75 yards distant, captor and captured being under water most of the way. And after all this labor the cow slipped away three minutes later while the bull was engaged in a discussion with a neighbor. Occasionally, too, it will happen that when a cow has been seized by some predatory bull her rightful lord and master will dash to the rescue and grasp her by the most convenient spot, usually the neck, and endeavor to liberate his abducted bride by main force. A game of pull devil, pull baker, ensues, and the poor cow is tugged about until the skin gives way or one of the bulls gets tired and lets go. Observation of a rookery impresses one with the fact that among fur seals matrimony is a very serious matter for all parties concerned, and that the bad temper displayed by the bulls is, to a great extent, excusable.

Rough handling by the males may be set down as the most evident known cause of death among the females, and the greater the proportion of bulls the greater the number of deaths, so that in a state of nature the superabundance of bulls must probably be an important factor, if not the chief factor, in checking the increase of the fur seals. As the proportion of the sexes at birth is equal, and as at least thirty males are born where one is needed, there must in olden times have been a prodigious amount of fighting and a mighty turmoil on the breeding grounds, with a consequent destruction of mothers and pups. There were 42 dead cows on Reef rookery in 1897, and if there was such a visible loss with only a moderate surplus of males what must have taken place before any males were killed by man? It is evident that if many cows are killed outright many more must be badly injured and eventually die, an inference made in discussing the mortality among the pups, where it was suggested that the loss of these injured females at sea probably accounted for much of the early starvation of the young.

While rough handling by bulls is thus the most evident factor in the death of cows, yet the vast majority perish from causes which must, from the nature of things, remain unknown. Occasionally, however, we find deaths resulting from unsuspected causes, as when four cows were found to have died during parturition from a wrong presentation of the fetus; in two cases the shoulder having offered, and in the third the occiput. In this latter case the head of the fetus was doubled up on the body and firmly wedged in the pelvis of the mother, which had evidently lived some time after the death of her offspring. The fourth case was in many ways very remarkable, for while death had occurred in parturition from a breech presentation, the conditions showed a pretty clear case of superfetation. The placenta was torn away and lay outside the ruptured uterus, which contained in the left branch a pup of the ordinary size and also a small, shrivelled-up fetus, about 6 inches long, attached to the caudal side of the horn near its junction with the main branch. This had apparently reached a certain stage of development and then been resorbed, leaving little more than the skeleton. Owing to the long time that had elapsed since death it was not possible to make as critical an examination as might be desired.

Losses from such causes as the above must naturally be few and form but a trifling factor in the total death rate, still it is interesting to find such cases among wild animals.

Killed by a fish bone sounds like the heading of a newspaper item, and yet one cow seal was found dead from an accident, not in swallowing, but in unswallowing the remains of a pollock. As noted in the chapter on food bones or other hard substances swallowed by seals, they are sooner or later regurgitated, bones of good-sized pollock being thus disposed of, usually with success. In the present instance the bone had lodged crosswise in the larynx, perforating both the right and left sides, though finally working through the left side for more than half its length, making so bad a cut that death may be said to have resulted from the combined effects of strangulation and loss of blood. The cow was found washed up on the beach, and an autopsy revealed no injury save a slight congestion of the lungs and the presence of an unaccountable quantity of clotted blood in the stomach. While skinning the animal the bone was found fixed in the muscles of the neck and subsequent examination revealed the extent of the damage which had been done.

Not only were few dead adult seals found, but very few that were seriously injured, this for the reason that in the majority of cases serious injury promptly leads to death where the struggle for existence is so severe as among the fur seals. A crippled bachelor shot on Zoltoi was probably the victim of an encounter with a killer, the location and extent of his injuries being just such as would have resulted from the bite of a pursuer, the right hind flipper being bitten, both sides of the pelvis crushed, two ribs and the processes of several vertebrae broken. (See Pl. XX.) As a direct result of these injuries, which involved the spinal cord, this young bull was paralyzed in his hind quarters, dragging them laboriously along the ground, and another large bachelor, seen on Kitovi, but unfortunately not secured, was very probably hurt in a similar manner. On October 10 the natives brought in the remains of a pup said to have been destroyed by a killer, and on October 13 a female was found whose death was also ascribed to the same cause, while two pups were seen each minus a flipper. A cow on Zapadni had lost a hind flipper, possibly from the bite of a killer, and an old bull was observed on Zapadni for several consecutive years minus the greater part of the fore flipper, and yet thus handicapped able to maintain his place on the rookery. A cow with a broken or dislocated right fore leg was noticed on the North rookery of St. George, and a young male similarly crippled was seen on Zoltoi sands.

As to the number of seals, young or old, which perish when absent from the islands and the causes of their deaths we know absolutely nothing, but wind and sea, or anything which leads to interference with the food supply, are probably the fur seal's worst natural enemies, while ice lingering about the islands in spring would be very deadly to the females seeking the shore to bring forth their young. Once, indeed, the Pribilof herd seems to have been reduced to its lowest ebb from this very cause, the scarcity of seals during and for some time after 1836 having been brought about by the persistence of ice floes about the islands long into June, causing bulls and cows alike to perish by thousands.

The only two species of sharks which could possibly eat seals are fortunately rare, even in southern waters, and deaths from this source are probably not worth mentioning, even if they occur at all. The killer (Pl. XXI) is charged with the destruction of many seals, and, as intimated above, many undoubtedly are lost at sea, but the killer is reticent on the subject, and, in this instance at least, the sea does not give up its dead.

The killer, when in the same locality as the seals, may, undeniably, be a terrible enemy, since it is not only extremely voracious but swift enough to catch a seal and sufficiently powerful to attack and kill a sea lion. Fortunately killers are largely absent from the vicinity of the islands during the breeding season, the majority of them leaving in May and returning in September. It must, however, be said that very little is known as to the destruction caused by the killer. Very few have actually seen the killer capturing and eating seals, and still fewer have had the good fortune to perform a post-mortem on one of these cetaceans, so that information on this point is much to be desired.[1]

Killers were seen on July 8, when about 40 miles south of St. George, and on September 9, when between St. George and Unalaska, but the only one seen during the intervening time was on August 6, when on the *Corwin*, about 10 miles to the east of St. Paul. Of course this does not mean that there were no killers about the islands during this time, but as a careful watch was kept for them it is safe to say that they were not numerous. After this date they seem to have suddenly become abundant, for the presence of killers about St. Paul, in proximity to the seals, is frequently mentioned in the journal kept by Mr. Clark, and although they were not actually seen to attack and eat seals, yet it is hardly probable that these carnivorous cetaceans were prowling about the island solely for amusement.

A most extraordinary concourse of these animals was noted by Captain Garforth, of H. B. M. S. *Pheasant*, who states that on September 13, 1896, killers were so numerous to the northward of Unimak Pass, hundreds, if not thousands, being gathered in that vicinity, that it was necessary to stop several times in order to avoid running into them. As Captain Bryant says that he took, respectively, 18 and 24 seal pups from the stomachs of two killers, the possibilities of this animal as a destroyer of seals would seem to be considerable, and while little is actually known concerning losses from this source it seems not unfair to charge a certain proportion of the unknown death rate to the killer.

That this unknown death rate is normally high is certain, and it is equally certain that it has never been duly considered, not even approximately, in estimating the natural increase or decrease of the seals, although all such "estimates" are, at the best, mere guesses. If the death rate among young pups is now something like 10 per cent it may have ranged as high as 20 per cent in former days of abundance. And if to this we add a loss of half the pups which leave the islands in the fall we are probably inside the mark, for, as Dr. White says, "Nature is extravagantly wasteful and terribly cruel." Although the death rate presses so heavily on the pups, it must be equally, or even more, severe on the breeding females, which, heavy with young, are less able than the others to procure food, escape from their enemies, and withstand the buffetings of winds and waves. We get some idea of this from the great proportion of female seals which are taken at sea—not alone by the pelagic

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[1] Personally I am inclined to hold the killer guiltless of very much slaughter of young seals, believing that starvation from inability to capture food when they are first turned off by their mothers, and forced to shift for themselves, is the most important factor in the death rate among pups.

sealers, but by the Indians of the Northwest coast, whose catch consists mainly of females and yearlings, and we get a further idea from the comparative scarcity of 3-year-old cows on the rookeries.[1]

Not only are the females heavily handicapped by the weight of their unborn offspring, but during three months of the year they are compelled, in order to withstand the drain of the nursing young, to frequently go to sea in search of food, while at that very time the great majority of males is on land, or in the immediate vicinity of the islands, safe from natural enemies.

If the death rate among females was not so high as to have kept the breeding portion of the herd practically at a standstill year after year, the effects of pelagic sealing would not have made themselves visible on the rookeries so rapidly as they did. Evidence of the large number of deaths among females also appears in the comparatively small area of the rookeries as figured in Elliott's first report, when they were nearly or quite at their highest level. The bachelor seals seem to have increased enormously prior to the occupation of the islands by the United States, but there does not appear to have been any corresponding increase among the females, great though their numbers actually were, and the breeding grounds form but a small part of the entire area occupied by seals. The female portion of the herd, the very one on which depends not only the increase but the preservation of the seal race, always has been and always will be the most susceptible to attack, and it is small wonder that its ranks have been decimated by pelagic sealing.

That the death rate is high is certain; that it is variable is equally sure, for climatic conditions, with their bearing on the all-important question of food supply, vary from year to year. No man can safely assert that because seals are abundant one season they will be equally numerous the next; and for this reason, if for no other, it would be dangerous to permit the killing of seals at sea even in limited numbers; while another point to be borne in mind is that while the numbers of the seals have been greatly lessened, nothing has occurred to lessen the number of their enemies or to change whatever natural causes may be injurious to them.

If little can be said about the causes of mortality among seals, less can be said regarding the complaints to which they may be subject, although, from the prompt manner in which the weak or ailing are weeded out by natural causes, disease seems to be more rare than it probably is in reality. Cases of some complaint apparently related to mange are not infrequent, the hair being worn down short, the rough and thickened epidermis showing through the hair.[2] The examination of specimens of the skin dried and preserved in alcohol failed to throw any light on the exact nature of the disease, which, from the worn condition of the adjacent fur, seems to produce intense itching. The trouble is usually on some part of the back, but one female was seen on which the head was affected. It is said that this complaint is of more frequent occurrence now than formerly, but this may be simply because the seals are more closely observed than they were.

[1] These 3-year-old seals may be distinguished by their rather small size and their gray mustaches; they were particularly looked for in 1897 in order that their abundance or scarcity might form the basis for some estimate as to the losses among seals up to 3 years, but it can simply be said that the 3-year-old cows form but a small part of the breeding herd, the majority being 4 years old and over.

[2] Seals suffering from this trouble were taken by the pelagic sealers off the coast of Japan and gave rise to the rumor that seals branded on the Pribilofs had been captured in Japanese waters.

Diseases of the eye, more or less severe, seem to be common, or at any rate not uncommon, among the seals, ranging in virulence from a mere suppuration of the eyelids to complete blindness. Cases of suppurating eyelids or lachrymal glands may be seen among the pups at almost any time, on almost any rookery, but many of the pups are totally blind from some disease of the retina, the cornea being transparent, but the pupil greatly dilated, giving to the eye a peculiar greenish appearance, as in seals recently killed. One young male was seen on Polovina which seemed to be suffering from cataract in the left eye, the cornea being transparent, but the pupil showing as a white spot, as though the lens were opaque. Most of the cases of blindness among the bulls are, however, the direct outcome of rookery battle, and one-eyed bulls are by no means rare, nor do they seem as much handicapped by the loss as one might expect, since a one-eyed bull on Zapadni gave more trouble than any six of his fellows with the normal complement of eyes. There are frequent instances among the pups of blindness in one eye, seemingly from accident, the cornea being sometimes thick and white, sometimes ulcerated or even perforated. Similar disease of the eye is produced in man by the irritation of foreign particles, such as iron filings, sand, etc., and there is no reason why it should not be similarly brought about among seals, although it is often the direct result of a bite. There is more or less sand on all rookeries, and particularly on the hauling grounds and localities where the pups pod out, and it would be strange indeed if the seals never got any in their eyes.

The eye of a pup killed on Zapadni in August, showing a fine case of perforation of the cornea, was preserved. This has been carefully examined by Dr. D. K. Shute, who has made a special study of diseases of the eye, and he has made the following report:

The whole cornea is densely opaque, the corneal layers being replaced by fibrous tissue (leucoma). About the center of the cornea there is distinct evidence that a perforation had taken place. A well-marked band of cicatricial tissue is shown along the site of the perforated cornea. The cicatrix contains pigment from the iris. The iris is infiltrated with inflammatory cells (leucocytes) and its pupillary margin is adherent to the cicatrix and the cornea (synechia anterior).

The uveal pigment has been detached at various points of the iris and lies in the vitreous.

The ciliary body was detached and dragged toward the site of the corneal perforation and is infiltrated with numerous inflammatory cells (cyclitis).

There is a large amount of inflammatory material in the place of the lens and adjacent vitreous composed of fibers and leucocytes.

The retina was detached and swollen, and the choroid was infiltrated with large numbers of inflammatory cells.

The perforation through the cornea is about 4 millimeters in diameter.

I am of the opinion that the probable cause of the diseased eye was the presence of foreign bodies in it, which could easily be brought about by windstorms and the consequent blowing of sand against the cornea.

Dr. Norgaard has called my attention to the fact that there is also a widespread disease among domesticated animals, known as infectious opthalmia,[1] which presents symptoms precisely similar to those noticed among the pups, so that it is by no means improbable that a like disease may account for many of the sore eyes seen. It is of

[1] "Keratitis acuta infectiosa, Möller, Lehrbuch der Augenheilkunde für Thierärzte, p. 25; "Infectious ophthalmia," W. F. Weese, American Veterinary Review, Jan., 1897, pp. 707–711.

course understood that it does not necessarily follow that the disease among the seals is caused by the same germ which produces the trouble among domesticated animals, and even among the latter it is suspected that more than one pus-producing germ is at work.

The blindness of the bachelors has been ascribed to overdriving, although no explanation was offered as to why any amount of driving should cause loss of sight. Five pups totally blind and two blind in one eye each were noted while counting the starved pups, as well as one "wall-eyed" cow and one cow and two bulls each with one white eye.

A feature of considerable interest is the liability of the seals to attacks of what Dr. T. M. Wood considers hystero-epilepsy, the first instance of which was noticed by Colonel Murray and Mr. Macoun on East rookery, St. George. The subject was a cow recently in from the sea, and apparently dying. The eyes were rolled upward, the head was bent slightly backward, the body was rigid, and although the animal still breathed, it seemed at the last gasp. The seal was turned over and examined for wounds or other injuries, but none were found, and when, half an hour later, the spot was revisited the animal had disappeared. Several similar attacks, seen when counting dead pups, were apparently brought on by fright,[1] but in the case just noted there was no apparent cause, nor was there in the case of a young male noted by Mr. Barrett-Hamilton. This bachelor was, to all intents and purposes, dead, and was turned over and pulled about for some time, although when someone started to pull out the long bristles from the moustache the seal, to the astonishment of all, roused up and went away. The attacks noted lasted but a few minutes, although while they endured the animals were in a perfectly comatose condition.

While, like other wild animals, the fur seal is ordinarily free from blemishes, one bachelor was killed which bore a fatty tumor, 2 inches in diameter, on the side, and an adult female was obtained by Mr. Townsend in which a fibrous tumor was developing on the left ovary, the one functional for the season in which the animal was killed.

A few more or less complete albinos were seen among the pups, and two instances of malformation. One of these was a pup with the nose surrounded by a series of fleshy protuberances, suggesting that of a star-nosed mole, and the other was a pup in which eyes were totally lacking.[2]

From the above observations on the mortality and diseases of seals it is apparent that, while they are subject to a variety of complaints, there is no evidence that any great number of deaths is caused by specific disease, much less that there is, or has been, any epidemic among them aside from that caused by *Uncinaria*. Of course it is possible that such a thing might occur, as the cormorants of the Commander Islands have twice been decimated by some disease, but it would be from causes which can not be foreseen; although, as Dr. Stiles points out elsewhere, we have in the numbers and habits of the fur seal conditions favorable to an epidemic.

The following tables summarize the results of the work of 1896 and 1897, and show the number and causes of deaths so far as is known.

[1] See Vol I, Pt. II, pp. 497, 506, 581.

[2] I have no details concerning this specimen, which was procured by Mr. Barrett-Hamilton, except his statement that there were no eyes in the sockets.

MORTALITY OF ADULT FUR SEALS ON THE PRIBILOF ISLANDS IN 1896.

The following is a record of the adult seals found dead on the islands, made at the time of the count of dead pups, August 5 to 14:

Rookery.	Cows.	Bulls.	Bachelors.
St. Paul.			
Kitovi			
Lukanin	3		1
Lagoon	4	2	
Tolstoi	16	3	
Zapadni	16	6	
Little Zapadni	6		
Zapadni Reef	5	1	1
Gorbatch	5	1	
Ardiguen			
Reef	24	2	
Polovina	4	2	1
Vostochni } Morjovi }	30	11	
St. George.[1]			
North	7		
Little East	1		
East	2		
Zapadni	2		
Staraya Artel	6		
Total	131	28	3

[1] Bulls and bachelors not counted.

Dead pups counted on the Pribilof Islands between August 5 and 14, 1896, by rookeries.

St. Paul:		
Kitovi	109	
Lagoon	78	
Lukanin	205	
Tolstoi	1,895	
Zapadni	3,095	
Little Zapadni	134	
Zapadni Reef	104	
Gorbatch	712	
Ardiguen	2	
Reef	950	
Sivutch Rock	50	
Polovina	635	
Little Polovina	47	
Vostochni	1,808	
Morjovi	485	
Total		10,309
St. George:		
North	259	
Little East	31	
East	112	
Zapadni	199	
Staraya Artel	135	
Total		736
Grand total		11,045

Causes of death among nursing fur seals on St. Paul, as determined by the dissections of 1896–97.

Cause.	Up to August 15—		Total.	After August 15—		Total.
	1896.	1897.		1896.	1897.	
Uncinaria	45	71	116	1	51	52
Starvation	29	55	84	14	122	136
Uncinaria plus starvation	5	10	15	....	12	12
Trampled	7	4	11	....	....	....
Bitten or otherwise injured	....	5	5	....	....	....
Drowned	10	2	12	....	....	....
Inflammation of bowels	1	5	6	....	1	1
Falling from cliffs	3	....	3	....	....	....
Crushed under rocks	3	....	3	....	....	....
Inflammation of kidneys	1	....	1	....	....	....
Catarrhal pneumonia	1	....	1	....	....	....
Suppurating shoulders	....	....	....	....	1	1
Unknown	1	2	3	....	1	1
Total	106	154	260	15	188	203

Summary of dissections on St. Paul in 1897 divided into periods of five days.

Date.	Cause of death.						Total.
	Starvation.	Uncinaria.	Uncinaria plus starvation.	Violence.	Sundry.	Unknown.	
July 25	2	1	....	2	....	1	6
30	5	12	....	3	2	....	22
Aug. 5	15	18	4	2	1	....	40
10	24	33	4	2	1	4	68
15	9	7	2	....	....	....	18
20	6	13	1	....	....	1	21
25	25	23	3	....	1	2	54
30	5	3	1	....	....	....	9
Sept. 5	86	12	7	....	1	1	107
Total	177	122	22	9	6	9	345

Summary of dissections in 1897 by rookeries.

Rookery.	Date.	Starvation.	Uncinaria.	Starvation plus uncinaria.	Violence.	Sundry.	Unknown.	Total.
Northeast Point	August 6	3	5	2	....	....	....	10
Polovina	July 31	2	5	1	1	1	....	10
Lukanin	July 24, 25, 26; August 1, 12	3	4	3	2	....	....	12
Kitovi	July 26; August 3, 12, 14	10	6	1	....	....	....	17
Reef	July 19, 27; August 2, 5, 9, 16; September 1	42	10	2	3	....	....	53
Gorbatch	August 4, 16; September 1	16	14	1	1	....	1	33
Lagoon	August 2	4	....	....	....	....	....	4
Tolstoi	July 28, 29; August 7, 11, 14, 19, 23, 24, 27; September 1, 4.	50	44	8	....	3	4	109
Zapadni	July 30; August 7, 24; September 4	47	34	4	2	2	4	93
Total		177	122	22	9	6	9	345

Summary of dissections on Tolstoi between July 28 and September 4, 1897.

Date.	Cause of death.					Total.
	Starved.	Uncinaria.	Uncinaria plus starvation.	Sundry.	Unknown.	
July 28	1	2	....	....	....	3
29	2	6	....	1	....	9
Aug. 7	1	6	1	....	....	8
11	....	2	1	....	....	3
14	....	6	....	....	....	6
19	2	5	....	....	1	8
23	12	10	....	....	2	24
24	5	2	....	....	....	7
27	5	3	1	....	....	9
Sept. 1	16	2	3	....	....	21
4	6	....	2	2	1	11
Total	50	44	8	3	4	109

DEAD PUPS ON TOLSTOI, 1892.
From a photograph by J. M. Macoun.

DEAD PUPS ON TOLSTOI SAND FLAT, 1896.

From a photograph by J. M. Macoun.

Plate XVIII.

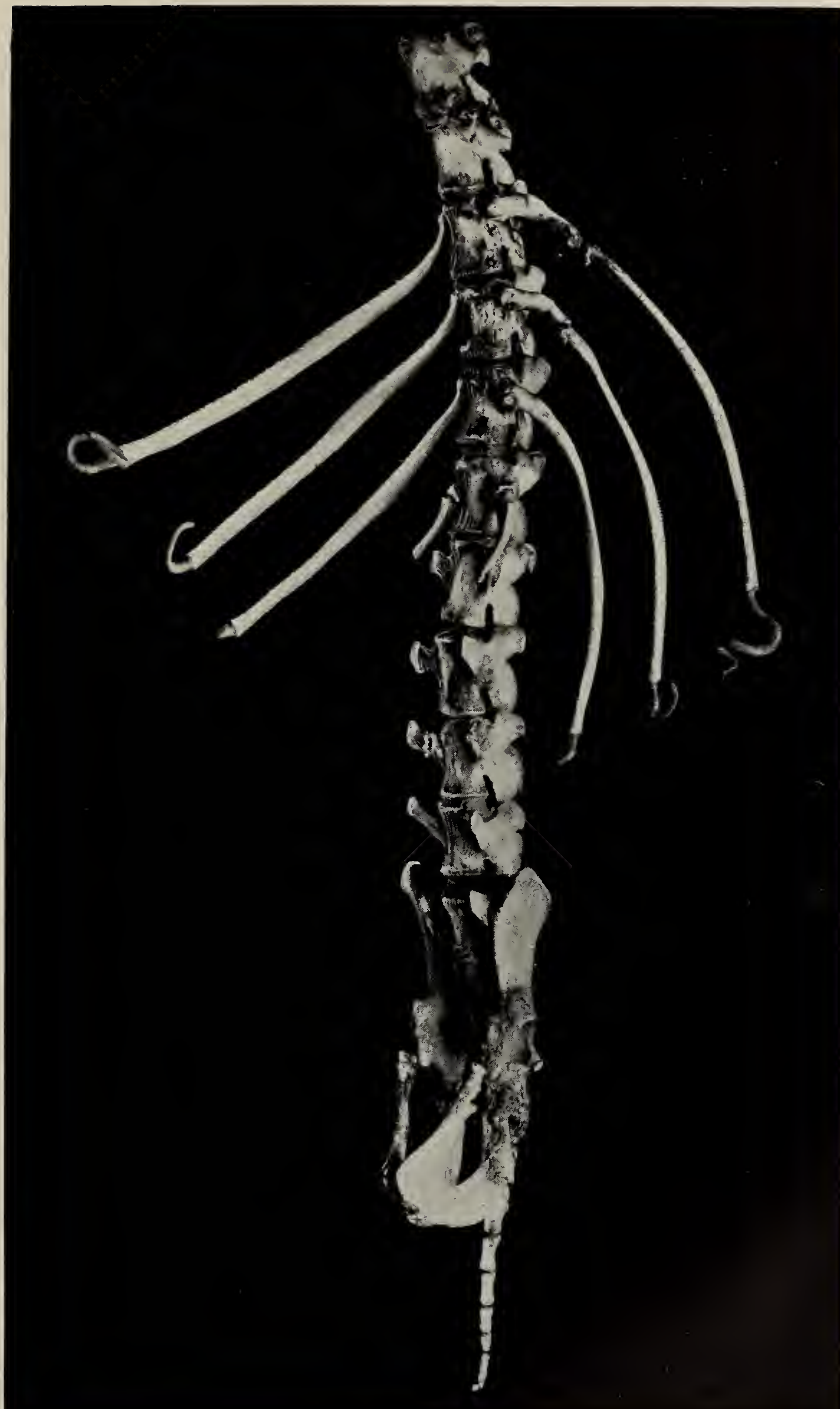
STARVED PUP, AND PUP DEAD FROM UNCINARIA.

From a photograph by C. H. Townsend, September 12, 1894.

PLATE XIX.

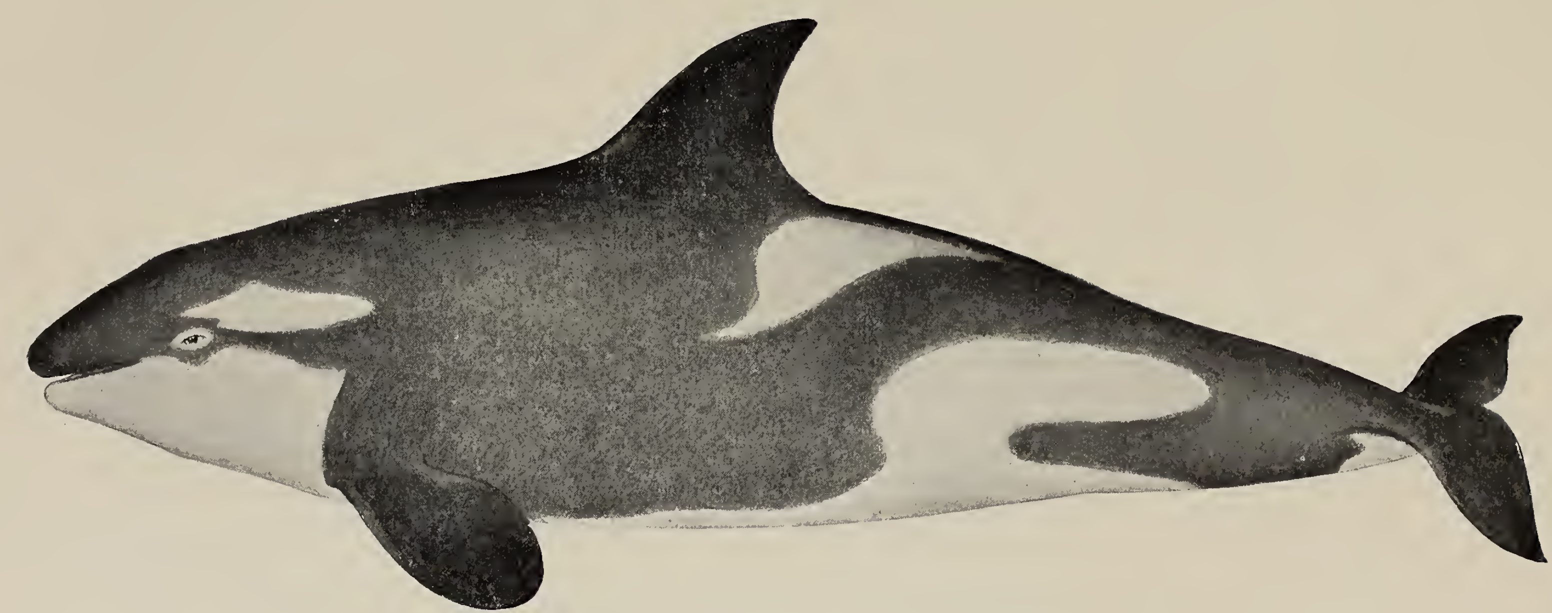
A WINDROW OF DEAD PUPS AT THE END OF TOLSTOI ROOKERY, 1896. WASHED UP BY THE GALE OF AUGUST 17.

From a photograph by J. M. Macoun.



PART OF SKELETON OF YOUNG BULL, SHOWING INJURIES PROBABLY DUE TO THE BITE OF A KILLER.

PLATE XXI.



THE KILLER, *Orca orca.*

After Lütken.

VII.—INTERNAL PARASITES OF THE FUR SEAL.[1]

By Ch. Wardell Stiles, Ph. D.,
Zoologist of the Bureau of Animal Industry,
and
Albert Hassall, M. R. C. V. S.,
Inspector in the Bureau of Animal Industry.

SUMMARY.

I.—Introduction: The first parasitic worms recorded from Bering Sea were collected by Steller in 1742 from the now extinct sea cow (p. 100). Since that time parasites (p. 100) have been mentioned from the fur seal of Bering Sea by Elliot, 1882, and by the British Commissioners in the Paris hearing, but the worms were not studied. The subject of the parasites of the fur seal bears an intimate relation to the parasites of marine mammals in general (p. 101), but references to the parasitic diseases of marine mammals are meager, and none of them treat the subject in detail (p. 101–102).

The parasitic worms collected by Lucas in Bering Sea came from the fur seal, the hair seal, and the sea lion (p. 102), and belong to three different families of worms (p. 103): mawworms of the genus *Ascaris*, strongyles of the genus *Uncinaria*, and tapeworms of the genus *Bothriocephalus*. Of these the ascarides and strongyles are the most important in connection with the subject at hand, and of mawworms alone we have sufficient material for proper study.

II.—Family Ascaridae (p. 103). Genus *Ascaris:* Synonymy (p. 103); diagnosis (p. 103). These worms occur normally in the digestive tract, but are occasionally found in other parts of the body (p. 104); a few specimens have little or no effect upon the host, but heavy infections may injure the hosts in various ways; by stoppage of the bowels, by wandering, taking food intended for host, wounding the mucosa, production of a toxic substance (p. 104). None of these effects have been observed in any degree of importance in the case of the fur seal, but there is no reason to assume that the effects of ascarides upon these animals will be different from the effects of mawworms upon other animals (p. 104). In our opinion, while the mawworms will undoubtedly be a factor in the general debility of seals in cases of excessive infections, the relation of the worms to the mortality of seals will be insignificant (p. 104). The seals become infected with their ascarides by eating fish; these worms accordingly play no rôle

[1] This report on the parasitic worms of the fur seal, collected by the United States Commission of 1896, was prepared under the direction of Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, United States Department of Agriculture, at the request of the Secretary of the Treasury.

in the death rate of pups too young to catch fish, and a crowded condition of the rookeries is of no importance in connection with the spread of infection. There is evidently no way open to prevent infection. *Ascaris decipiens* was collected by Lucas from the fur seal, the hair seal, and the sea lion; and *A. osculata* from the sea lion (p. 105). These same worms are found in other parts of the world (Greenland, etc.) in other hosts.

The Ascarides of marine mammals.—Under this head we discuss the history of the subject, the division of the genus, and the history and structure of all of the various forms described.

III.—Family Strongylidae; (p. 164), subfamily Sclerostominae; genus *Uncinaria*.

A few worms of this genus were found by Lucas in a fur-seal pup, three months old, but our material is not sufficient to permit a detailed study of the form. The worms of this genus are blood suckers of the worst type, and a heavy infection would undoubtedly have very serious effects upon the pups, as allied worms do upon man, dogs, cats, and other animals. The life history of and source of infection by the seal *Uncinaria* is not demonstrated, and can not well be demonstrated at this distance from its habitat, but analogy would point at a direct development without an intermediate host. (See also Supplementary Note, p. 165.) If this view drawn from analogy is correct, the infection would take place upon the rookeries, and a crowding of the rookeries with an open season and lack of nourishment would give the conditions necessary for an epizootic; thus this worm might under conditions play an important rôle in the mortality of the pups, more especially if the latter were deprived of nourishment from their mothers because of pelagic sealing or other causes.

IV.—Family Bothriocephalidae (p. 167;) subfamily Bothriocephalinae; genus *Bothriocephalus*. A few worms of this genus were collected from the fur seal by Lucas who states that about 40 per cent of the seals are infected with them. Lack of time prevents our making a detailed study of the form. Analogy points to fish as the intermediate host, and hence as source of infection. These worms would accordingly not be found in young pups.

V.—Compendium of parasites arranged according to their hosts.

VI.—Bibliography.

I.—INTRODUCTION.

The earliest record we have been able to find of parasites in the marine mammals of Bering Sea is a statement by Steller (1751[1]) that in July, 1742, he found some parasitic worms about half an inch long in the stomach of the now extinct sea cow, *Hydrodamalis Stelleri*. These helminthes (*Ascaris rytinae*, see p. 163,) are now unidentifiable, but have been referred to by various helminthologists.

In helminthological literature we have not succeeded in finding any further references to parasitic worms in Bering Sea, and especially of the fur seal, but Mr. Lucas has called our attention to the following passages in other works.

Elliot (1882,[1] p. 35) in his Monograph of the Sea Islands of Alaska, refers to worms in the stomach of the fur seal and the sea lion as follows:

> I have examined the stomachs of hundreds which were driven up and killed immediately after their arrival in the spring near the village; I have the word of natives here, who have seen hundreds of thousands of them opened during the slaughtering seasons past, but in no one single case has

[1] The dates enclosed in parentheses refer to the works cited in the bibliography, pp. 171-174.

anything ever been found other than the bile and ordinary secretions of healthy organs of this class, with the marked exception of finding in every one a snarl or cluster of worms (*Nematoda*) from the size of a walnut to a bunch as large as a man's fist. Fasting apparently has no effect upon the worms, for on the rare occasion, and perhaps the last one that will ever occur, of killing three or four hundred old bulls late in the fall to supply the natives with canoe skins, I was present, and again examined their paunches, finding the same *ascaridae* within. They were lively in these empty stomachs, and their presence, I think, gives some reason for the habit which the old bulls have (the others do not) of swallowing small water-worn bowlders, the stones in some of the stomachs weighing half a pound apiece; in others, much smaller. In one paunch I found over 5 pounds, in the aggregate, of large pebbles, which, in grinding against one another, I believe, must comfort the seal by aiding to destroy in a great measure those intestinal pests.

The sea lion is also troubled in the same way by a similar species of worms, and I preserved the stomach of one of these animals in which there was more than 10 pounds of stones, some of them alone very great in size. Of this latter animal, I suppose it could swallow bowlders that weigh 2 or 3 pounds each. I can ascribe no other cause for this habit among those animals than that given, as they are the highest type of the carnivora, eating fish as a regular means of subsistence, varying the monotony of this diet with occasional juicy fronds of seaweed or kelp, and perhaps a crab or such once in awhile, provided it is small and tender or soft-shelled. I know that the sailors say that the *Callorhinus* swallows stones to "ballast" himself; in other words, to enable him to dive deeply and quickly; but I noticed that the females and the "holluschickie" dive quicker and swim better than the old fellows above specified, and they do so without any ballast. They also have less muscular power, only a tithe of that which the "see-catch" possesses. No, the ballast theory is not tenable.

In the Report of the British Commissioners (p. 97, sec. 343) in the Paris Arbitration the following rather indefinite reference to the parasites of seals is found:

The fur seals upon the Pribilof Islands are, however, afflicted by at least one known trouble, that of intestinal worms, and in the stomachs of every seal killed a certain number, and often a very considerable number, of such worms are found. This can not, of course, be considered as constituting in itself a very serious affection, but if under any particular train of circumstances it should be considerably increased, it alone might become a danger to the continued well-being of the seals.

These, so far as we are aware, are the only published statements regarding the parasitic worms found in Bering Sea. The preliminary study of the parasitic diseases of the fur seal is thus reduced to indefinite and vague statements of little or no value. We may, however, expect that a review of the parasites of marine mammals will aid us in the subject at hand, as basis for comparison and inference, and it will be well, therefore, to take a glance at the literature upon this subject before passing to a determination of the worms collected by Lucas in Bering Sea.

The greater part of the literature upon the parasites of marine mammals is purely zoological, dealing with descriptions, lists, and synonymy of forms found in various parts of the world.

Both worms and arthropods have been found parasitic in or upon marine mammals. So far as the effect of animal parasites upon these hosts is concerned, the majority of helminthological articles do not refer to it. The following references to this subject have, however, been found:

Murie (1868) gives an account of a post-mortem examination upon a young male walrus which died at London. In this account, which is reprinted in full in connection with the parasite present (see p. 139), Murie found a large number of worms, *Ascaris bicolor* Baird, in the stomach, to the presence of which he attributed a congestion and ulceration of that organ. He also states that an abscess was found in the brain. In one portion of the account Murie says that "death seems to have resulted from the ulceration of the stomach," although he admits that "it is not clear why the animal should have succumbed so suddenly," and adds: "Literally speaking, these ulcerations were so extensive that it is curious the animal should have survived so long." In another portion of his report Murie, in referring to the abscess of the brain, remarks: "Whether this lesion was the more immediate cause of death, and not the ulcerated condition of the stomach, is an open question."

Admitting that the ulcerated condition of the stomach was caused by the worms, and admitting that with "only the muscular and a very thin lining of the submucous tissue" remaining perforation might have easily occurred and been followed by a fatal peritonitis, we fail to see that Murie has made a clear case in diagnosing the cause of death.

Cobbold (1879) devotes a portion of his work on "Parasites" to a discussion of the animal parasites of Pinnipedia (Part V, pp. 313–315) and Cetacea (Part XI, pp. 416–430), from which the following passages are extracted:

Cobbold, 1879, page 418: The apparently healthy cetacean [*Phocaena communis* = *Phocaena phocaena*] was shot by Mr. Jardine Murray in the Firth of Forth in April, 1855. I mention its condition because the bile ducts were found to be diseased in a way similar to that ordinarily observed in cases of fluke rot affecting sheep, cattle, and other animals. In my MS. note book I remarked: "The liver ducts were in several places thickened and knotted near the surface of the organ. On opening these they were found to be loaded with small distomata" [*Distoma Campula*—*Campula oblonga*].

Cobbold, 1879, p. 422: * * * The small intestine of this porpoise [*Delphinus phocaena* = *Phocaena phocaena*] was completely choked for the space of 8 or 9 feet by fine tapeworms so closely packed together that the gut presented the appearance of a solid cylinder.

A most remarkable infection of a *Globicephalus Svineral* (=*Globlicephala melas*) with thorn-headed worms (*Echinorhynchus capitatus*) was reported by Parona (1893), who estimated that 25,305 specimens were present in the intestine. Parona does not give a detailed account of the pathological effects of this infection, nor of any symptoms observed by the captors, but argues in favor of the view that a heavy infection like this one must have the same effect upon a wild animal as upon a domesticated animal.

These four citations are the most important references we have found dealing with the effects of parasitic worms upon marine mammals. It might, however, be added that the supposed genus *Conocephalus* (see *Ascaris typica*, p. 127) was based upon a coagulated body formed by mucus and epithelial cells from the stomach of the host; but the relation of the worms to any possible erosion of the stomach wall is not mentioned.

As it is impossible, in the time alloted to the preparation of this report, to discuss in detail all of the different parasites we find recorded for marine mammals, our discussion will be confined to forms directly bearing upon the parasites collected by Mr. Lucas.

THE PARASITIC WORMS COLLECTED BY LUCAS IN BERING SEA.

Mr. Lucas has furnished us with the following data concerning his examinations of marine mammals in Bering Sea during the summer of 1896:

Nematodes in varying numbers are always present in the stomach of the fur seal. There may be only two or three or there may be, roughly speaking, one hundred or more. Only in rare cases does their presence seem to cause any irritation, but occasionally a number may be found attached to one spot, and the stomach wall is there thick and hard.

An extreme case of this is shown in the specimen of stomach of sea lion, *Eumetopias*, but no case so bad as this was met with in any fur seal. The tapeworm is found in about two out of every five seals. Sometimes but one is present, sometimes ten or a dozen, though so many as this is rare.

The tapeworms are found in the large intestine, in the majority of cases with the head fastened in or near to the caecum, which, in the fur seal, is short.

No tapeworms were found in the two old males killed in August, which had not eaten for at least two months.

The worms collected by Lucas came from the fur seal (*Callorhinus ursinus*), the sea lion (*Eumetopias stelleri*) and the hair seal (*Phoca largha* Pallas).

A species of tapeworm (*Bothriocephalus*, see p. 168) was found in *Callorhinus;* a few strongyles (*Uncinaria*, see p. 165) were present in the intestine of a *Callorhinus* pup, and ascarides (*Ascaris*) were present in *Callorhinus*, *Eumetopias*, and *Phoca*. The ascarides alone were present in large numbers. As it is evidently these worms to which the British referred in the Paris report, and as these were the only worms present in sufficient numbers in 1896 to come into consideration from a medical point of view, furthermore as the time at our disposal for this report is exceedingly limited, almost the entire time allotted for study of the seal parasites has been given to studying the members of this genus.

II.—Family ASCARIDAE.

This family of round worms is variously diagnosed by different authors, but it must be subjected to a rigid and critical study, with modern methods, before we can tell with any degree of satisfaction which genera should be included in it and which should be eliminated from it. For generic diagnoses of the forms which come into question, Dujardin (1845), Diesing (1860), and Schneider (1866) especially should be consulted.

No attempt will be made in this report to define these various genera, as only one of them, the type of the family, comes into consideration in connection with the parasites of seals. It may, however, be remarked that the genus *Conocephalus* and probably also *Peritrachelius* fall as synonyms of *Ascaris*.

ASCARIS Linnaeus, 1758.

[1] 1758. *Ascaris* LINNAEUS, Systema naturae, 10th. ed., p. 648. Type by elimination, *A. lumbricoides* Linnaeus, 1758.

1800. *Capsularia* ZEDER, Erster Nachtrag Naturg. Eingeweidew., pp. xl, 5, 7. Encysted larvae in *Salmo* and *Clupea*.

1800. *Fusaria* ZEDER, Erster Nachtrag Naturg. Eingeweidew., pp. xl, 6, 16. *Ascaris* renamed and including *A. lumbricoides*, hence type, *A. lumbricoides*.

1845. *Ascaris* (*Ascaris*) DUJARDIN, Hist. nat. Helminthes, p. 154. Includes type of genus, hence type, *A. lumbricoides*.

1845. *Ascaris* (*Anisakis*) DUJARDIN, Hist. nat. Helminthes, p. 20. Type, "*A. simplex* Rudolphi," misdetermined = *A. Dussumierii*.

1860. *Conocephalus* DIESING, Sitzungsber. k. Akad. Wiss. Wien, XLII, no. 28, p. 669. Type, *Conocephalus typicus* Diesing, 1860.

DIAGNOSIS.—Body more or less elastic, elongate, cylindrical, more or less attenuated toward both extremities. Mouth anterior, terminal, with three terminal convergent lips, two of which are ventro-lateral, the third dorso-median; armed pharyngeal bulb absent. Anus near posterior extremity. Sexes separate.

Male: With two spicules, ventral caudal papillae present; praeanal sucker absent.

Female: Vulva in anterior two-thirds of body.

Type: *Ascaris lumbricoides* Linnaeus, 1758.

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[1] No pretensions to a complete generic synonymy are here made. Only such genera and subgenera are cited which have a direct bearing upon the type species and those species considered in this paper. A complete revision of the nematodes must be made to establish complete generic synonymy.

Worms of this genus occur in the adult stage in the stomach and intestine of various animals. They are occasionally reported in other portions of the body, as the mouth, nasal passages, bile ducts, peritoneal cavity, etc. In many instances this aberrant position of the worms is undoubtedly due to an active wandering of the parasites after the death of the host, although cases are also recorded where the nematodes have been taken from other portions of the body than the stomach and intestine immediately after death. Cases are also recorded of expulsion of ascarides through the mouth or nose during the life of the host.

A few ascarides may occur in an animal and yet not have any serious effect upon it, especially if the host is large. When present in considerable numbers, however, they are undoubtedly of importance and may bring about serious trouble. The injury to the host may be of different kinds:

(1) By the presence of a large number of ascarides the lumen of the intestine may be so filled as to cause a temporary stoppage of the bowels.

(2) A wandering of ascarides from the intestine to the liver through the bile ducts, which rarely occurs, may interfere with the flow of the bile, and may even result in more serious complications.

(3) It is claimed by some that the ascarides may perforate the intestine, especially in case of intestinal ulceration, and thus gain access to the body cavity. An ingress of faecal matter through the perforation will result in peritonitis and thus lead to death. Such active perforation of the intestinal wall is, however, certainly rare.

(4) The assimilation of food by the ascarides results of course in depriving their hosts of a certain quantity of nourishment; but this will be insignificant in cases of light infections.

(5) Some ascarides have very strong lips and become firmly attached to the walls of the intestinal tract. It is but natural that numerous wounds in the mucosa arising from the lips and teeth of the worms should produce some injury, as they would form points of attack for bacteria. If Murie's opinion (see p. 139) is correct that the ulcers in the stomach of the walrus he examined were due to the presence of the ascarides found, these ulcers probably began in this way.

(6) It has been shown that some ascarides secrete a substance which produces a swelling around the eyes, a profuse flow of tears, and intense itching. This action on the part of the ascarides of seals does not seem to have been noticed as yet.

The above-known conditions are taken from ascaride infection of land animals. We know nothing of the effects of these parasites upon the seals; but we do not hesitate to assume from analogy that they will have practically the same effect upon seals which similar parasites have upon other animals. We do not, however, believe that they will enter into serious consideration in connection with the mortality of seals, since death from ascarid infection must be exceedingly rare.

It is generally assumed that ascarides are all autoecious parasites; that is, they have a direct development with only one host. While this point has been established for *A. lumbricoides* of man, it will be shown below that seals become infested by eating fish.

This fact has an important bearing upon the relation of these worms to the diseases of the seals, for although we may find ascarides in very young dogs and cats, the pups of seals will not become infected with them until they begin to eat fish. In other words, while the crowding on the rookeries would naturally present conditions which would be most favorable to the development of parasitic diseases, such conditions in no way enter into the consideration of infection by the ascarides in question. The infection takes place in the water, not upon the land.

The maw worms collected in Bering Sea by Lucas have been referred to two species, both of which have already been recorded for other parts of the world. *Ascaris decipiens* was found in the material taken from the fur seal, the hair seal, and the sea lion, and *Ascaris osculata* in the material taken from the sea lion.

As these two species are considerably confused in helminthological works, not only with each other, but with still other forms, it has been necessary to consult the entire literature upon the ascarides of marine mammals; and as a knowledge of the characters of all these parasites is necessary in judging the forms found by Lucas, it has been decided to incorporate in this report their descriptions, hosts, and synonymy.

THE ASCARIDES OF MARINE MAMMALS.

According to Krabbe (1878), O. Fabricius (1780, p. 272—not accessible to us) mentioned three species of nematodes, namely *Ascaris phocae*, *A. bifida*, and *A. tubifera* from Greenland seals, but Krabbe states that none of these forms can be recognized. Goeze (1782, pp. 73, 74) described an *Ascaris phocarum* collected by Soemmering in 1781 from *Phoca vitulina;* the animals were 4½ inches long and not quite a line thick. Gmelin (1790, p. 3030) cites *A. phocae*, to which he refers Goeze's *A. phocarum;* he also cited *A. bifida;* short diagnoses are given. Rudolphi (1793, p. 10) also refers to *A. phocae*, but does not add anything to the description.

The later history of these worms is intimately connected with the history of the genera *Rictularia* Froelich, *Ophiostoma* Rudolphi, and *Dacnitis* Dujardin. As so much uncertainty exists concerning the forms, and as they can not be properly judged without a careful study of the history of the genera in question, they will not be considered further in connection with this report.

The history of the ascarides of marine mammals, so far as species recognized to-day are concerned, begins with Rudolphi (1802), who described an *Ascaris osculata* from *Phoca*. Between the appearance of Rudolphi's article containing a description of this worm and the appearance in 1866 of Schneider's Monographie der Nematoden, authors pretended to recognize Rudolphi's species and to distinguish from it certain other species and genera described as new.

With Schneider (1866) a new epoch in nematode literature began. This author restudied Rudolphi's material, together with other specimens preserved in the Berlin Museum, and gave good descriptions and figures. Very unfortunately he failed to state in most cases whether the description of a given form was based directly upon Rudolphi's originals or upon other material, so that in many cases we are left in uncertainty regarding the weight which should be attached to his diagnoses of Rudolphi's forms. As Schneider definitely states, however, that he examined Rudolphi's originals, and as his work in reality represents the first extensive publication upon nematodes prepared in a manner to be of much service, we consider it obligatory upon us to accept his determinations as correct until they are proved to be erroneous. We consider all literature upon the subject of the nematode parasites of marine mammals published prior to 1866, and all determinations made before this date, except in so far as the specimens have since been reexamined, as open to question.

Since Schneider's monograph appeared, various authors have studied the nematode parasites of marine mammals; some of their articles are worthless, as they show a complete ignorance of the literature of the subject as well as superficial study of the worms. The most important studies upon the subject have been made by Krabbe (1878) and Jägerskiöld (1894), whose writings will frequently be referred to in the text of this report.

Before passing to a description of the worms to be studied, it will be necessary to consider for a moment the classification of the genus *Ascaris*.

Various attempts have been made to divide this genus into subgenera and sections. The divisions made by earlier authors, Rudolphi (1809), and de Blainville (1828) need hardly be considered here.

Dujardin (1845) proposed a division based upon anatomical characters, and this classification, although not generally accepted, should be given here because of its relation to some of the forms which occur in marine mammals. The following table shows the various groups proposed by Dujardin.

I. Subgenus *Ascaris:* Uterus with two parallel branches extending caudad.
   1. Section: Oesophagus simple, with or without ventricle, but without pyloric (caecal) appendages. This section, with 54 species, included the type of the genus and *Ascaris osculata* Rudolphi (see p. 151).
   2. Section: Oesophagus followed by a more or less distinct ventricle, with oesophageal caecum, or with an intestinal pyloric appendage. Species Nos. 55 to 66, none of which are considered in the present report.
   3. Section: Oesophagus prolonged by a caecum or pyloric appendage at the side of the intestine, and accompanied also by another caecum from the intestine and directed cephalad. Species Nos. 67 to 71, none of which are considered in this report.
   4. Section: Oesophagus with a single caecum or pyloric appendage extending caudad at the side of the intestine. One species, *A. acus*.

II. Subgenus *Ascaridia:* Uterus with two branches extending in opposite directions. Species Nos. 73 to 75, not considered in this report.

III. Subgenus *Anisakis:* Male with two unequal specules. See *A. Dussumierii*, p. 161.

IV. Subgenus *Polydelphis:* Uterus divided into more than two branches. Type and only species, *A. anoura*.

Investigations since Dujardin's time seem to prove that this classification can not be accepted.

Schneider (1866) proposed to divide the genus *Ascaris* as follows:

A. Lips with dentigerous ridge, but without intermediate lips.
B. Lips with dentigerous ridge and with intermediate lips.
C. Lips without dentigerous ridge, but with auriculae and intermediate lips.
D. Lips without dentigerous ridge, with "Löffeln" and intermediate lips.

The importance of the intermediate lips as a means of classification seems to be well established, and will be adopted in this report.

As stated above, a study of the ascarides collected by Lucas necessarily led to a study of all of the ascarides found in marine mammals, since it immediately seemed probable that the parasites from Bering Sea were closely allied to the forms collected from allied hosts from Greenland and Iceland. Unfortunately we have had very little material for comparison, and have not had time to obtain for consultation any of the types contained in the European collections.[1] Our determinations are therefore based entirely upon the diagnoses of other workers.

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[1] See pp. 113, 126, 134, 142, 157.

The material we had on hand for comparison consisted of a few worms collected in Europe by Stiles and a few bottles found in the Leidy collection. Taking the characters from our own specimens and from the literature upon the subject, the following key has been prepared and will be of service in determining the known[1] ascarides of marine mammals.

KEY TO THE ASCARIDES OF MARINE MAMMALS.

1. Adult forms 2
   Larval forms which are not developed to a degree permitting the determination of the species; generally with prominent tooth ventral of mouth and with conical spine on the tail. *A. capsularia* (p. 164).
2. Intermediate lips absent 3
   Intermediate lips present 9
   No data at hand concerning intermediate lips 10
3. Dentigerous ridge present on lips 4
   One papilla on each ventro-lateral lip, said to bear 6 to 7 teeth; oesophageal and intestinal caeca apparently absent; second portion of oesophagus usually sigmoid.
   Male: 70 to 90^{mm} long; tail with 7 to 8 pairs of postanal papillae, of which 1 to 4 are near the tip, 5, 6 + 7, and 8 near the cloaca; left (2.3^{mm}) spicule longer than right (1.7^{mm}) spicule.
   Female: 80 to 100^{mm} long; vulva near the middle of the body.
   Host: *Delphinapterus leucas*. See also *A. simplex* (p. 121) .... *A. Kükenthalii* (p. 144).
   Data concerning dentigerous ridge are wanting 8
4. Dentigerous ridge, single 5
   Dentigerous ridge, double; cuticular bands provided with fine transverse striae.
   Male: 28^{mm} long; caudal papillae numerous.
   Female: 57^{mm} long; vulva?
   Host: *Otaria jubata;* Patagonia .... *A. patagonica* (p. 143).
5. Cuticular bands with finer transverse striae; spicules nearly equal 6
   Cuticular bands without finer transverse striae, but arranged so as to give a serrate appearance to the margin of the worm when seen under the microscope; oesophageal and intestinal caeca absent 7
6. Lips of nearly equal diameter, but of very different outline; oesophageal caecum may be present or absent; intestinal caecum present, long or short.
   Male: 33 to 70^{mm} long; 5 to 6 pairs of praeanal papillae, of which 1, 2, 3 are conical and nearer the tip, 3 larger than 2, 2 larger than 1; 4, 5, 6 shorter and nearer the cloaca, 5 larger than 4 or 6. About 60 pairs of praeanal papillae, increasing in size from first to eighth; spicules nearly equal, 1.5 to 2.5^{mm} long.
   Female: 25 to 80^{mm} long; vulva near middle of the body.
   Hosts: *Phoca, Cystophora, Odobenus, Halichoerus, Callorhinus, Eumetopias;* Arctic Ocean and Bering Sea .... *A. decipiens* (p. 109).
   Lips of nearly equal size (Krabbe), or dorsal lip (0.12^{mm}) much smaller than ventral (0.30^{mm}) lip; oesophageal and intestinal caeca absent.
   Male: 37 to 130^{mm} long; 6 to 8 pairs of postanal papillæ, of which 1 to 4 nearer the tip, the outer pair being longest; 5 to 8 are shorter and nearer the anus; praeanal papillae arranged each side in one or two rows, the first six pairs nearest the cloaca are shortly pedunculate; the others are longer; spicules 1.68^{mm} long.
   Female: 97 to 200^{mm} long; vulva a little in front of the middle of the body.
   Hosts: *Balaenoptera, Delphinapterus, Monodon, Hyperoodon, Lagenorhynchus, Otaria, ? Phocaena, ? Delphinus, ? Platanista;* Greenland, Iceland, Denmark, and elsewhere ..*A. simplex* (p. 120).

[1] *Heterocheilus tunicatus* found in *Manatus inunguis* and *Peritrachelius insignis* found in *Delphinus amazonicus* (= *Inia Geoffroyi*) are not considered in this key. From Drasche's studies it seems probable to us that *Peritrachelius*, type *P. insignis*, is a synonym of *Ascaris*, but we hesitate to suppress the genus at present without first examining specimens of it. *Heterocheilus* also may be an *Ascaris*, but we have no specimens for study. See footnote, p. 103.

7. Cuticular bands, 32 μ broad; dorsal lip divided into a large base, and a very small anterior bilobed projection; second portion of oesophagus generally sigmoid.
   Male: 31 to 70^{mm} long; with 9 to 10 (11) pairs of postanal papillae, of which 1, 2, 3 are conical and near the tip, 4 to 10 (11) shorter and nearer the cloaca; praeanal papillae numerous, arranged in three rows each side; left (3^{mm}) spicule about three times as long as right (0.96^{mm}) spicule.
   Female: 37 to 90^{mm} long; vulva near middle of the body.
   Hosts: *Delphinus* and *Prodelphinus;* Atlantic and Pacific oceans .... *A. typica* (p. 127).
   Cuticular bands 24 μ broad; lips not well studied, but apparently of nearly equal size.
   Male: unknown.
   Female: 62 to 75^{mm} long; of a dark brownish or white color.
   Host: *Odobenus rosmarus* .... *A. bicolor* Baird sp. inq. (p. 138).
8. Lips of nearly equal size; intestinal caecum present.
   Male: 85 to 115^{mm} long; one pair of postanal papillae, four pairs of praeanal papillae; spicules short.
   Female: 85 to 144^{mm} long; vulva one-third to two-thirds the length from anterior extremity.
   Host: *Dugong dugon* .... *A. halicoris* (p. 117).
   Host: Antarctic seal (genus? species?). Wings said to extend the whole length, becoming thicker at distal extremity. Worms 37 to 50^{mm}, of a dark olive color.
   A. similis, sp. inq. (p. 146).
9. Cuticle immediately back of lips, in deep folds; posterior portion of oesophagus, including oesophageal caecum, between one-third and one-half as long as anterior portion; cuticular bands 8 μ broad, without finer striation.
   Male: 31 to 70^{mm} long; 8 to 10 pairs of postanal papillae, of which 1 to 4 are near the tip, and one pair of double papillae between these and cloaca; 30 or more pairs of praeanal papillae, arranged on each side irregularly or in a double row; spicules equal, 3 to 8^{mm} long.
   Female: 40 to 80^{mm} long; vulva on a prominent tranverse ridge about one-third the length of the body from the head.
   Host: *Phoca, Halichoerus, Stenorhynchus, Eumetopias;* cosmopolitan .... *A. osculata* (p. 151).
   Posterior portion of oesophagus, with oesophageal caecum, scarcely one-sixth as long as anterior portion.
   Male: 40^{mm} long; 12 pairs of postanal papillae, of which 1 to 3 are near the tip, 1 to 12 irregularly arranged; praeanal papillae in a single row.
   Female: 50^{mm} long; vulva about one-fourth the length of the body from the head.
   Host: *Platanista gangetica;* Ganges.. *A. lobulata* (p. 159),
10. No details of structure known.
   Hosts: *Platanista* and the extinct *Hydrodamalis*.. 11
   First portion of oesophagus 5^{mm} long; second portion 1.5^{mm} long, sigmoid; cuticular bands 29 to 30 μ broad; head 0.4^{mm} broad; lips small.
   Male: 79^{mm} long, tail curled, caudal alae present with 8 to 10 papillae; spicules unequal (27:15).
   Female: 70 to 100^{mm} long, vulva 25 to 40^{mm} from anterior extremity.
   Host: Dolphin (gen.? sp.?), Indian Ocean.................................. *A. Dussumierii* (p. 161).

UNIDENTIFIABLE SPECIES.

11. Host: Dolphin of the Ganges (*Platanista gangetica*) near Calcutta. Length over an inch long.. *A. delphini* (p. 162).
   Host: Steller's extinct sea cow (*Hydrodamalis gigas*) Bering Sea. Length "half a foot" .... *A. rytinae* (p. 163).

I. Intermediate lips absent.
   A. Dentigerous ridge present on lip.
      a. Dentigerous ridge simple.
         α. Cuticle with broad cuticular bands, and narrow transverse striae; spicules of nearly equal length.

1. ASCARIS DECIPIENS Krabbe, 1878.

(Figs. 1–22.)

? 1853, *Ascaris similis* Baird, see p. 146.

1878, *Ascaris decipiens* Krabbe, Oversigt K. Danske Videnskab. Selskabs Forh., pp. 45–47, fig. 1; pl. I, fig. 3; résumé pp. 10–12.—Jägerskiöld, 1894, Zool. Jahrb., VII, pp. 452, 467–474, pls. XXV, fig. 14, XXVI, 26, XXVIII, 40–41.—Stossich, 1896, Boll. Soc. adriat. Sci. nat. Trieste, XVII, p. 20.

? 1888, *Ascaris bulbosa* Cobb, Jenaische Zeitschr. Naturw., XXIII, (n. F., XVI), I, 8 Dec., 1888, pp. 59–64, pl. V, figs. 29–30.—Cobb, 1889, Arch. f. Naturg., 55 Jhg., I, p. 150, pl. VII, figs. 7–8.

1894, "*Ascaris osculata* Rudolphi," misdet. in Coll. Leidy, see Stiles & Hassall, Veterinary Mag., I, 5, p. 340.

Diagnosis.—Intermediate lips absent; lateral cervical alae absent; lips of nearly equal diameter, but with different outlines, with bilobed anterior projection, which is much more prominent on the dorsal than on the ventral lips, and armed in both on its inner surface with a dentigerous ridge. Cervical papillae about 0.5 to 1^{mm} from the anterior extremity. Body attenuated more toward the anterior than toward the posterior extremity. Cuticle with 40 to 48 μ transverse cuticular bands, which are provided with much smaller (4 μ) striae. Oesophagus divided into two portions: oesophageal caecum may be distinct or incorporated in the second portion of the oesophagus; intestinal caecum present, may be short or long. Excretory pore median, anterior, between the ventral lips.

Male: 33 to 70^{mm} long, by 1 to 1.5^{mm} thick; tail with lateral alae, about 3^{mm} long; 5 to 6 pairs of postanal papillae divided into two groups; 1, 2, 3 near the tip of the conical tail, 3 larger than 2, 2 larger than 1; 4, 5, 6 nearer the cloaca, 5 larger than 4 or 6; about 60 pairs of praeanal papillae, arranged on each side in single or double row, increasing in size from first to eighth; spicules of nearly equal length, varying from 1.5 to 2.5^{mm} long.

Female: 25 to 80^{mm} long by 1 to 2^{mm} thick; vulva marked by a transverse ridge in the middle third of the body. Eggs spherical, 48 to 56 μ, segment to morula stage in the uterus.

Habitat: Stomach and intestine of marine mammals, larvae encysted in marine fish.

Hosts.	Locality.	Collector.	Authority.
A. *For adult.*			
Callorhinus ursinus	Bering Sea	Lucas, 1896	Stiles & Hassall, 1899, p. 113.
Cystophora cristata	Greenland	Olrik	Krabbe, 1878, p. 45.
Erignathus barbatus	Greenland	Vahl, Olrik, Pfaff	Krabbe, 1878, p. 45.
Erignathus barbatus	Spitzbergen	Kükenthal	Cobb, 1888, p. 64; 1889, p. 150.[1]
Erignathus barbatus	Specimens from Vienna Museum.		Stiles & Hassall, 1899, p. 113.
Eumetopias stelleri	Bering Sea	Lucas, 1896	Stiles & Hassall, 1899, p. 113.
Halichoerus grypus	Bohuslän		Jägerskiöld, 1896, p. 467.
Macrorhinus angustirostris	(?)	Chapman	Stiles & Hassall, 1899, p. 112.
Odobenus rosmarus	Greenland	Zimmer	Krabbe, 1878, p. 45.
Phoca foetida	Greenland	Pfaff	Krabbe, 1878, p. 45.
Phoca groenlandica	Greenland	Mørch, Møller, Andersen, Pfaff.	Krabbe, 1878, p. 45.
Phoca groenlandica	Specimens from Vienna Museum.		Stiles & Hassall, 1899, p. 113.
Phoca largha	Bering Sea	Lucas, 1896	Stiles & Hassall, 1899, p. 113.
Phoca vitulina	Greenland	Mørch, Olrik, Pfaff	Krabbe, 1878, p. 45.
Phoca vitulina	Schleswig		Krabbe, 1878, p. 45.
Phoca vitulina	Leipzig	Stiles	Stiles & Hassall, 1899, p. 113.
Phoca vitulina	Specimens from Vienna Museum.		Stiles & Hassall, 1899, p. 157.
Seal, gen.? sp.?	Faroe	Müller	Krabbe, 1878, p. 46.
Seal, gen.? sp.?	Iceland	Steincke	Krabbe, 1878, p. 46.
Seal, gen.? sp.?	Greenland	Andersen	Krabbe, 1878, p. 46.
B. *For larva.*			
Gadus macrocephalus	Bering Sea	Lucas, 1896	Stiles & Hassall, 1899, p. 119.
Theragra chalcogramma	Popoff Island		Stiles & Hassall, 1899, p. 120.

[1] Recorded as *Ascaris bulbosa*. See p. 111.

SUMMARY.—The ascaride of the Alaskan fur seal is specifically indentical with an ascaride found in *Phoca largha* and *Eumetopias stelleri* in the same locality, and with the form described by Krabbe in 1878 as *Ascaris decipiens* from the stomach of *Phoca vitulina, P. groenlandica, P. hispida* (=*P. foetida*), *P. barbata* (=*Erignathus barbatus*), *Trichechus rosmarus* (=*Odobenus rosmarus*), *Cystophora cristata* and several undetermined marine mammals. The species from *Phoca barbata*, described by Cobb in 1888 as *Ascaris bulbosa*, does not appear to differ essentially from this form. Baird's (1853) *Ascaris similis*, from the stomach of an Antarctic seal (see p. 147), and his *Ascaris bicolor*, described in 1868 as parasitic in the stomach of *Trichechus rosmarus* (see p. 142), are possibly also identical with Krabbe's species. The parasite has a wide geographical distribution, and is acquired by seals through eating fish. In detail the history of the worm is as follows:

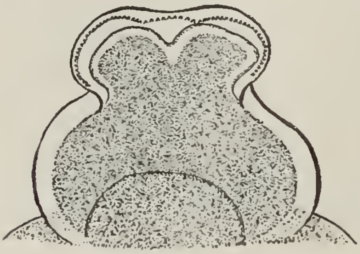

Fig. 1.

HISTORICAL REVIEW.—Regarding *A. similis*, see page 147; for *A. bicolor*, see page 139.

Krabbe (1878, pp. 45-47, résumé, pp. 11, 12) described this species from material collected in Greenland by various persons (see p. 109) from *Phoca groenlandica*, *P. barbata* (=*Erignathus barbatus*), *P. hispida* (=*P. foetida*), *P. vitulina*, *Cystophora cristata*, and *Trichechus rosmarus* (=*Odobenus rosmarus*). Besides these hosts, from which the worms were collected, in all in seventeen cases, specimens were found three times in unnamed seals from Faroe (by Müller), Iceland (by Steincke), and Greenland (by Andersen). It was also found once in *Phoca vitulina* off the west coast of Schleswig. The parasite often occurs with *A. osculata* in the same host, and for both of these species the stomach is a more common habitat than the intestine. In one case a "couple of hundred" worms were present, of which one-third were males. The males attained 45^{mm} in length, the females 60^{mm}.

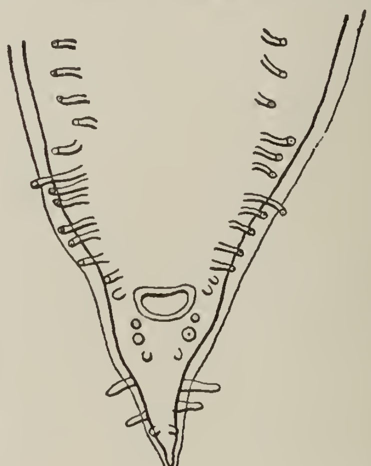

Fig. 2.

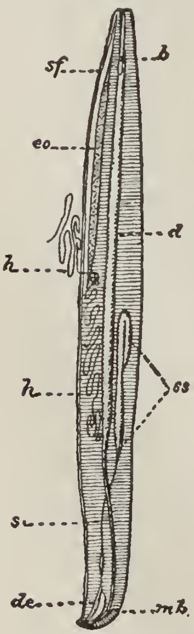

Fig. 3.

The lips are nearly alike, without intermediate lips; each lip bears (fig. 1) a broad, rounded anterior double lobe, separated from the basal portion of the lip by a lateral concave border. The inner surface of the margin of the anterior lobe is provided with a dentigerous ridge, arranged in a tripply curved line. Of the six pairs of postanal papillae in the male (fig. 2) three pairs of conical papillae are near the tip, and increase in size from the tip forward, so that the third pair is the largest; nearer the anus are three pairs of smaller papillae; antero-lateral of the anus is situated on each side a row of conical papillae, which increase in size from the first to the seventh or eighth.

Krabbe was not able to definitely determine whether or not this form was identical with *A. maritima*, but Leuckart, who examined *A. decipiens* at Krabbe's request, stated that it was specifically distinct from *A. maritima*. The two forms belong to the same group, but there seems to be no evidence in support of the view that *A. maritima* of man occurs in seals.

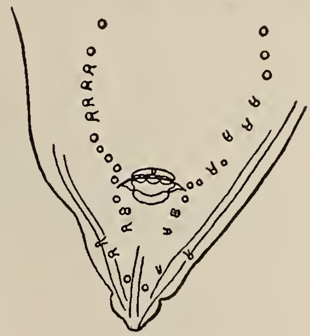
Fig. 4.

Cobb (1888, pp. 59–64) described as a new species *A. bulbosa*, some nematodes taken by Kükenthal from the stomach of *Phoca barbata* (=*Erignathus barbatus*); although certain important details of structure are omitted in Cobb's article, there can be scarcely any doubt regarding the specific identity of his form with *A. decipiens*, as is shown by the following abstract of Cobb's work:

The male (figs. 3, 4) measures 50 to 70^{mm} long, with cylindrical body attenuated anteriorly; the head is about 0.33^{mm} broad, while the breadth of the body is one-twenty-fifth to one-twenty-sixth of its length. The transverse striae can be seen only with the aid of the microscope. The tail is curved and possesses papillae (fig. 4) which can be distinguished with the hand lens. Cobb's figure shows 7 pairs of postanal papillae; 1, 2, and 3 nearer the tip, 4, 5+6, and 7 nearer the cloaca; praeanal papillae about 60 in number on each side, extending forward in two irregular rows; in the figure the first five praeanal papillae are smaller than those which follow; the spicules measure 2 to 2.5^{mm} long, are nearly similar, but the left spicule (2.5^{mm}) is slightly longer than the right (2.3 ^{mm}). The female measures 50 to 80^{mm}, the vulva is situated somewhat more than one-third the length of the body from the anterior extremity. The 3.3^{mm} long oesophagus is composed of three portions: an anterior portion 2^{mm} long by 0.5^{mm} in diameter (broadest portion); a second bulb-like portion 0.33^{mm}, and terminal cylindrical portion 1^{mm} long by 0.33^{mm} broad. The intestine possesses a proximal caecum. The excretory organ opens between the ventro-lateral lips. The vagina measures 2 to 3^{mm} long; the uterus, including the horns, 15 to 16^{mm}; eggs develop to the morula stage in the uterus. The cervical papillae are situated 0.5^{mm} back of the mouth. From the fact that the excretory organ opens between the ventral lips, intermediate lips must be absent.


Fig. 5.

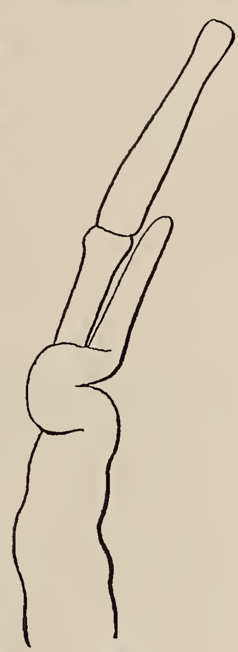
Fig. 6.

In his second paper Cobb (1889, p. 150) gives a short abstract of his first article.

Jägerskiöld (1894, pp. 452, 467–474) determined as identical with *A. decipiens* parasites preserved in the Zoological Institute of the Upsala University and taken from the mouth and pharynx of *Halichoerus grypus* Nilsson. From his anatomical discussion the following data are abstracted.

The oesophagus is divided into two portions: The anterior portion agrees essentially with the corresponding portion of the oesophagus in "*A. simplex*" as defined by Krabbe; the second portion is shorter than the first, and may be united with the intestine in two different manners; either the dorsal surface of the oesophagus may be united with the ventral surface of the intestine, thus leaving the distal portion of the second part of the oesophagus and the proximal portion of the intestine as two caeca (fig. 5), or the distal end of the oesophagus may be united with the intestine in such a way that the intestinal caecum is present, the oesophageal caecum on the other hand, absent (fig. 6). The excretory organ is developed in the same peculiar manner as in *A. osculata* and *A. spiculigera*, but discharges between ventral lips, while in *A. osculata* and *A. spiculigera* it discharges distally of the intermediate lip; the gland extends beyond the middle of the body. The vulva is situated about in the middle of the body, or somewhat distal to the middle. "The vagina, which first runs cephalad for about 5^{mm} and then turns, becomes widened into the uterus a few millimeters back

Fig. 7.

Fig. 8.

Fig. 9.

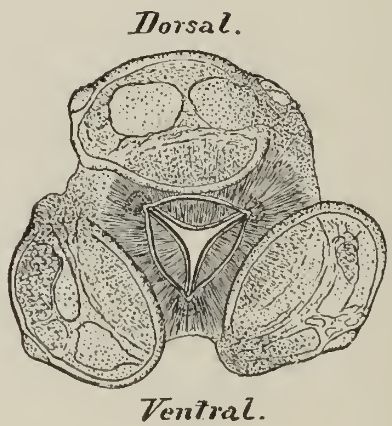

Fig. 10.

of the turning point; about 6^{mm} back of the foremost point of the vagina, that is, immediately distal of the vulva, the uterus branches into two horns 8^{mm} long."

Jägerskiöld calls attention to the resemblance which *A. bulbosa* Cobb bears to this form; he believes they are identical, but owing to the lack of certain details regarding the lips of Cobb's form, he reserves definite judgment upon the case.

The observations by Krabbe, Cobb, and Jägerskiöld seem to be the only original work upon *A. decipiens* which has been published, and in this connection it must be recalled that the specific identity of the worms described by Baird and Cobb, with the parasites discussed by Krabbe and Jägerskiöld is probable, but not absolutely established; furthermore, that Rudolphi's (1809) original *A. simplex* may possibly belong to this species rather than to *A. angulivalvis* (see p. 124).

Stiles and Hassall (1894, p. 340) catalogued specimens found in the Leidy collection (No. 259=U.S.N.M., No. 5051), collected by Dr. Chapman from *Macrorhinus angustirostris*, and determined as *Ascaris osculata*. An examination of this material shows that the worms agree in essential characters with *A. decipiens.* There are also a few unrecorded female specimens of the same species in the Stiles collection (U.S.N.M., No. 5341), taken from *Phoca vitulina*, at Leipzig, in July, 1890; the origin of the host is not noted on the label.

After this manuscript was ready for press we received a sending of parasites from Dr. von Marenzeller, of the Vienna Museum. The labels do not give the history of the specimens, but an examination of the material has resulted in the following determinations:

B. A. I., No. 2829, contains several young specimens, labeled *Ascaris decipiens.* No host is given. There are no males present, but we believe the determination to be correct.

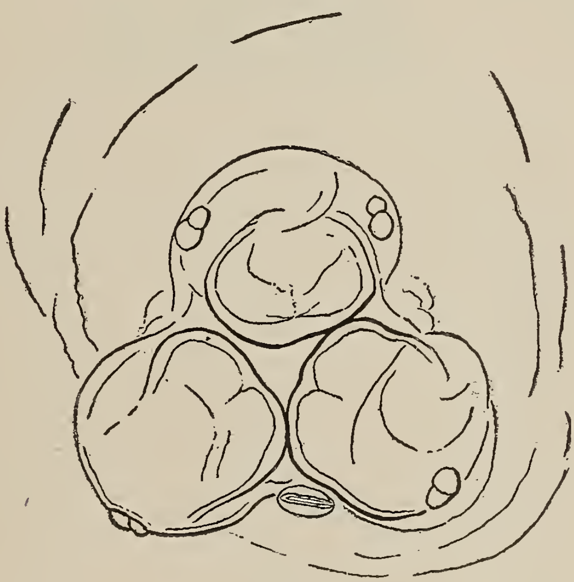

Fig. 11.

One bottle with the label "*Ascaris osculata, Phoca barbata*," contains both *Ascaris decipiens* (B. A. I., No. 2841), and *A. osculata* (B. A. I., No. 2831). One bottle, with the label "*Ascaris osculata, Phoca groenlandica*," contains both *Ascaris decipiens*, (B. A. I., No. 2843) and *A. osculata* (B. A. I., No. 2835).

Specimens from Bering Sea.—Among the parasites collected by Lucas, from the Alaskan fur seal, *Phoca largha* and *Eumetopias stelleri*, we find quite a number of ascarides (figs. 7–9) which agree in essential characters with *A. decipiens*, as diagnosed by Krabbe. The worms represent various stages of development, from larval forms 14^{mm} long by 0.5^{mm} broad, described below, to adults 80^{mm} long by 2^{mm} in diameter.

Adults.—The head of the adult is about 0.46^{mm} broad in an average specimen, but varies, of course, with the size and development of the worm. Intermediate lips are absent, as shown by transverse sections (fig. 10) and other views (figs. 11–14). Transverse sections show that the bases of the lips are of nearly equal size; dorsal and ventral views (figs. 12, 13), however, show that the outline of the dorsal lip is somewhat different from that of the ventral lips. The dorsal lip has a large base 0.27^{mm} broad by 0.128^{mm} long, which bears the usual pair of sense papillae, one on each antero-lateral margin; it bears also an anterior double-lobed projection 0.144^{mm} broad by 80 μ long, the measurements varying somewhat in different specimens; a dentigerous ridge is present on the inner surface of the anterior projection; the ventrolateral lips are essentially of the same differentiation, namely, a large base with a smaller double-lobed anterior projection, but in the ventral lips the base is longer, and the anterior projection extends more into the space between the three lips, so that

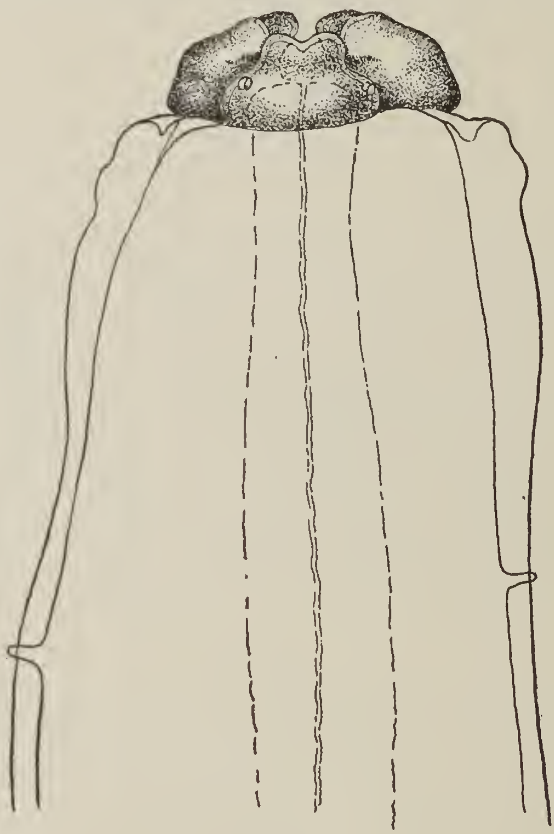

Fig. 12.

the lobes are somewhat concealed; on apex view (fig. 14) and on transverse section (fig. 15), however, these lobes are plainly visible; they are provided with an inner dentigerous ridge; the basal portion of each ventral lip is provided with the usual sense papilla. The excretory pore (figs. 11, 14) opens in the median line between the ventral lips, immediately ventral to the apex of the oesophageal triangle.

Cervical alae are absent; cervical papillae are plainly visible about 1^{mm} from the anterior extremity.

The cuticle of the body is provided with 40 to 48 μ transverse bands, which are provided with a much finer striation.

Our examination of the oesophagus of the Bering Sea form gives the same results which Jägerskiöld obtained in studying parasites of the same species taken from *Halichoerus grypus*. Figs. 16, 17 bring out this point very clearly, so that it is scarcely necessary to repeat the description, although it may be remarked that the intestinal caecum may be long or short, in some cases so short as to appear almost absent, while it is usually concave on the surface which rests upon the oesophagus.

The adult males (fig. 9) vary from 33 to 63^{mm} in length by 1 to 1.5^{mm} in diameter; the body is slightly more attenuated toward the anterior than toward the posterior extremity; the latter (fig. 18) is curled ventrally; it appears somewhat flattened

Fig. 14.

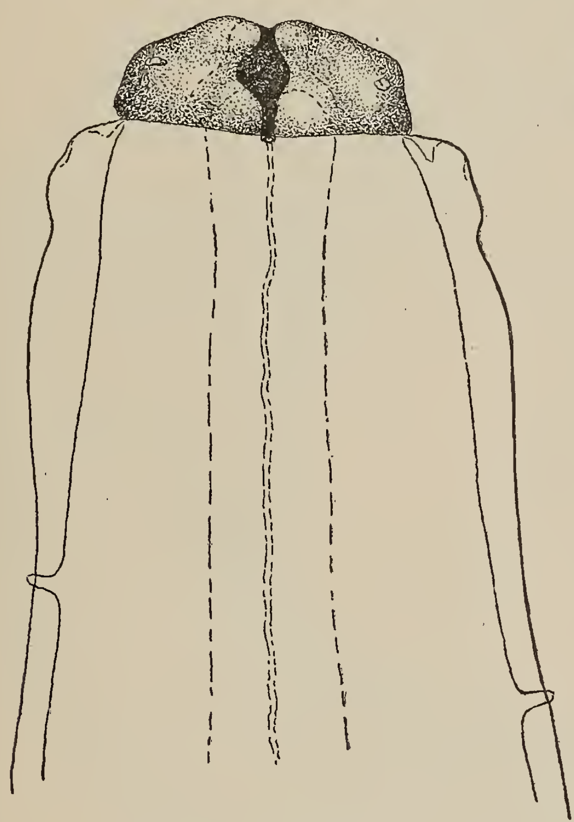

Fig. 13.

dorso-ventrally, and upon closer study is seen to possess a rounded keel-like dorsal ridge, with lateral alae which are curled ventrally, giving the ventral surface a concave spoon-like appearance. Numerous caudal papillae (figs. 18, 19) are present. The six pairs of postanal papillae (fig. 19) are divided into two groups; 1, 2, and 3 are nearer the tip of the conical tail and increase in size so that 2 is larger than 1, and 3 larger than 2; occasionally one or another of these papillae are absent; 4, 5, and 6 are nearer the cloaca, and of these 5 is larger than 4 or 6. The praeanal papillae are arranged in a single or double row each side, and increase in size from the cloaca to a short distance in front (about praeanal No. 7 or 8), the papillae farther forward being slightly smaller. The spicules are nearly equal in size, 1.5^{mm} long.

The adult females vary in length from 25 to 75^{mm}, with a diameter of 1 to 2^{mm}. The body is attenuated more toward the head than toward the tail. The vulva is found in the middle third of the body, generally near the middle; in a specimen 65^{mm} long it was 27^{mm} from the anterior extremity. In the same specimen the vagina

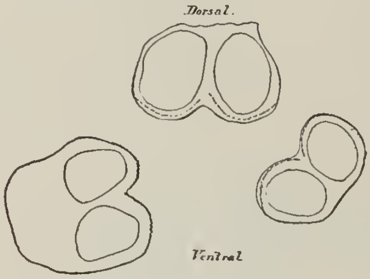

Fig. 15.

measures 5^{mm} long, the body of the uterus 12^{mm}, the horns of the uterus 18^{mm}. The eggs are spherical, 48 to 56 μ in diameter, and reach the morula stage in the uterus.

Immature stage.—Among the nematodes taken from the stomach of seals are to be found a number of smaller worms, which upon closer examination proved to be young specimens of *Ascaris*. Similar worms were found also in Leidy's collection

Fig. 16.

Fig. 17.

in association with *A. typica.* These parasites agree in a general way with the descriptions given of *A. capsularia*, and we have no hesitation in considering them the immature stage of the adult worms with which they are associated. This is by no means intended to imply that all specimens recorded by various authors as "*A. capsularia*" are the young forms of *A. decipiens* or *A. typica.* On the contrary, *A. capsularia* is probably a collective designation, including the young stages of a number of distinct species of *Ascaris*, and would thus from a biological standpoint nearly correspond to such expressions as *Agamodistomum*, *Cysticercus*, etc.

Fig. 18.

The young stages (figs. 20–22) in the fur seal attained 14^{mm} or more in length by about 0.528^{mm} in diameter, and possessed a finely traversely striated cuticle. The head is provided with a well-developed spine, ventral of the round mouth, and four papillae; in some specimens the cuticle was being cast, and within it the three characteristic lips were then visible. A small, conical spine, about 20 μ long, is also present on the tip of the tail; this spine is finely striated tranversely and is curved ventrally or dorsally. Of internal organs, the intestinal tract is well developed; the oesophagus is divided into an anterior portion about 1.8^{mm} long and a posterior portion about 0.8^{mm} long; in younger specimens (fig. 20) in which the oral tooth was present, the oesophageal and intestinal caeca were absent, but in specimens which had shed the oral tooth the intestinal caecum was present, the intestine and rectum were distinct. From lack of time the other internal organs were not studied carefully.

Von Linstow (1878, pp. 237, 238) described a young nematode from the muscles of *Osmerus eperlanus* under the name *Ascaris eperlani.* These worms measure 23.4^{mm} long by 0.72^{mm} broad; the oral tooth is absent, but the three lips are present; the intestinal caecum is also present. "*Nematoideum salmonis eperlani* Rud." is given

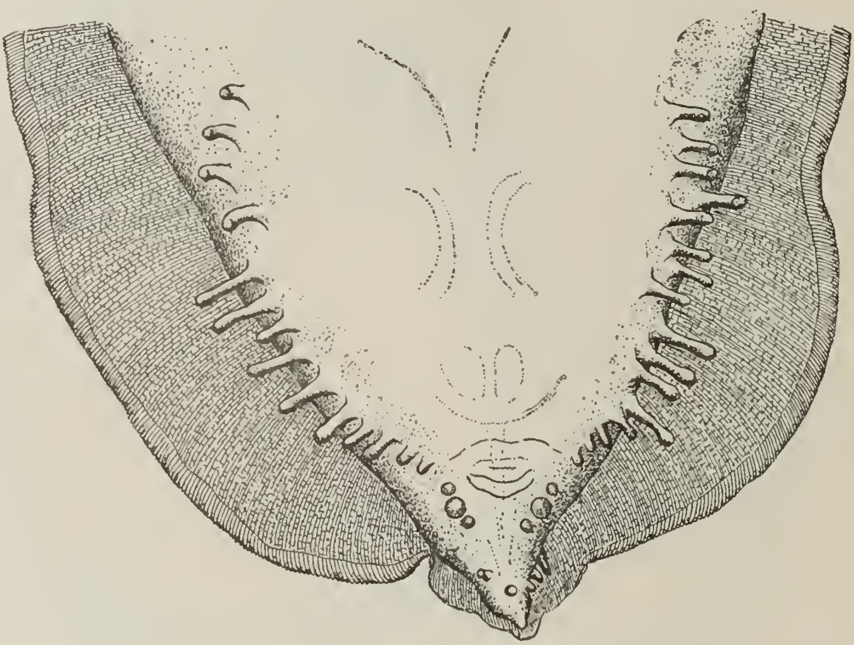

Fig. 19.

as a synonym, and *Agamonema bicolor* Diesing is mentioned as the embryonic form. This latter worm von Linstow also found in *Osmerus eperlanus;* it measured 8.8^{mm} long by 0.23^{mm} broad, the oral tooth was present, and the intestinal caecum was well developed. Later von Linstow (1895, pp. 519–524) describes *Ascaris eperlani* more in detail and suggests that it represents the larval stage of *Ascaris decipiens. Agamonema bicolor* was first described as *Filaria bicolor* Creplin, and is reported from "*Perca fluviatilis, Acerina vulgaris, Osmerus eperlanus, Lota communis,* and *Gasterosteus fluviatilis.*"

Von Linstow may be correct in his supposition that the worms known as *Agamonema bicolor* (*Filaria bicolor*), *Nematoideum salmonis eperlani* and *Ascaris eperlani* represent the younger stages of *A. decipiens*, in which case the five fish just mentioned would form intermediate hosts, but our experience with the earlier determinations of nematodes has been such that we are inclined to suspend judgment upon them all until the originals have been restudied. (See *Ascaris capsularia*, p. 164.)

Source of Infection.—From the facts that ascarides corresponding to the so-called *A. capsularia* are present in the seal's stomach, and that all intermediate stages between these young forms and the adults are found, it is clear that the seal becomes infected with *A. decipiens* by eating fish. According to the reports of those who have studied the question, the food of the fur seal consists mainly of surface swimming fishes and of squid. The Alaskan pollock (*Pollachius chalcogrammus* =

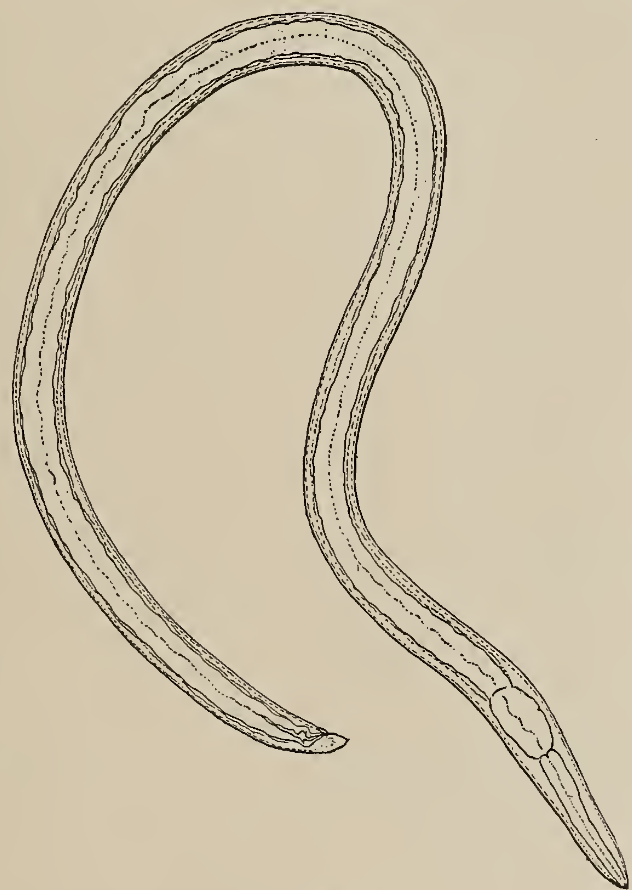

Fig. 20.

Theragra chalcogramma), a species of red rockfish (*Sebastodes*), a squid (*Gonatus amoenus*) are the forms most frequently eaten; salmon and other fishes are occasionally taken.

Numerous encysted specimens (U. S. N. M., No. 2821) of "*A. capsularia*" were found in a specimen of Pacific cod (*Gadus macrocephalus*) collected by Lucas in Bering Sea. We have been unable to recognize any differences between these larval worms and the youngest forms found in the stomach of the seal. At the same time we have not been able to distinguish the lips clearly in this form, and on that account it is impossible to state definitely whether these larvae represent the young of *A. decipiens* or *A. osculata.* Mr. Lucas informs us that the seal occasionally, though rarely, eats this species of cod, which is a deep swimmer and almost too agile for the seal, but from the general structure of the worm, and from the fact that the seal does occasionally eat this food, we are inclined to look upon it as one of the sources of infection of the seal ascarid.

The chief source of infection is probably the Alaskan pollock (*Theragra chalcogramma*). In a specimen of this species taken off Popoff Island, which we owe to the kindness of Mr. Barton Bean, of the U. S. National Museum, we have found encysted nematodes which also agree essentially with the so-called "*Ascaris capsularia*," and with the youngest forms found in the seal's stomach.

We have, of course, not been able to make any direct infections, so that this view that the Alaskan pollock and the Pacific cod form the intermediate hosts for *Ascaris decipiens* is not absolutely demonstrated, but taking into consideration the similarity of the encysted worms with the youngest worms found in the seal, and

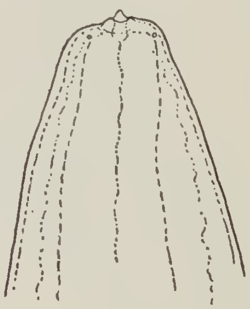
Fig. 21.

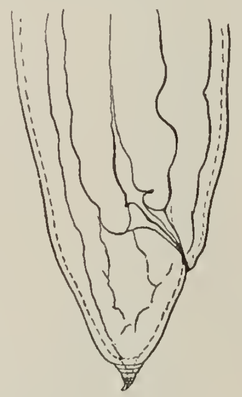
Fig. 22.

the fact that the seal feeds upon these fish, the probabilities in favor of the view border upon a certainty.

From the probable fact that the seals thus obtain their ascarid parasites from their regular food, and from the fact that we are dealing in both cases with wild and marine animals, it will be seen that nothing can be done to prevent infection.

2. ASCARIS SIMPLEX Rudolphi, 1809, det. Krabbe, 1878.

Figures 23–29.

? 1804, *Ascaris simplex* RUDOLPHI, Bemerkungen, etc., p. 94. Nomen nudum.

? 1809, *Ascaris simplex* RUDOLPHI, Entozoorum hist. nat., II, II, p. 170.—RUDOLPHI, 1819, Entozoorum synopsis, p. 49.—DIESING, 1851, Systema helminthum, II, p. 155.—VAN BENEDEN, 1870, Bull. Acad. roy. Belgique, 2 ser., XXIX, 363.—COBBOLD, 1876, Proc. Zool. Soc. London, p. 297.—COBBOLD, 1876, Journ. Linn. Soc. London, Zool., XIII, No. 65, Sept. 19, 1876, pp. 42–43.—COBBOLD, 1879, Parasites, p. 426.—COBBOLD, 1886, Linn. Soc. Journ., XIX, pp. 176–177.—MONTICELLI, 1889, Boll. Soc. Naturalisti Napoli, III, pp. 69–70.

? 1819, *Ascaris delphini* RUDOLPHI, see p. 162.

1851, *Ascaris angulivalvis* CREPLIN, Arch. f. Naturg., 17 Jhg., 1, pp. 158-160.—DIESING, 1860, Sitzungsber, k. Akad. Wiss. Wien, XLII, No. 28, pp. 656-657.

1878, *Ascaris simplex* RUDOLPHI, of KRABBE, Oversigt k. Danske Videnskab. Selskab Forhand., 1878, 1. pp. 47-49, fig. 2, pl. I, fig. 4, résumé, p. 12.—VON LINSTOW, 1888, Report H. M. S. *Challenger*, Zool., XXIII, part LXXI, pp. 2-3, pl. I, figs. 1-4.—BRAUN (1891), Arch. d. Fr. d. Naturg. i. M., p. 110.—JÄGERSKIÖLD (1891), Biol. Fören. Förhandl., Stockholm, III, No. 7, p. 132.—JÄGERSKIÖLD, 1894, Zool. Jahrb., VII, pp. 474-476, pl. XXVIII, fig. 42.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat., XVII, p. 17.

? 1889, *Ascaris Kükenthalii* COBB, see p. 144.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; lips of nearly equal size (Krabbe), or (von Linstow) dorsal lip (0.12^{mm}) smaller than ventro-lateral lips (0.30^{mm}); lips with two anterior lobes, constricted from the base, and armed on their inner surface with a dentigerous ridge; cervical papillae. Body attenuated more toward the anterior than toward the posterior end. Cuticular bands 23 μ broad, with finer striae about one-eighth as broad; lateral lines 0.23 μ broad, dorsal and ventral lines 35 μ. Oesophagus composed of two portions; anterior portion increases gradually in diameter; posterior portion begins with a swelling and then decreases; caeca absent.

Male: 37 to 130^{mm} long by 0.9 to 2.5^{mm} in diameter; tail with lateral alae about 2.5^{mm} long; 6 to 8 pairs of postanal papillae; of these, 4 pairs are near the tip, the outer pair being the longest; the other 2 or 3 pairs are shorter and nearer the anus; 50 or more (pairs?) praeanal papillae; of these, 6 pairs of shortly pedunculate papillae lie antero-lateral of the cloaca; then follows cephalad on each side one row of long papillae, or two rows which are closely approximate; spicules long (1.68^{mm}), with saber-like curvature (Linstow).

Female: 79 to 200^{mm} long by 2.2 to 2.75^{mm} thick; vulva three-sevenths the length from the anterior end (Linstow), about one-half (36:72 and 70:150) the length from the anterior end (Jägerskiöld). Eggs spherical, 52 μ with roundish elevations.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
Balaenoptera rostrata		Koren	Creplin, 1857, pp. 158-160.[1]
Balaenoptera rostrata		Koren	Krabbe, 1878, p. 12.
Balaenoptera rostrata			Jägerskiöld, 1894, p. 475.
Balaenoptera sibbaldii	Specimens from Sparre	Schneider of Tromso	Jägerskiöld, 1894, p. 475.
Delphinapterus leucas	Greenland	Olrik, Pfaff, Andersen	Krabbe, 1878, p. 48.
Delphinapterus leucas	Sepecimens from Levinsen of Copenhagen.		Jägerskiöld, 1894, p. 475.
Delphinus sp.	Patagonia	Chierchia	Monticelli, 1889, p. 69.
Hyperoodon rostratus	Faroe	Suenson	Krabbe, 1878, p. 48.
Lagenorhynchus albirostris	Denmark	Ibsen, Reinhart	Krabbe, 1878, p. 48.
Monodon monoceros	Greenland	Olrik, Pfaff	Krabbe, 1878, p. 48.
Monodon monoceros	Specimens from Steenstrup.		Diesing, 1860, p. 657.
Otaria jubata	Kerguelen Islands	Challenger expedition	Linstow, 1888, p. 2.
Phocæna phocæna[2]			Krabbe, 1878, p. 48.
Phocæna phocæna[2]		Albers	Rudolphi, 1809, p. 170.
Plantanista gangetica[2]		Anderson	Cobbold, 1876, p. 297.
Porpoise, gen.? sp.?[2]	Chiloe Island	Darwin, 1835	Cobbold, 1886, p. 176.

[1] Recorded as *Ascaris angulivalvis*. [2] In need of verification, see p. 124.

SUMMARY.—Our first exact statements regarding this species we owe to Krabbe (1878), who determined certain worms from toothed whales as *Ascaris simplex* Rudolphi, and upon examination of material collected by Koren, a part of which was described by Creplin (1851) as *A. angulivalvis*, determined the latter form as identical with the former. We have at present absolutely no exact knowledge of the forms determined as *A. simplex* prior to the appearance of Krabbe's work, and some of the later determinations are exceedingly doubtful. The exact status of *A. delphini*, quoted by most authors as a synonym of *A. simplex*, can not be ascertained (see p. 162), but further investigation may show that *A. Kükenthalii* Cobb (see p. 144) is synonymous with the form now under discussion. In detail the history of *A. simplex* is as follows:

HISTORICAL REVIEW.—Rudolphi's (1809, p. 170) original diagnosis reads as follows:

35. *Ascaris simplex* R.

Ascaris: *Capite tenuiore caudaque teretibus obtusis.*

Hab.: In *Delphini Phocaenae* ventriculo primo ab am. Albers magna copia reperta, et mecum communicata.

Descr.: Vermes pollicem vel sesquipollicem longi, crassiusculi, albidi, spiraliter convoluti.

Caput obtusum, trivalve, valvulis exiguis. Corpus undique teres, utrinque, antrorsum tamen magis attenuatum. Cauda obtusa. Membrana linearis nullibi conspicua.

Obs.: Inter specimina plurima vix nuum alterumve possideo, cujus cutis vel in antica vel in postica parte in processum pellucidum et vacuum protracta non sit, ut Ascaride obiter spectata mox caput mox cauda vacua appareat. Nil nisi emphysema post mortem obortum, cutem laxiorem tamen indicans, alias enim haec in crenas potius abiisset.

Later Rudolphi (1819, p. 49) adds:

Asc. capite nudo, corpore retrosum crassiore, cauda obtusa. * * * An huc n. 82?

N. 82, to which he refers, is *Ascaris delphini*, cited by Rudolphi (1819, pp. 54, 296) as having been collected by Lebeck in *Delphinus gangeticus* (= *Platanista gangetica*). There is, however, nothing in Lebeck's citation of the worm which warrants the assumption that his form was *Ascaris simplex*, and although nearly all authors consider it a synonym of that species, and on this ground give *A. simplex* as one of the parasites of *Platanista gangetica*, it seems to us much more logical to dispose of the doubtful species *A. delphini* by making it a doubtful synonym of *Ascaris lobulata*, which is described from the same host species (*P. gangetica*), or by ignoring it entirely. (See p. 162.)

Regarding the worms which Dujardin (1845, pp. 220, 221) determined as *Ascaris simplex* Rudolphi some difference of opinion exists among authors. Diesing (1851, p. 155) and Stossich (1896, p. 17) accept the determination as correct, while van Beneden (1870, p. 362) considers that these parasites represent a distinct species *A. Dussumierii;* von Linstow (1888, p. 3) even doubts whether the Dujardin's worms belong to the genus *Ascaris*. The host was a dolphin, taken near the Maldives in 1830. (See p. 161.)

Creplin (1851, pp. 158, 160) described under the name *Ascaris angulivalvis* three specimens of nematodes taken from *Balaena rostrata* (=*Balaenoptera rostrata*); the worms were given to him by Oskar Schmidt, who received them in 1850 from Mr. Koren, of Bergen. One of the specimens was deposited in the Zoological Museum in Greifswald. More exact data concerning the origin of specimens were not published. Creplin was unable to utilize Rudolphi's diagnosis of *A. simplex* in trying to determine his own specimens, since the description was so poor, but he considered his parasite closely related to, yet perfectly distinct from, the worms which Dujardin determined as *A. simplex*. Creplin's description reads as follows:

Die drei oben erwähnten Specimina bestanden in einem—dem Anschein nach—erwachsenen Paare und einem jüngeren Weibchen. Sie waren sämmtlich schmutzig grau von Farbe. Das Männchen des Paares war ungefähr $2\frac{3}{4}''$ lang und in der Mitte $1\frac{1}{4}'''$ dick, das Weibchen desselben etwa $3\frac{1}{2}''$ lang und in der Mitte $1\frac{3}{8}'''$ dick. Das jüngere Weibchen hatte eine Länge von $2''$ und eine mittlere Dicke von c. $\frac{3}{4}'''$. Beide Geschlechter waren nach vorn ein wenig mehr, als nach hinten, verschmächtigt; von Seitenmembranen fehlte hier, wie bei Rudolphi's und Dujardin's Species, jede Spur.

Die Mundklappen waren mittelmässig gross, eckig, mit einer nach aussen stark vorspringenden Ecke, und mit schief von hinten nach vorn abgestutzter Endspitze.

Des Männchens Schwanztheil war von auffallender Bildung, auf eine $1\frac{1}{4}'''$ lange Strecke, vom Ende ab gerechnet, nämlich leicht einwarts gekrümmt und von der Bauchseite daneben der Länge nach tief ausgehöhlt; die Ränder dieser Höhlung waren dick-wulstig und convergirten, so wie sich der Schwanztheil ein wenig verschmälerte, nach hinten, traten aber am letzten, sehr stumpfen Ende des Schwanztheils aus einander und liessen hier, ganz dicht vor der stumpfen Spitze zwischen sich ein ganz kurzes, borstenförmiges Penis-Spiculum heranstreten, und zwar nicht aus der Mitte ihres Zwischenraumes, sondern ein wenig nach der einen Seite hin. Wie in anderen Askariden-Männchen ist jedoch auch in diesem kein einfacher Penis zu erwarten, und das hier vermisste Spiculum lag daher ohne Zweifel nur neben dem hervorgeschobenen versteckt. Eines Afters ward ich nicht ansichtig. Auf der Rückenseite des Wurms zog sich, dem eingekrümmten Schwanztheil entlang, so weit sich unten die Aushöhlung erstreckte, zwischen den Wulsträndern eine hohe, übergerundete Carina, wie ein dritter, höherer, dicker Wulst, zum Schwanzende hinab. Die seitlichen Wülste waren stark quergerunzelt und gestreift, und dieser ganze, so eigenthümlich gebildete Schwanztheil zeigte ein äusser straffes und rigides Ansehen, (Dujardin giebt von den Männchen seiner "Ascaris simplex Rud." an, dass der eingekrümmte Hintertheil an der Bauchseite zwei membranöse, durch 8-10 Papillen gestützte Flügel besitze. Von solchen war hier keine Spur zu sehen).

Von dem Weibchen habe ich wenig zu bemerken. Der Körper ging hinten dick und abgestumpft, ohne Verschmächtigung des Endtheils, aus. Der After stand, wenn ich nicht irre, an der Unterseite der stumpfen Endspitze. Die Vulva ward mir nicht sichtbar; sie befand sich vermuthlich an einer Stelle des Körpers welche durch Druck und Quetschung gelitten hatte, dergl. sich an diesem, wie an dem jüngeren Weibchen hier und da fanden, bei welchem letztern ich denn die Vulva ebenfalls vergebens suchte.

Character specici

Ascaris angulivalvis m.

Ascaris utrinque, sed antrorsum magis, attenuata, nuda, valvulis oris mediocribus, in angulem acutum extrorsum protractis, cauda maris incurva, infra excavata, supra carinta, feminae recta, obtussissima.

Hab.: Specimina nobis adducta in Balaena rostrata a cel Koren reperta erant.

Greifswald, den 5. März 1851.

Diesing (1851, p. 155) adds no new facts to our knowledge of *A. simplex;* he accepts *A. delphini* Rudolphi and Dujardin's specimens (= *A. Dussumierii*) as identical with this species. In his publication (1860, pp. 656–657) he accepted *A. angulivalvis* as distinct from *A. simplex*. To a condensed diagnosis of the former, based upon Creplin's description, he adds:

Specimina plura feminea Musei zootomici Hafniensis e *Monodonte Monocerote* lecta, a cl. Steenstrup benevole communicata, probabiliter ab hac specie vix diversa.

Van Beneden (1870, p. 363) had evidently not seen *Ascaris simplex;* he cites it as a parasite of *Phocaena communis* (= *P. phocaena*) simply stating "Ce ver est signalé dans l'estomac du marsouin par Rudolphi, Synopsis 54 et 296." This bibliographic citation refers to "*Ascaris delphini* Rudolphi," collected by Lebeck, but as van Beneden mentions this form elsewhere (1870, p. 359) as *A. delphini*, an error must be assumed in his bibliographic references. As he does not mention *A. simplex* in any other species of *Phocaena*, nor in any species of *Delphinus*, his citation of the presence of this worm in "*Phocaena communis*" (= *P. phocaena*) must refer to Alber's original collection from *Delphinus phocaena* (= *Phocaena phocaena*), and his bibliographic reference should read Rudolphi, Synopsis, p. 48.

Cobbold (1876A, p. 297) examined four female ascarides collected by Dr. John Anderson from the intestine of the dolphin of the Ganges (*Platanista gangetica*), the largest of which measured 1⅜ inches long; "they presented the peculiarly flexed state of the chylous intestine or stomach, as described by Dujardin." Cobbold determined the worms as "characteristic specimens" of *A. simplex* Rudolphi, and states that "*A. delphini* of Rudolphi" must clearly be regarded as identical with this species.

Regarding Cobbold's statements, it may be remarked that they were made two years before Krabbe determined what a "characteristic specimen" of *A. simplex* was, and also, as his later articles show, he did not clearly understand the history of *A. delphini*. His determinations, therefore, are worthless. Cobbold (1876^B, p. 42) refers again to the specimens collected by Anderson, and states they correspond to *A. simplex* of Dujardin.

Fig. 23.

Krabbe (1878, p. 47–49, résumé, p. 12) referred to *A. simplex* all the ascarides found in the toothed whales from the coast of Denmark, Faroe, and Greenland, namely, in two specimens of *Lagenorhynchus albirostris* from Denmark, in seven specimens of *Beluga leucas* (= *Delphinapterus leucas*) from Greenland, in one specimen of *Hyperoodon rostratus* from Faroe, and in three specimens of *Monodon monoceros* from Greenland. He also had some young specimens of *Ascaris* from *Phocaena communis* (= *P. phocaena*), but he could not definitely state that they belonged to *A. simplex*. In one *Beluga leucas* 177 specimens were taken, about one-third of which were males; the males measured 130^{mm}, the females 200^{mm}. This form (*A. simplex*) belonged to Schneider's Group A (intermediate lips absent, labial dentigerous ridge present). The lips were of nearly equal size; each bore anteriorly two lobes (fig. 23), which were constricted from the base and armed on their inner surface with a row of small teeth; on the end of the tail of the male (fig. 24) there were four pairs of conical papillae, of which the outermost was longest; between these and the cloaca were found two short papillae, occasionally apparently united in a double papillae; on each side antero-lateral of the cloaca were six short papillae, then followed on each side one row of long papillae or two rows which were closely approximate. Krabbe obtained from Koren specimens of the worm which Creplin had described from *Balaenoptera rostrata* as *Ascaris angulivalvis*, but was unable to notice any specific differences between these and the form he (Krabbe) had determined as *A. simplex*.

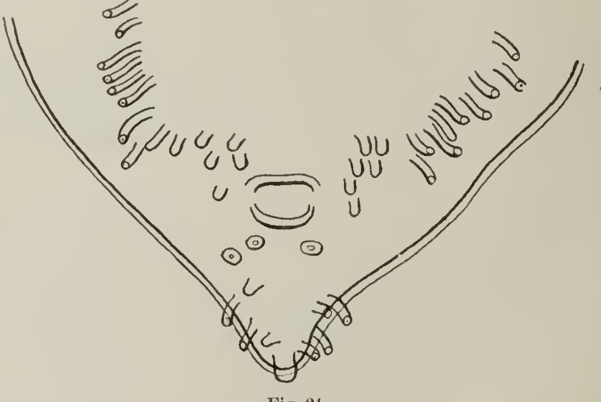

Fig. 24

The following year Cobbold (1879, p. 426) reverts to the species *A. simplex*, but has decidedly confused the history of the worms he discusses. He states that *A. simplex* was originally found in the dolphin of the Ganges, and later by Albers in the common porpoise; he admits *A. Dussumierii* as distinct from *A. simplex*, but claims that "Lebeck's *A. delphini*" is identical with the latter species; yet the worms from the dolphin of the Ganges which he (Cobbold) examined and determined according to

Dujardin's description (=*A. Dussumierii*) he still retains under the name "*A. simplex.*" In a later publication Cobbold (1886, pp. 176, 177) mentions some ascarides which Charles Darwin collected "from stomach of a porpoise off the island of Chiloe, January, 1835." There were thirteen specimens, mostly females, the longest of which did not exceed 3 inches. These Cobbold determined as "*A. simplex*," again stating that *A. delphini* found by Lebeck belonged to the same species; this view he "confirmed from an examination of nematodes procured from a *Platanista gangetica* by Dr. John Anderson," and he thinks "it probable that the *Ascaris* found by Krefft and Masters in a dolphin captured in Port Jackson is of the same species. If so, the worm occurs in *Delphinus phocaena*, in *D. Forsteri*, and in *Platanista gangetica*, and probably in the dolphins generally. * * * The ova from Mr. Darwin's specimens are nearly spherical, furnished with thin, transparent chorional envelopes. They give an average diameter of $\frac{1}{650}$ of an inch from pole to pole. M. Dujardin, whose description of the species is the best on record, found the eggs to be a trifle longer." In his bibliography of this worm Cobbold does not cite Krabbe's paper.

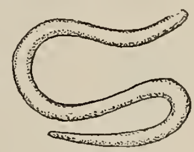

Fig. 25.

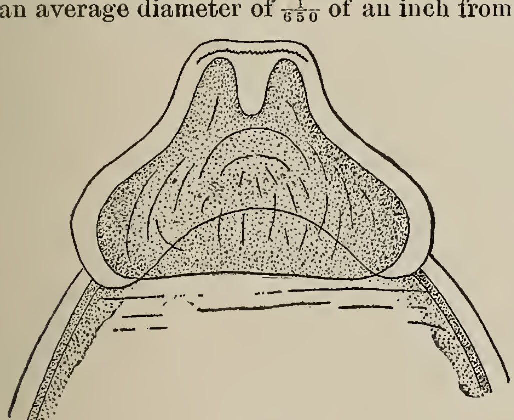

Fig. 26.

It is evident from Cobbold's discussion that at no time had he any clear idea of the worms he was attempting to describe; and all of his statements concerning them should be either preceded with a prominent mark of interrogation or rejected *in toto*.

Leidy (1886, p. 311) next recorded "*Ascaris simplex* Rudolphi from the stomach of a dolphin, *Lagenorhynchus?* Pacific ocean," but as we show on page 134 of this report, his specimens belong to *Ascaris typica*.

Von Linstow (1888, pp. 2, 3) appears to be the next zoologist to examine *A. simplex*. He records it "from the stomach of *Otaria jubata*, January 27, 1874, Kerguelen Island," collected by the *Challenger* expedition. Thirteen specimens (fig. 25) were taken, the largest measuring 79^{mm} long and 2.2^{mm} broad. The dorsal lip (fig. 26) is described as semicircular, with an anterior protrusion; the pulp sends two cylindrical protrusions into the latter, and these are rounded off anteriorly; the anterior end bears a dentigerous ridge with pointed teeth; accessory lips wanting; dorsal lip (fig. 27) (0.12^{mm} broad) smaller than ventro-lateral lips (0.30^{mm}). The cuticle exhibits cuticular bands 23 μ broad, with finer striae about eight times as narrow; lateral lines 0.23^{mm} broad, dorsal and ventral lines 35 μ. The male measures 37 by 0.9^{mm}; its tail is provided with four [pairs] of conical papillae on extremity, two or three others of round form "just in front of the cloaca," at each side of these six other shortly stalked papillae, and again in front an inconstant row of fifty or more; cirri long (1.68^{mm}) with saber-shaped curvature. The female attains 79^{mm} in length by 2.2^{mm} in breadth; anus

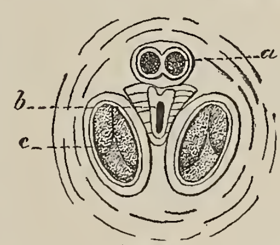

Fig. 27.

0.48^{mm} from the tip, which is rounded and bears a small styliform process embedded in the cuticle; vulva three-sevenths of the length from anterior extremity. The ova (fig. 28) are spherical, 52 μ in diameter, with roundish elevations.

Von Linstow does not believe that Dujardin's (1845) "*Ascaris simplex* Rud." (see *A. Dussumierii*) is identical with the species he studied.

Fig. 28.

Monticelli (1889, pp. 69, 70) records *A. simplex* from the stomach of "*Delphinus* sp., of Porto La gunas (*canali Patagonici*)," taken by Captain Chierchia in the voyage of the royal corvetta *Vettor Pisani*. His determination was made by comparing the specimens with the worms (N. 529, 829) at the Vienna Museum determined by Diesing. It will thus be seen that this record depends entirely upon a determination made before Krabbe definitely defined *Ascaris simplex*, and on this account calls for confirmation.

Braun (1891, p. 110) and Jägerskiöld (1891) are not accessible to us at present.

Jägerskiöld (1894, pp. 474–476) examined specimens of *A. simplex* from *Beluga leucas* (= *Delphinapterus leucas*), which he had obtained from Levinsen; he found the bursa as well developed in these as in *A. angulivalvis* Creplin from *Balaenoptera rostrata*, and no longer doubts the identity of the two forms. He describes the oesophagus (fig. 29) as composed of two portions, an anterior longer portion, which increases gradually in diameter, and a second shorter portion, which begins with a swelling and then gradually decreases in size; no caeca are present. The intestine is provided with several rows of groups of elongate cells, each group having a V shape, the apex directed caudad. The excretory organ is about one-third as long as the animal. The vulva was 36^{mm} from the anterior end in a specimen 72^{mm} long, and 70^{mm} from the anterior end in one 150^{mm} long, these measurements thus differing considerably from those given by von Linstow (1888). The vagina is long and narrow, the uterus bicorn. Jägerskiöld inclines decidedly to the opinion that *A. Kükenthalii* Cobb, from *Beluga leucas* (= *Delphinapterus leucas*) is identical with *A. simplex* as defined by Krabbe, but, being unable to examine specimens of Cobb's species, he reserves positive judgment.

Fig. 29.

Stossich (1896, p. 17) adds no new facts to our knowledge of *A. simplex*. He considers *A. delphini* and *A. Dussumierii*, as well as *A. angulivalvis*, as synonyms, but gives *A. Kükenthalii* as a distinct species.

Regarding *A. Kükenthalii* see p. 144.

Since finishing this manuscript we have received from Dr. von Marenzeller, of the Vienna Museum, a bottle of specimens with the label "*Ascaris simplex*, *Delphinus phocaena*." These worms we have redetermined as *Ascaris typica* (B. A. I., No. 2828). The label does not show whether these parasites were determined by Diesing or not.

β. Cuticular bands do not exhibit the finer transverse striae, but give a serrate appearance to the margin of the worm when viewed under a microscope; oesophageal and intestinal caeca absent.

3. ASCARIS TYPICA (Diesing, 1860) Jägerskiöld, 1894.

(Figs. 30–51.)

? 1845, "*Ascaris simplex* RUDOLPHI, 1809," of DUJARDIN, see p. 161.
1860, *Conocephalus typicus* DIESING, Sitzungsber. k. Akad. Wiss. Wien, XLII, No. 28, p. 669.—VON LINSTOW, Compendium: d. Helminthologie, p. 59.—CARUS, 1863, in Peters, Carus & Gerstaecker, Handbuch der Zoologie, II, p. 462.
? 1870, *Ascaris Dussumierii* BENEDEN, see p. 161.
1878, *Ascaris conocephalus* KRABBE, Oversigt K. Danske Videnskab. Selskabs Forhand., 1, pp. 49–51, fig. 3, pl. I, fig. 5, résumé p. 12.
1889, "*Ascaris conocephala* KRABBE," in VON LINSTOW, Compendium: Nachtrag, pp. 25, 26.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, pp. 17–18.
1883, *Peritrachelius typicus* (DIESING, 1860) VON DRASCHE, Verhandl. k. k. zool.-bot. Gesellsch. Wien, XXXIII, pp. 109–111, pl. III, figs. 1–9.
1886, "*Ascaris simplex* RUDOLPHI," misdetermined, LEIDY, Proc. Acad. Nat. Sci. Phila., p. 311.
1894, *Ascaris* (*Peritrachelius*) *typicus* (DIESING, 1860) JÄGERSKIÖLD, Zool. Jahrb., VII, p. 453.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; lips with very different outline and with dentigerous ridge; dorsal lip with basal portion 0.16 to 0.2^{mm} broad by 80 to 88 μ long, which is divided into two large lateral lobes, bearing in its median line a prominent anterior double-lobed projection 48 μ long by 48 to 64 μ broad; the latter contains on each side a lobe of parenchyma and on its inner surface a dentigerous ridge; the lateral lobes bear laterally what appears to be a very delicate dentigerous ridge, but what is evidently a striation; ventro-lateral lips with large, almost semicircular basal portion 0.16^{mm} broad, bearing on the inner surface of the anterior portion a partially concealed double-lobed projection provided with a dentigerous ridge; they bear laterally also what appears to be a very delicate dentigerous ridge, which resolves itself into a striation; cervical papillae 0.66^{mm} from anterior extremity. Body attenuate more toward anterior than toward posterior extremity, which ends conically. Cuticle with cuticular bands 32 μ broad, but apparently without finer striae. Oesophagus composed of two portions: anterior portion 4^{mm} long by about 0.3 to 0.4^{mm} in diameter at distal end; posterior portion 1.25^{mm} long by 0.25^{mm} in diameter, generally sigmoid; oesophageal and intestinal caeca absent.

Male: 31 to 70^{mm} long by 1 to 1.5^{mm} in diameter; tail compressed dorso-ventrally with dorsal median rounded keel and with lateral alae. It is curved ventrally and bears numerous papillae; 9 to 10 (occasionally 11) pairs of postanal papillae, of which 1, 2, 3 are conical and near the tip; 4 to 10 (11) shorter and nearer the cloaca; 3 and 9, 10, 11 may occasionally be wanting; more than 75 praeanal papillae each side, arranged in three rows; those nearer the cloaca smaller and more irregularly arranged; cloaca 0.27^{mm} from tip of tail; spicules unequal, left spicule (3^{mm}) about three times as long as right spicule (0.96^{mm}).

Female: 37 to 90^{mm} long by 1.5 to 2^{mm} in diameter; vulva in middle third (generally near middle) of the body. Eggs globular, 46 to 56 μ, segment to morula stage in the uterus.

Types: Diesing's types in Vienna Museum; Krabbe's types in Kopenhagen Museum. Typical specimens (Stiles & Hassall det.) in Coll. Leidy (U.S.N.M. No. 5015); from which specimens will be distributed as follows: U.S.N.M. No. 2813; Coll. B. A. I. (U.S.N.M. No. 2812); Coll. Stiles (U.S.N.M. No. 5456); South Kensington Museum, London; Berlin Museum; Coll. R. Blanchard, Paris; Copenhagen Museum; Vienna Museum.

Habitat: Stomach of marine mammals.

Hosts.	Locality.	Collection.	Authority.
Delphinus (*?delphis*)	Atlantic Ocean	Hygom	Diesing, 1860, p. 669.
Delphinus sp	Pacific Ocean	W. H. Jones	Stiles & Hassall, 1899, p. 132.
Phocœna phocœna	Specimens from Vienna Museum.		Stiles & Hassall, 1899, p. 134.
Prodelphinus	Atlantic Ocean	Andrea	Krabbe, 1878, p. 49.
Dolphins gen.? sp.?	Atlantic Ocean	Hygom, Iverson, Andrea.	Krabbe, 1878, p. 49.

SUMMARY.—*A. typica* (Diesing) belongs to Dujardin's subgenus *Anisakis* (type, *A. Dussumierii*). It was described in 1860 by Diesing as type of a supposed new genus *Conocephalus*, but Krabbe (1878) and Drasche (1883) showed that the structure upon which the genus was based was not a part of the worm. Krabbe described it as a new species, *A. conocephalus;* Drasche placed it in the genus *Peritrachelius;* Leidy misdetermined specimens from the Pacific Ocean as "*Ascaris simplex* Rudolphi," and

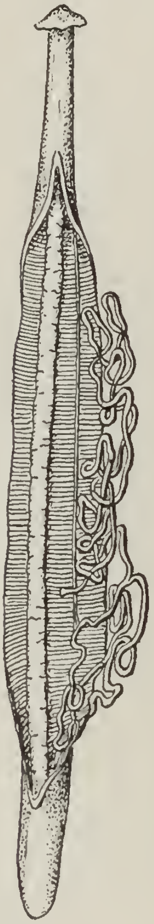

Fig. 30.

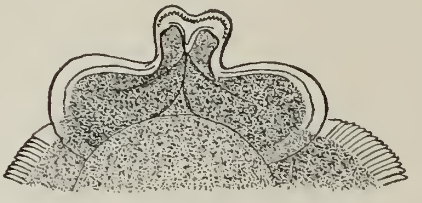

Fig. 31.

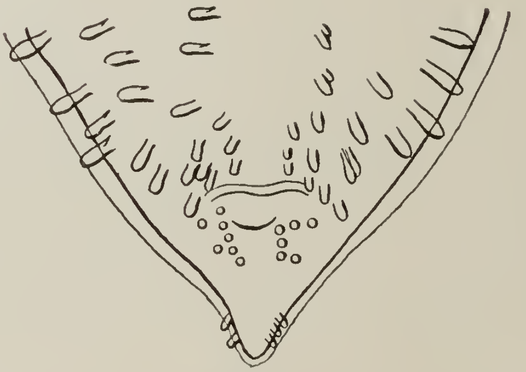

Fig. 32.

it is not at all impossible that Dujardin's "*A. simplex* Rudolphi" = *A. Dussumierii* is identical with this form (see p. 161). In detail the history of the species is as follows:

HISTORICAL REVIEW.—For a discussion of Dujardin's form see page 161. Diesing (1860, p. 669) described a parasite (fig. 30) as *Conocephalus typicus*, type and only species of a supposed new genus, as follows:

Familia XII. Conocephalidea. Character generis unici simul familiae.

XLI. CONOCEPHALUS Diesing.

Corpus elongatum teretiusculum. Caput conicum, limbo suo postico crenulato a corpore distante, retractile. Os in apice capitis. Extremitas caudalis maris semispiralis, subtus excavata, papilla duplici subterminali, feminae subrecta. Penis apertura genitalis feminea infra corporis medium sita; uterus simplex, ovariis et oviductibus duobus. Ovipara. In Cetaceorum ventriculo endoparasita.

Echinorhynchorum more caput totum in corpus retractile.

I. *Conocephalus typicus* Diesing. Tab. I, fig. 1–11.

Corpus subaequale, transverse striatum. Os minimum. Longit. mar. ad 2″, crassit. ad ¾‴, feminae ultra 2″, crassit, 1‴, longit. capitis ad ¾‴.

Habitaculum. *Delphinus* (*Delphis?*): in ventriculo, in oceano atlantico sub latit. b. 20° et longit. occ. 39° (*Mus. Hafniense*).

Cl. Steenstrup specimina nonnulla generis hujus insignis Museo Caesareo Vindobonensi dono obtulit.

Krabbe (1878, pp. 49–51, résumé 12) states that the worms Diesing obtained from Steenstrup were collected by Captain Hygom, and that several were retained in the

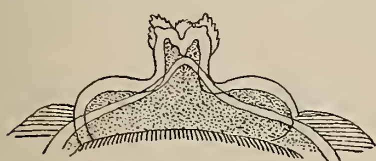

Fig. 33.

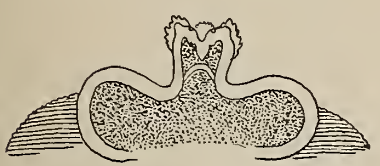

Fig. 34.

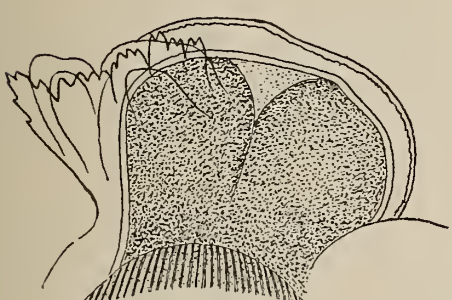

Fig. 35.

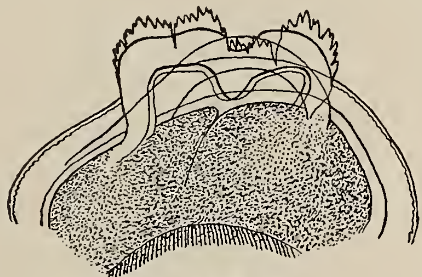

Fig. 36.

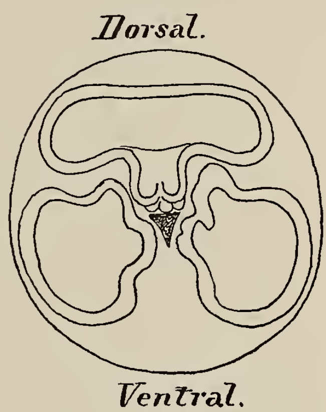

Fig. 37.

Zoological Museum of the University of Kopenhagen. Upon examination of this material Krabbe convinced himself that the supposed hood on the head was composed only of coagulated mucus and epithelial cells from the mucosa of the host. When this is separated from the head, three lips are seen and an impression of the lips is noticed on the inside of the hood. Krabbe has noticed similar structures on ascarides of seals, and he explains Diesing's error of interepretation by the fact that when this author published his Revision der Nematoden he was blind, and able to work only by the aid of others. Diesing's fig. 8, in fact, which is supposed to represent the head retracted into the body similar to the proboscis of *Echinorhynchus*, in reality exhibits the lips without foreign appendage.

Krabbe proposed the name "*Ascaris conocephalus* n. sp." for this parasite, which was collected by Hygom nine times, by Iverson once, and by Andrea twice, from the stomach of dolphins of the Atlantic between America and Africa, ranging from 4° south latitude to 20° north latitude, and from 23° to 67° west longitude. Reinhardt determined the toothed whales in which Andrea found the worm as belonging to the genus *Clymenia* (= *Prodelphinus*); but regarding the other hosts he was unable to state anything definite.

In one lot of 370 specimens the proportion of males to females was 1:1. The males attained 70mm in length, the females 90mm. The worms are somewhat similar to "*A. simplex*," but differ in essential details of the lips and caudal papillae. The lobes of the lips are provided with a dentigerous ridge, are narrower, and more distinctly separated from the rest of the lip (see fig. 31) than is the case in *A. simplex*. Nine or ten pairs of postanal papillae are found on the tail of the male (fig. 32). Of these

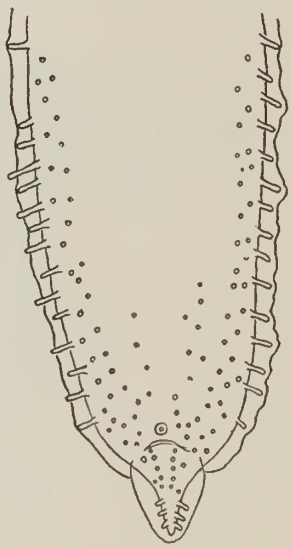

Fig. 38.

Fig. 39

Fig. 40.

generally three pairs, occasionally two pairs, are conical and near the tip. The other seven pairs are shorter and situated near the cloaca. The numerous praeanal papillae are conical and arranged on each side in three rows, well separated from one another, those situated nearer the cloaca being shorter and more irregularly arranged.

Drasche (1883, pp. 109–111), evidently overlooking Krabbe's paper, reexamined Diesing's original specimens. He found one male with the umbrella-like structure on the head, as described and figured by Diesing, one worm without the head, and two which plainly showed three lips. Upon closer examination he found that the umbrella-like structure on the head was simply a portion of the mucosa of the host. Upon the removal of this mucosa the three lips were plainly visible. These lips (figs. 33–37) Drasche (p. 110) describes as follows:

Die Lippen zerfallen in eine Rücken -und zwei Bauchlippen. Nicht allein jedoch dass die erstere von den letzteren sehr verschieden ist, ja selbst die Bauchlippen sind nicht ganz symmetrisch zu nennen. Die Dorsallippe (Taf. III, Fig. 6 und 7) besitzt eine schräg nach aussen geneigte Basis und zerfällt in zwei halbkreisförmige Seitenlappen und einen zweigetheilten Mittellappen. In letzteren gehen zwei Lobi ein; an seiner Innenseite bemerkt man eine fein zerschlitzte Zahnplatte, ebenso trägt der Vorderrand der beiden Seitenlappen eine Zahnreihe. Die beiden Bauchlippen haben einen halbkreisförmigen Vorderrand. An ihrer Innenseite sind zwei Zahnplatten zu sehen, welche eine vielfach zerschlitzte Lamelle tragen. Der bogenförmige Vorderrand der Lippe ist mit feinen Zähnen versehen. Wie die 280fache Vergrösserung (Taf. III, Fig. 1 und 2) zeigt, sind diese Bauchlippen keineswegs symmetrisch. Ich muss hier ausdrücklich bemerken, dass die Lippen, ohne durch ein Deckgläschen beschwert zu sein, mit der Camera lucida gezeichnet wurden, dass also die verschiedene Gestalt derselben nicht etwa die Folge einer ungleichen Compression sein kann; übrigens constatirte ich die Asymmetrie der Bauchlippen an zwei Exemplaren. Hinter den Lippen zeigen die Cuticularringe einen schneidenden Rand.

Drasche further mentions the presence of a "Gefässband" similar to what he found in "*Peritrachelius*," in a female 40^{mm} long, it being directly back of the lips and extending caudad for 20^{mm}; its greatest breadth was 1^{mm}, and it extended from the

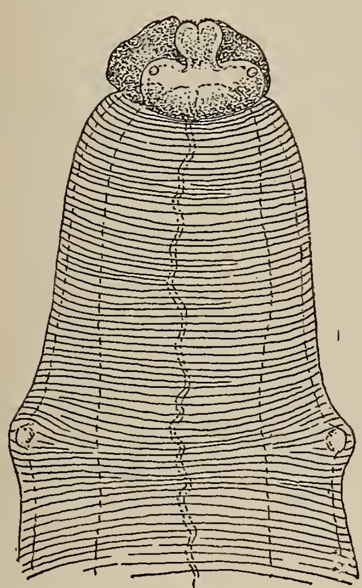

Fig. 41.

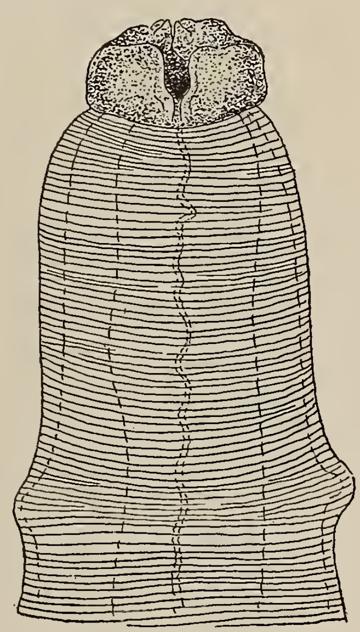

Fig. 42.

right lateral line to the ventral line, surrounding a portion of the intestine. The furrows of the intestine were particularly well developed in the middle portion. The vulva was in about the middle of the animal, 23^{mm} from the anterior extremity in a specimen 40^{mm} long; vagina short, uterus double.

The tail of the male (fig. 38) was curved and was provided with a bursa; ten postanal papillæ were observed, of which Nos. 1, 2, and 3 were conical; over seventy præanal papillæ were present, arranged in several longitudinal rows; spicula were not observed.

Drasche concluded that the mouth parts, "Gefässband," bursa, arrangement of the papillæ and presence of an evertible penis sheath undoubtedly showed that this worm belonged to Diesing's genus *Peritrachelius*, and he proposed to name it *P. typicus*.

In one of Leidy's (1886, p. 311) articles, we find "*Ascaris simplex*" cited as having occurred in large numbers in "the stomach of a dolphin, *Lagenorhynchus*? Pacific

Ocean." The collection was made by Dr. William H. Jones, U. S. N. Leidy does not describe the specimens, but in his collection we find a bottle (Coll. Leidy, No. 23= U.S.N.M., No. 5015) containing numerous specimens of *Ascaris*, with the label "*Ascaris simplex. Delphinus.* Dr. W. H. Jones." As these are the only specimens we find in Leidy's collection bearing a label which in any way corresponds to the data given in Leidy's article, they are probably the worms which Leidy had before him at the time he quoted "*Ascaris simplex*" from the Pacific Ocean. These specimens, as will be shown below, agree in essential characters with the description of Diesing's *Conocephalus typicus* as given by Krabbe and Drasche.

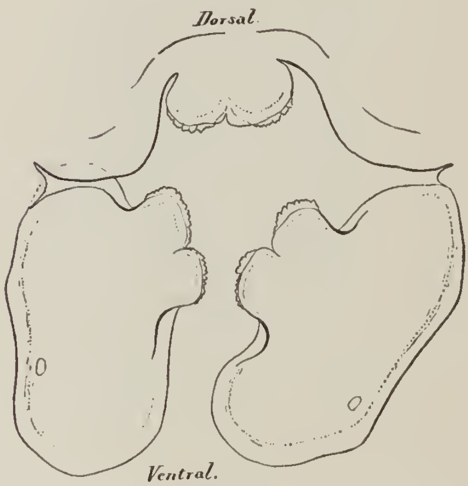

Fig. 43.

Fig. 44.

Von Linstow (1889, p. 25) cites "*Ascaris conocephala*" with "*Conocephalus typicus*" and "*Peritrachelius typicus*" as synonyms.

Jägerskiöld (1894, p. 453) does not state that he has examined this species; his remarks are of historical and nomenclatural nature, and he accepts the name "*Ascaris* (*Peritrachelius*) *typicus*."

Stossich (1896, pp. 17, 18) has evidently overlooked Drasche's article on this worm, but gives a diagnosis by which, however, it would scarcely be possible to recognize the parasite. He has evidently not examined specimens, but bases his statements upon Diesing (1860) and Krabbe (1878). He includes Leidy's specimens under *A. simplex*.

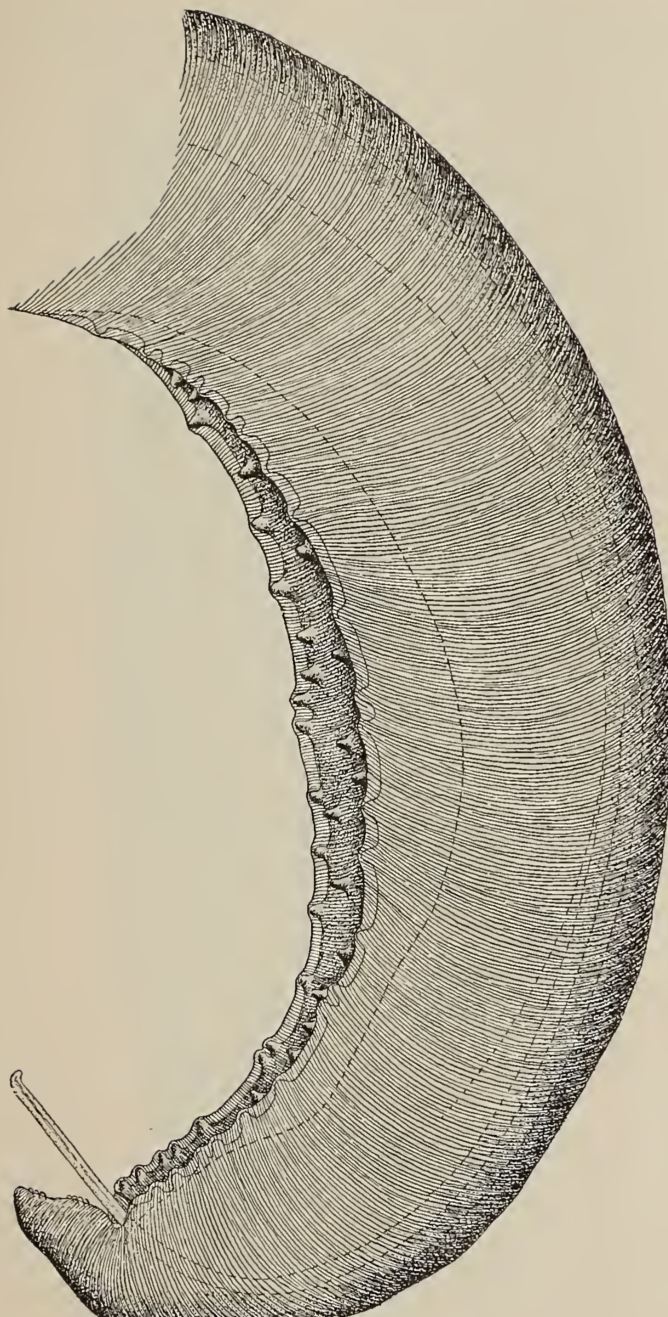

Fig. 45.

Since completing this manuscript we have received from the Vienna Museum a bottle containing nematodes labeled "*Ascaris simplex, Delphinus phocaena;*" these worms we have redetermined as *Ascaris typica.*

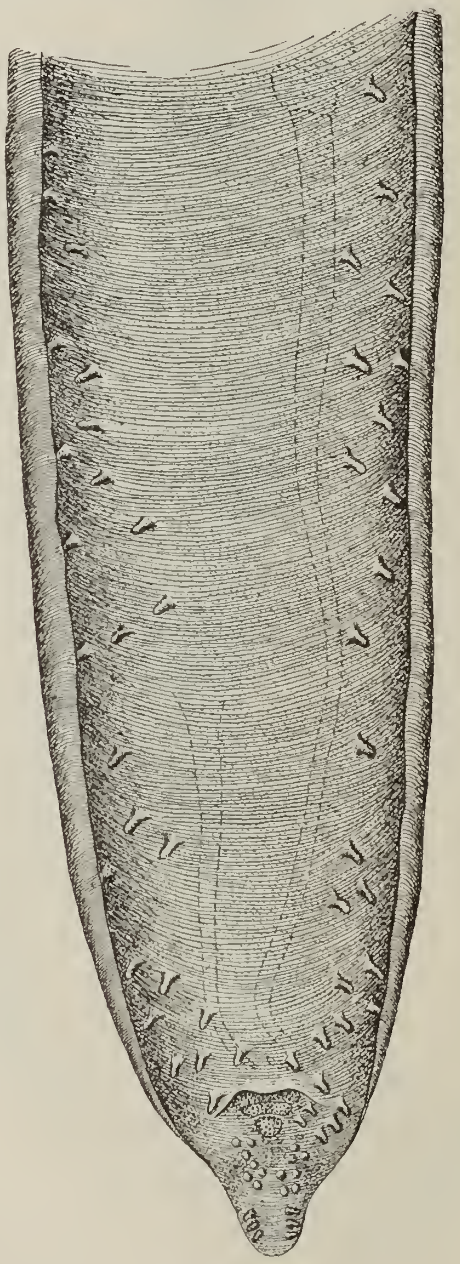

Fig. 46.

Specimens in Leidy's collection.—The bottle in Leidy's collection (No. 23= U.S.N.M., No. 5015) contains about half a pint of nematodes (figs. 39, 40, 49), rather poorly preserved.

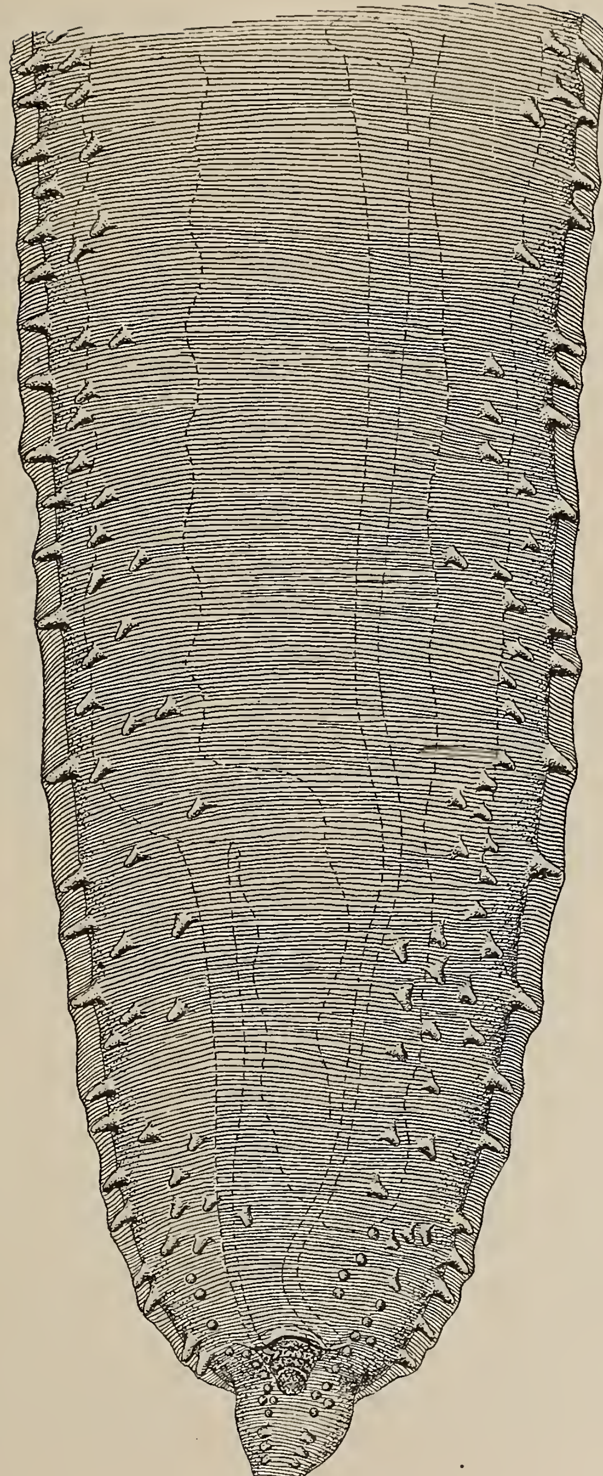

Fig. 47.

These specimens, which we have determined as *A. typica*, represent various stages of development, from young worms 10^{mm} long by 0.27^{mm} broad to fully grown worms 44^{mm} long by 2^{mm} broad.

The head of a female specimen examined measures 0.288^{mm} broad, and 0.112^{mm} long. The base of the dorsal lip measured 0.2^{mm} broad by 88 μ long, while its anterior projection measured only 64 μ broad by 48 μ long (compare figs. 41, 43); the dentigerous ridge of the dorsal lip located on the inner surface of this dorsal prolongation, as was figured by Krabbe.

Our observations also agree with those of Krabbe, in that we find the anterior margin (figs. 41, 43) of the median projection indented in the median line, thus forming two lobes, and at this point a prominent tooth is occasionally noticed. The parenchyma forms an anterior lobulate branch into each side of the projection. The basal portion is divided into two lateral rounded lobes, near the antero-lateral margin of which a round papilla is plainly visible. Drasche states that the lateral lobes also

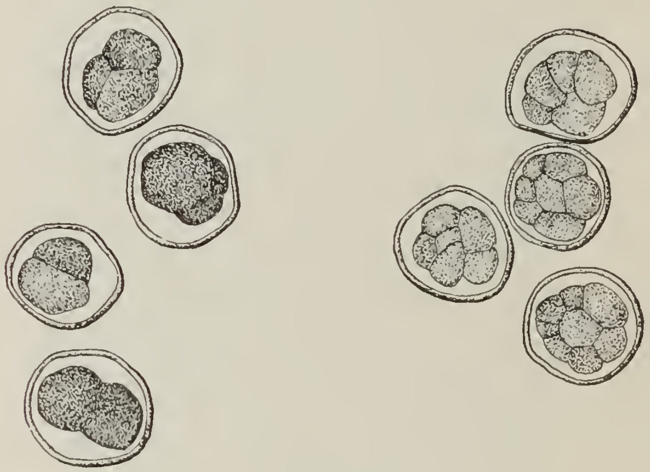

Fig. 48.

bear a dentigerous ridge. This we have not been able to verify, although on the margin of the lobes we noticed a structure which might be interpreted as a dentigerous ridge, but which appeared to us more like a striation.

The ventro-lateral lips do not, upon first examination, show the distinct division into a prominent anterior narrower and a basal broader portion, such as is described for the dorsal lip; upon careful investigation, however, and especially upon isolation of the cuticle, a bilobed anterior projection may be seen extending into the space between the three lips, similar to but broader than the bilobed anterior portion of the dorsal lip; this projection bears a dentigerous ridge; the base of the lip is about 0.16^{mm} broad, and the lip is 0.12^{mm} thick; ordinarily the ventro-lateral lips appear nearly semicircular but asymmetrical in outline. We have not been able to clearly define any dentigerous ridge on the base, but we find a number of striae, which might easily be mistaken for such a ridge. The usual papilla is found on the basal portion of each ventro-lateral lip. Intermediate lips are absent; cervical alae absent. The cervical papillae ar. plainly visible 0.66^{mm} from the anterior extremity. The cuticle of the body is provided with 32 μ transverse cuticular bands, apparently without the finer striae seen in some other species. The posterior edge of each cuticular band projects prominently beyond the anterior edge of the one next succeeding, so that the edge of the worm appears distinctly serrate. The oesophagus (fig. 44) is divided into two portions; an anterior portion about 4^{mm} long by 0.4^{mm} in diameter at its distal end. This part, which is extremely muscular, is followed by a second portion of different histological appearance and wider lumen, measuring about 1.25^{mm} long by 0.25^{mm} in diameter, and in all cases examined it was sigmoid. The distal end of this body leads directly into the anterior end of the intestine; both oesophageal and intestinal caeca are absent.

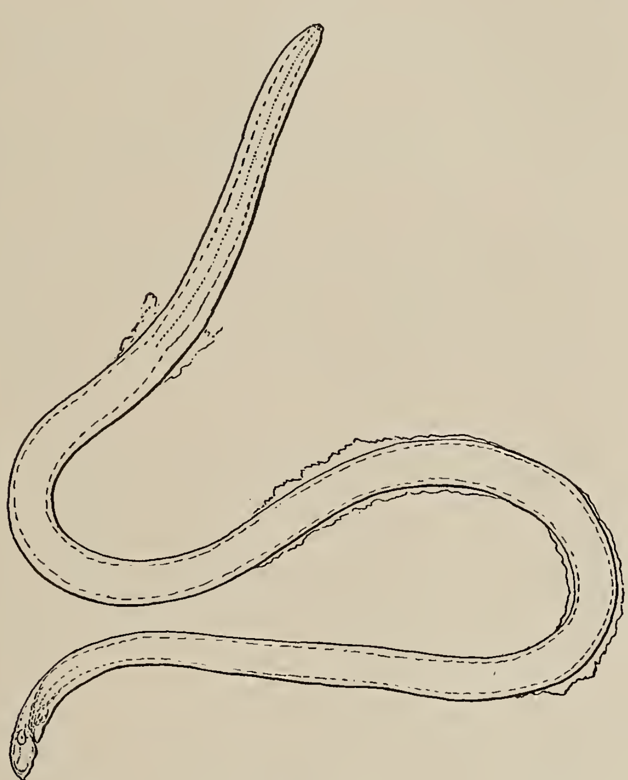

Fig. 49.

The adult males (fig. 37) vary from 31 to 38^{mm} long and 1 to 1.5^{mm} in diameter; the proximal extremity is more attenuate than the distal end (figs. 45–47), which is curled, flattened dorso-ventrally, and provided with lateral alae; the postanal portion is conical and bent vertically. Nine to ten, or possibly eleven, pairs of postanal papillae are present; of these, three occasionally two or two and a half pairs of conical papillae are nearer the tip, while six to seven, possibly eight, pairs of shorter papillae are nearer the cloaca. The arrangement of the praeanal papillae varies greatly in different specimens; there may be over seventy-five on each side, arranged in three irregular rows. The cloaca is 0.27^{mm} from the tip of the tail, and extruding from it may frequently be seen the spicules. The latter are of very unequal size, the left spicule (3^{mm}) about three times as long as the right (0.96^{mm} long).

The adult females (fig. 40) vary in length from 37 to 44^{mm}, in breadth from 1.5 to 2^{mm}, and are attenuated slightly toward each extremity. The vulva, according to Diesing, lies distal of the middle of the body; according to Drasche, about in the middle. In one of our specimens, 44^{mm} long, the vulva was found 20^{mm} from the head. The vagina measured 6^{mm} long, the body of the uterus 8^{mm}, the horns 8^{mm}. The eggs (fig. 48) are globular, 40 μ to 56 μ, and undergo segmentation in the uterus. The anus is about 0.26^{mm} from the tip of the conical tail.

Nomenclature.—The specific term *typica* has priority, while Diesing's (1850) name *Peritrachelius* can not be applied to this form, either as generic or subgeneric name, even should, as Drasche thinks, *A. typica* be generically (or subgenerically) related to *Peritrachelius insignis*, since *A. typica* belongs in Dujardin's (1845) subgenus *Anisakis*, of which we make it the type.

Young specimens of Ascaris typica.—Besides the adults described above, U.S.N.M. No. 5015 contains numerous specimens (figs. 49–52) of young ascarides corresponding

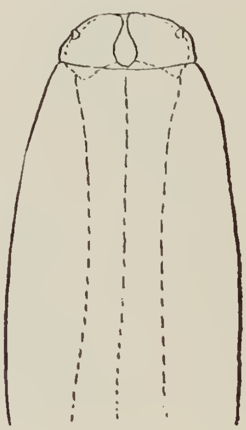

Fig. 50.

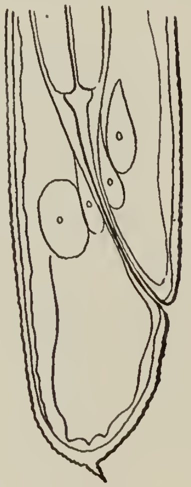

Fig. 51.

to the young forms of *A. decipiens* described on page 116. They measure 15 to 22^{mm} in length by 0.25 to 0.34^{mm} in breadth, and present the characters usually given for "*A. capsularia.*" The ventral tooth is slightly more prominent than in the young of *A. decipiens*. Specimens may be found with the larval cuticle, or with this cuticle partially discarded.

We do not hesitate to look upon these as the young of *A. typica* and to assume that the host becomes infected by eating fish.

4. ASCARIS BICOLOR Baird, 1868 [nec Rudolphi, 1793]. Sp. inq.

(Figs. 53–57.)

? 1809, *Ascaris simplex, Rudolphi*, see pages 120–126.

1868, *Ascaris bicolor* Baird [nec Rudolphi, 1793], Proc. Zool. Soc. London, p. 71. figs. A–C. — Murie, 1868, Proc. Zool. Soc. London, pages 67–71.—Von Linstow, 1878, Compendium der Helminthologie, p. 42.—Stossich, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 67.

Diagnosis.—Intermediate lips absent; lateral cervical alae absent; lips distinct, prominent, rounded, of moderate size, more distinct and larger than in *A. simplex*, and provided with a dentigerous ridge. Body cylindrical, attenuated anteriorly (but less so than *A. simplex*), of a brownish color, except at the anterior extremity which is white; the posterior extremity is sometimes red. Cuticle provided with cuticular bands 0.024 broad, but without finer striae; the bands give a serrate appearance to the margin of the worm, when seen under the microscope. Oesophagus consists of two portions, an anterior and a posterior; oesophageal and intestinal caeca absent.

Length (all females?): 62 to 75^{mm}; breadth 2 to 2.5^{mm}.

Cotypes: British Museum and Coll. B. A. I. (U.S.N.M., No. 2824).

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
Odobenus rosmarus	Died at London	Murie, 1867	Murie and Baird, 1868, pp. 67–71.

Summary.—This supposed species from *Trichechus rosmarus* (=*Odobenus rosmarus*) should not be confused with "*A. bicolor* Rudolphi, 1793," from *Perca fluviatilis*. *A. bicolor* Baird was described in 1868 from specimens taken from a walrus; it has not been reported since that time. We have examined several of Baird's originals, but having no males we are unable to definitely place the worm, although we are somewhat inclined to look upon it as identical with *A. simplex*. Murie, who collected the nematodes, considered them to be the cause of death of a walrus he examined. The worm is cited by von Linstow (1878) and Stossich (1896), but these authors did not examine specimens. In detail the history of the parasite is as follows:

Historical review.—As the original article by Murie and Baird has an important medical as well as zoological bearing, we quote it here in full, with the original illustrations:

(1868.) [p. 67.]

4. On the Morbid Appearances observed in the Walrus lately living in the Society's Gardens. By James Murie, M. D., Prosector to the Zoological Society. With a Description of a New Species of *Ascaris* found in the Stomach. By Dr. Baird, F. L. S.

In 1853 the society obtained a very young walrus (*Trichechus rosmarus*, Linn.), which specimen unfortunately only lived some few days after its arrival. From that time up to the 1st of November last (1867) no opportunity has offered of adding another example of this exceedingly interesting animal to the collection. When, therefore, a tolerably well-developed, although still young, male sea horse was reported to have arrived safely in the gardens, the curiosity of the members of the society and the public generally naturally was aroused. Notwithstanding the inclemency of the weather the number of visitors was great.

The proper food of a walrus in a state of nature has been variously stated by different naturalists. Some assert it to be a vegetable eater; others believe it to be entirely carniverous, while a third notion has gained ground that it may occasionally partake of food of the one kind or the other.

Our superintendent, therefore, under these circumstances, felt a difficulty in deciding what might be the best food to give the creature so as to retain it in as good health as possible. The results of his experiments concerning suitable diet he has himself laid before the society's meetings on a previous occasion. I shall just reiterate his conclusions, namely: It refused every kind of seaweed offered, but it greedily gulped up the soft bodies of *Mya truncata* and *M. arenaria*, which were its principal food, besides quantities of whelks, mussels, fish cut up in small strips, and the viscera of fish; these last, however, having previously been well washed and cleaned.

It may be remarked that the young walrus dissected by Professor Owen in 1853 had been fed during its captivity on oatmeal, milk, and water. The specimen at present under consideration, when first captured, and on shipboard, had also received a certain allowance of the above, along with strips of fat pork.

I have taken notice of the animal's food for the purpose of directing attention to the question, whence were the ova of the entozoa obtained that ultimately led to the walrus's death?

At the period of arrival in the gardens the walrus looked thin and lean. There was an amount of loose skin, however, which indicated that better regimen than that which he had lately been under would soon render the body plump and comparatively free from the very numerous skin folds. These wrinkles, it may be observed, in several places met each other, so as to form a series of elongated diamond-shaped inclosures.

It was early noticed that the conjunctivæ were suffused and injected with blood. This gave the eyes a disagreeable appearance [p. 68]. The animal at times chattered or rattled his teeth together in a very remarkable and noisy manner. This last habit, however, was put down to temper, or as a sign of hunger; the sanguineous effusion to a cold received during transport.

After the lapse of a few weeks it would seem that the body and limbs acquired more vigor; for the gait became altered; so that in walking on all fours, sea-bear fashion, the abdomen and chest were raised from the ground, whereas at first the animal rather trailed or draggled along than walked. This showed that the animal was growing stronger in body, an equivalent in some measure to improvement in health. It was noticed all the while that it remained emaciated and did not increase in stoutness or otherwise become fatter, although the quantity of food it consumed was enormous. The ravenousness of its appetite was something extraordinary, and many thought that the animal was underfed.

The walrus thus was considered by every one who saw it to have had apparently uninterrupted health till Monday the 16th of December. On that day the keeper first began seriously to apprehend that the animal was out of order—as he thought—constipated, but meanwhile it did not refuse food.

On Mr. Bartlett being consulted, he proposed to give it some oily substance which might act as a purgative. One pound and a half of horse fat, cut in strips, was therefore given the afternoon following. The next morning there were copious alvine evacuations. What passed at first was hard, black, and fetid, but the excretions became moister, though still very dark colored.

When this occurred it was thought relief was obtained and that the animal would go on well. It did not seem, however, to rally, but died rather suddenly on Thursday the 19th.

The body was examined by me a day afterwards and disclosed unusual conditions.

Not a particle of subcutaneous fat was present, and the mesentery and other abdominal parts usually containing fatty substances were equally destitute of such.

The viscera of the thorax and abdomen, with the exception of the interior of the stomach, appeared quite sound. The brain was also normal in structure.[1]

[69.] On opening the stomach, which was of moderate size, I was much surprised to find that it contained small, round worms, a species of *Ascaris*, in such quantities that, when these were turned out, there was altogether about half a pailful. They occupied the entire interior of the viscus, but were in greatest abundance at the bend of the peculiar siphon-like stomach.

The entozoa swarmed between the rugae, and in many cases were firmly attached to the membrane. The mucous membrane lining the interior was of an intense red hue; but here and there were somewhat paler patches. More rigid examination showed that these last were extensive ulcerations, the mucous membrane being entirely eroded, and only the muscular and a very thin lining of submucous tissue remained, preventing perforation of the walls of the stomach. The chief ulcerations were some four in number, and varied in size and situation.

One, nearly circular, three-fourths of an inch in diameter, occupied the anterior wall at a distance of between 5 and 6 inches from the cardiac end. Another, somewhat diamond-shaped, $2\frac{1}{2}$ inches by $1\frac{1}{2}$ at widest, also existed on the anterior wall of the viscus and about its middle. In the ulcerated erosion, the mucous coat was in some parts so excavated underneath as to leave one-half inch of an overhanging lappet of membrane. On a section being made vertically, the submucous tissue was seen to be absent, the muscular and serous coats alone preventing perforation of the wall. At this part of the wall the stomach had a thickness of only 0.1 of an inch, although it seemed as if the muscular fibers were slightly increased in numbers here, possibly from the effects of the irritation

[1] When the brain was taken out, its general appearance and firmness of texture, as implied above, was that of health. As it was desired for anatomical investigation, it was not then cut into or interfered with further than cursory examination permitted. At one point it was noticed that unusual vascularity existed; but as the diseased condition of the stomach was thought sufficient of itself to account for death, no great attention was then paid to this superficial cerebellar congestion. Subsequent examinations showed, however, that upon the upper surface of the cerebellum (between the posterior cerebral lobes) and underneath the injected pia mater an abscess had begun to be formed. The brain surface immediately underneath was very slightly softened, but around it was quite firm. The morbid deposit and infiltration had chiefly implicated the pia mater over the superior vermiform process. Whether this lesion was the more immediate cause of death, and not the ulcerated condition of the stomach, is an open question. Some of the symptoms during life might, indeed, be referred to it.

going on in the neighborhood and within. A third ulcer, of an elliptical form, 2½ inches long, and with more regular edges than the preceding, had been eaten away on the anterior wall, close to the lesser curvature of the stomach and between 5 and 6 inches from the pylorus. Between the second and third erosions here described, but on the posterior wall of the stomach, another very extensive patch of ulceration had taken place. This ulcer stretched between the greater and lesser curvatures. It had a semilunar figure, was rather more than 4 inches long, possessed irregular borders, and varied from one-half to 1 inch in width. The mucous coat around had been undermined in a manner similar to that described above as occurring in the second ulcer. To the right and lying parallel with this large excavation were a series of small circular and ovoid spots, which had been eroded in like manner with those already described. The spots just spoken of varied in size from about a threepenny piece to a shilling, and they evidently were fast running into one single, long ulcer, resembling that upon the left side. Only a very few worms were found here and there in the intestinal tract; some were observed to have passed previously to the horse fat having been given.

Dr. Baird, of the British Museum, having examined some of the entozoa, considers them new to science, and sufficiently different to require a new specific name. He proposed therefore, that of *Ascaris bicolor*, on account of a peculiarity common to most of [p. 70] them, viz, that the posterior half of the body is more or less of a reddish or pinkish hue, the remaining segment being pale colored. I myself incline to the opinion that this coloration may not be of a specific kind, but due in some measure to the intensely congested condition of the stomach and sanguineous nature of the food. The accompanying figures I have had drawn under my supervision; and Dr. Baird is pleased to consider them a faithful delineation.

ASCARIS BICOLOR, Baird.

Fig. 52.

♀

Fig. 53.

Fig. 54.

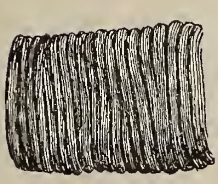

Fig. 55.

Fig. 56.

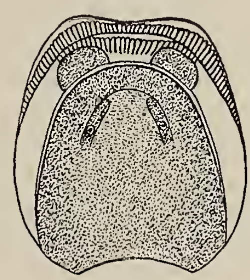

Fig. 57.

A. [Figs. 52–54.] Three female specimens, of about the natural size; that to the left shows the manner in which occasionally the caudal end is found coiled up.

B. [Fig. 55.] Portion near the middle of the body, enlarged so as to display the transverse striations and how some of them interdigitatè.

C. [Fig. 56.] Magnified view of the head and labia.

There still remain two points worthy of consideration—viz: the cause of death, and whence the entozoa were derived.

1. Death seems to have resulted from the ulceration of the stomach. It is not clear, though, why the animal should have succumbed so suddenly. Literally speaking, these ulcerations were so extensive that it is curious the animal should have survived so long. The chronic stage of the ulceration alone accounted for this. This instance is one exemplifying pure, chronic gastritis, due, no doubt, to the presence in such numbers of the entozoa.

2. It has been said by some parties that the entozoa were possibly derived from food given to the walrus after its arrival at the gardens; but there are many reasons against this being a likely circumstance. In the first place, the fact of the entozoa being a new species peculiar to the walrus militates against the above assertion [p. 71]. Again, the ulceration apparently took a longer period to attain the chronic stage extent than the few weeks' residence of the walrus in the gardens would account for. Furthermore, the nature of the food given at the gardens and the care and regularity with which it was examined make it unlikely that such swarms of entozoa were derived from it and developed in so short a period. Whether the entozoa had been derived from the food given on board ship or in what manner they had originally reached the stomach of the walrus are questions which I am quite unprepared to answer, and speculation leaves the matter quite as undecided.

Dr. Baird has furnished the subjoined description of this *Ascaris*, which proves to belong to a new species.

ASCARIS BICOLOR, Baird.

Head naked; labia distinct, prominent, rounded, and of moderate size. Both anterior and posterior portions destitute of alae or wings. Body of worm cylindrical, attenuated anteriorly, of a brownish color, except at anterior extremity, which is white; the posterior extremity is sometimes red. The surface of the body is beautifully and minutely but distinctly striated across; as seen under the microscope (with a power of two-thirds of an inch), the striae on each side terminate in such a manner that the edges of the body appear as if serrated. Caudal extremity thicker than anterior, obtuse, and generally convoluted.

A great many specimens were found in the stomach; but apparently all were females.

The *Ascaris simplex* of Rudolphi, found in the stomach of the porpoise (*Phocæna communis*), very nearly approaches this species in general appearance and size, but differs from it in several respects.

The *Ascaris bicolor* is less attenuated at the anterior extremity than the *A. simplex*, and is destitute of alae or wings equally at the posterior and at the anterior extremity. The striations on the surface of the body are much finer, and the labia or valves at the mouth are more distinct and larger.

Length from 2½ to 3 inches; breadth from 2 to 2½ millimeters.

Habitat: Stomach of a young male walrus (*Mus. Brit.*).

Reexamination of cotypes.—Almost at the moment of going to press we have received through the kindness of Prof. J. Jeffrey Bell, of the British Museum, several of Baird's originals of this worm. All of the specimens are females, and on this account we are unable to definitely place the parasites. They are poorly preserved, but we were able to distinguish a dentigerous ridge on the lips; no intermediate lips were present; the cuticular bands measure 24 μ broad, and are *apparently* not provided with any finer striation; the oesophagus resembles the oesophagus described by Jägerskiöld for *A. simplex*, oesophageal and intestinal caeca being absent. Further than this we are not willing to make any statements upon the material at hand.

We refrain from proposing a new name for the homonym *A. bicolor* Baird, as we doubt the validity of the species.

b. Dentigerous ridge double.

5. ASCARIS PATAGONICA Linstow, 1880.

(Fig. 57.)

1880, *Ascaris patagonica* VON LINSTOW Arch. Naturg., XLVI, I, pp. 41–42, pl. III, fig. 1.—VON LINSTOW 1889, Compendium. Nachtrag, p. 18. — STOSSICH, 1896, Boll. Soc. Adriatica Sci. nat. Trieste, XVII, pp. 20-21.

DIAGNOSIS.—Intermediate lips absent; cervical alae absent; lips with a double dentigerous ridge; in all three lips, the pulpa of the inner surface is divided into two roundish lobes; outer surface of dorsal lip elongate, oval, with narrow base; body thick and solid; cuticle with rather broad transverse cuticular bands together with very much finer transverse striae; tail clavate.

Male: 28^{mm} long by 1.3^{mm} broad; tail with obtuse conical projection; caudal papillae very numerous and crowded.

Female: 57^{mm} long by 2^{mm} broad; eggs $60\,\mu$ in diameter, with hyaline membrane widely separated from vitellus.

Type: Kiel University Museum, No. 40.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
Otaria jubata	Patagonia	(?)	Von Linstow, 1880, p. 41.

Von Linstow (1880, p. 41–42) described this species with the following diagnosis:

1. ASCARIS PATAGONICA n. sp. (K. Nr. 40).

Fig. 1 [see fig. 57].

Fig. 58.

Aus dem Magen von *Phoca jubata*. Patagonien.

Die Gestalt ist dick und gedrungen. Lippen ohne Zwischenlippen mit doppelten Zahnleisten; bei allen dreien ist die Pulpa an der Innenseite in zwei rundliche Ausläufer gespalten. Die Aussenseite der Oberlippe ist längsoval mit schmaler Basis. Die Haut zeigt Querstreifen in ziemlich breiten Abständen, zwischen denen wieder viel feinere Querstriche eng gedrängt stehen. Das Schwanzende ist kolbig, beim Männchen in eine stumpfe, conische Spitze ausgezogen.

Die Länge des Männchens beträgt 28, die Breite $1\frac{1}{3}^{mm}$; die Papillen am Schwanzende stehen sehr dicht und sind zehr zahlreich.

[p 42]. Das Weibchen hat eine Länge von 57 und eine Breite von 2 mm.

Die Eier sind kugelrund; sie haben eine hyaline, von dem Dotter weit abstehende Hülle und einen Durchmesser von 0.06^{mm}.

Die bekannten Formen, welcher hier in Frage kommen könnten, sind *Ascaris osculata, decipiens* und *similis* welche von dieser Form durchaus verschieden sind, wie aus Krabbe's neuester (1878) Darstellung der in Robben und Walen gefundenen Ascaris-Arten ersichtlich ist.

No other original observations have been made upon this parasite.

B. The ventro-lateral lips, said to bear a papilla armed with 6 to 7 small teeth [=dentigerous ridge on a bilobed projection?].

6. ASCARIS KÜKENTHALII Cobb, 1888. Sp. inq.

(Figs. 58–64.)

? 1809, *Ascaris simplex* RUDOLPHI, see page 121.

1888, *Ascaris Kükenthalii* COBB, Jenaische Zeitschr. f. Naturw., XXIII (n. F. XVI), I, Dec. 8, 1888, pp. 44–59, pls. III, figs. 1–11, IV, 12–30.—COBB, 1889, Archiv f. Naturg., 55 Jhg., I, pp. 149–150, pl. VII, figs. 4–6.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat., XVII, p. 53.

1894, *Ascaris Kükenthalii* COBB, as probable synonym of *A. simplex* Rud., JÄGERSKIÖLD, Zool. Jahrb., VII, pp. 474–476.

DIAGNOSIS.—Intermediate lips absent; lateral cervical alae absent; head (male) scarcely 0.33^{mm} broad, lips of nearly equal size; lobes not mentioned; dentigerous ridge not mentioned, but one papilla on each ventro-lateral lip said to bear teeth; dorsal lip bears a symmetrical pair of papillae, the ventro-lateral lips said to possess 3 papillae each; an upper one [double lobed projection?] with 6 to 7 teeth, a lower one on which no teeth were visible, and a very small one about in the middle of the inner side; cervical papillae 1^{mm} from the head. Excretory organ discharges between the ventro-lateral lips. Body attenuated toward both extremities. Transverse cuticular bands 30 μ. Oesophagus composed of two portions; anterior portion 5^{mm} long by 1^{mm} in diameter (distal end); posterior portion 2 to 2.5^{mm} long, generally sigmoid; caeca apparently absent.

Male: 70 to 90^{mm} long by 2 to 3^{mm} thick; tail with lateral alae; 7 to 8 pairs of postanal papillae; 1 to 4 near the tip; 5 to 8 near the cloaca, of which 6 and 7 are double; about 90 pairs of praeanal papillae extending about 10^{mm} forward from tip of tail; of these 6 to 10 pairs of short papillae lie antero-lateral of the cloaca; then follows cephalad on each side a row of longer papillae; apparently two median papillae immediately in front of the cloaca; left spiculum (2.3^{mm}) slightly larger than the right (1.7^{mm}).

Female: 80 to 100^{mm} long with maximum breadth of 2.5^{mm}; vulva a little anterior to middle of the body. Eggs reach the morula stage in the uterus.

Habitat: Stomach of marine animals.

Host.	Locality.	Collector.	Authority.
Delphinapterus leucas	Advent Bay, West Spitzbergen.	Kükenthal	Cobb, 1888, p. 44; 1889, p. 149.
? *Phoca barbata*			Stossich, 1896, p. 53.

HISTORICAL REVIEW.—This species was described by Cobb, but Jägerskiöld thinks it probably identical with *A. simplex*. In detail the history of the species is as follows:

Ascaris Kükenthalii, collected by Kükenthal, August, 1886, from the stomach of *Beluga leucas* (=*Delphinapterus leucas*) in the Advent Bay (West Spitzbergen), was described as a new species by Cobb (1888, pp. 44–59). While his anatomical discussion is excellent, he omits some extremely important points of systematic value; apparently he was not acquainted with Krabbe's work upon the parasites from this host.

He describes the male (fig. 58) as 70 to 90^{mm} long, by 2 to 3^{mm} broad: head scarcely 0.33^{mm} broad; body attenuate anteriorly, and very slightly pointed posteriorly; tail is curved and provided with a bursa; the papillae are figured (fig. 61) and agree to a great extent with the papillae figured by Krabbe for *A. simplex;* there are four pairs near the tip of the tail, three other pairs closely posterior to cloaca, an irregular row of simple papillae on each side antero-lateral to cloaca, and a row of longer papillae anterior to these; one larger and one small papilla appear to be present in the median line immediately anterior to the cloaca; in all about 100 papillae are present on each side, extending about 10^{mm} forward from tip of tail. The cuticular bands measure 30 μ. The left spicule (2.3^{mm}) is slightly larger than the right (1.7^{mm}). The dorsal lip (fig. 62) bears in the middle a symmetrical pair of papillae (evidently a double-lobed projection); the ventro-lateral lips apparently possess three papillae each; an upper one with 6 to 7 small teeth (possibly another double-lobed projection), a lower one on which no teeth were visible, and about in the middle of the inner side a third of very small dimensions.

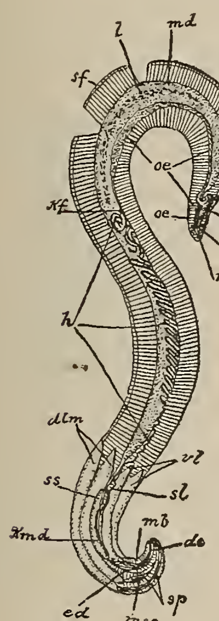

Fig. 59.

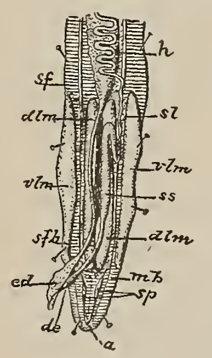

Fig. 60.

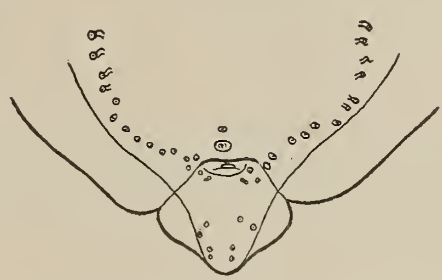
Fig. 61.

The female (fig. 63) is described as 80 to 100^{mm} long, with a maximum breadth of 2.5^{mm}; the vulva is five-elevenths of the length of the body from the anterior extremity (a little anterior to the middle of the body); the vagina measures 10^{mm} long, the bicorn uterus 20^{mm}, the receptacula seminis 10^{mm}; the ovaries 210 to 216^{mm}, the entire female genital organs thus being about three times as long as the worm. Eggs reach the morula stage in the uterus.

The oesophagus (fig. 64) is divided into two portions; an anterior part 5^{mm} long by nearly 1^{mm} in diameter (at posterior end), and a posterior portion 2 to 2.5^{mm} long, generally sigmoid. The intestine has three rows of V-shaped cellular bodies, such as Jägerskiöld (1894) described for *A. simplex*. Intestinal caeca are apparently not present. The sub-intestinal glands (back of the oesophagus) measure 0.6^{mm} broad by 30 to 40^{mm} long. The sub-oesophageal excretory organs are 2^{mm} broad and extend beyond the middle of the body. The cervical papillae are situated 1^{mm} from the head.

Cobb's second (1889, pp. 149, 150) article is for the most part a reprint of page 44 of his first article.

Jägerskiöld (1894, pp. 474–476) calls attention to the resemblance of *A. Kükenthalii* to *A. simplex;* he inclines decidedly to the view that the two forms are identical, but in the absence of specimens of *A. Kükenthalii* for comparison he reserves judgment. Stossich (1896, p. 53) cites *A. Kükenthalii* as a distinct species, gives a condensed diagnosis taken from Cobb's description, and adds *Phoca barbata* as a host. This new host, for which Stossich does not give his authority, is probably an error, and might have occurred while referring to Cobb's second article.

From the above review it will be clear that *A. Kükenthalii* bears a close resemblance to *A. simplex;* we agree with Jägerskiöld that the two forms are probably identical; in fact, we think there can be scarcely any doubt regarding this point. Cobb's median symmetrical papillæ of the dorsal lip would correspond to the small anterior bilobed projection of *A. simplex*, as his figure (see fig. 62) shows; the armed papilla of each ventral lip would correspond to dentigerous ridge of the ventral lips of

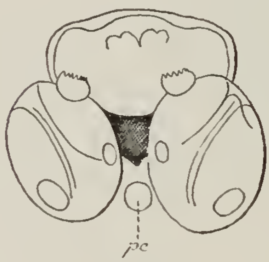

Fig. 62.

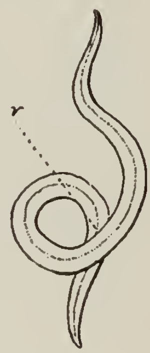

Fig. 63.

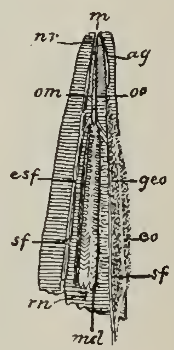

Fig. 64.

A. simplex; the other essential characters are practically the same in both forms. Not having specimens of either *A. simplex* or *A. Kükenthalii*, however, we follow Jägerskiöld in retaining the species as distinct, hoping that the originals of *A. Kükenthalii* may be found and reexamined.

C. Data concerning the dentigerous ridge wanting.

7. ASCARIS SIMILIS, Baird, 1853. Sp. inq.

(Figs. 65–69.)

1853, *Ascaris similis*, BAIRD, Catalogue Entozoa Brit. Mus., p. 19, pl. I, figs. 1*a–d*.—BAIRD, 1853, Proc. Zool. Soc. London, Part XXI, p. 18.—BAIRD, 1855, Ann. and Mag. Nat. Hist., 2 ser., XV, pp. 69, 70.—DIESING, 1860, Sitzungsber. Akad. Wiss. Wien, XLII, no. 28, p. 656.—VON LINSTOW, 1878, Compendium der Helminthologie, p. 44.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 63.

DIAGNOSIS.—Intermediate lips absent; lips of about equal size, slightly projecting beyond the margin; dentigerous ridge (?); body attenuated more toward anterior than toward posterior extremity, which is thick, round, and obtuse; wing extending along the whole length and becoming thicker and stronger at inferior extremity; cuticle with fine transverse striæ.

Male (female?): About 50^{mm} long by 2^{mm} broad; straight to within a short distance of tail, which is inflected; of a whitish color.

Female (male?): About 37^{mm} long by 1.5^{mm} broad; spirally twisted in many convolutions; of a dark-olive color.

Types: In British Museum.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
Antarctic seal, gen. ? sp. ?	Antarctic	(?)	Baird, 1853, p. 19.

Historical review.—This form was described by Baird in 1853, and has not been found or examined since that time. Professor Bell writes to us that the types are in very poor condition. Baird's (1853, p. 19) original diagnosis reads as follows—

ACARIS SIMILIS, Baird.


Fig. 65.


Fig. 66.


Fig. 67.


Fig. 68.


Fig. 69.

Length of male 2 inches, breadth 1 line. Length of female 1½ inches, breadth three-fourths of a line. Anterior portion much narrower than posterior. Head small, mouth with three small valves slightly projecting beyond the margin. Tail rounded, thick, obtuse. Females spirally twisted in many convolutions, of a dark-olive color. Male straight to within a short distance of tail, which is inflected; of a whitish color. Skin minutely and finely striated across. Wing extending along the whole length and becoming thicker and stronger at inferior extremity. Differs from preceding species (*A. osculata*) in having the wing stronger and thicker at inferior extremity, in having the head and mouth smaller, and having the skin finely striated across.

Habitat: Stomach of a seal from Antarctic regions.

Collected during the late Antarctic expedition. Presented by the Admiralty.

Baird's figures show that the intermediate lips are absent; his figure 1*a*, of a supposed male, is probably a female, while 1*c*, of a supposed female, is probably a male. In his second paper Baird (1853, p. 18) repeats his original diagnosis, with some slight verbal changes. The diagnosis in his third paper (1855, pp. 69, 70) is a reprint of the diagnosis given in the second paper.

Neither Diesing (1860, p. 656), von Linstow (1878, p. 44), nor Stossich (1896, p. 63) add any original observations.

8. ASCARIS HALICORIS Owen in Baird, 1859.

(Figs. 70–75.)

(1833), *Ascaris halichoris* Owen, Catalogue of the Physiological Series of Comparative Anatomy, Museum of the College of Surgeons, p. 121, London. Nomen nudum. (Quoted from Baird, 1859.)

(1834), —— ? —— Rüppell, Abhandl. Senkenberg. Museum, I, p. 106.

1838, "*Ascarides*" in Dugong Owen, Proc. Zool. Soc. London, Part VI, p. 30.

1839, "*Ascaris* of a Dugong," Owen, Art. Entozoa, Todd's Cyclopædia of Anatomy and Physiology, II, p. 136.

1851, *Ascaris dugonis* Diesing, Systema Helminthum, II, p. 191. Nomen nudum. Refers to Rüppell, 1834.

1859, *Ascaris halichoris* BAIRD, Proc. Zool. Soc. London, Part XXVII, pp. 148, 149, pl. LVI, figs. 2-2c.—Reprinted without figures, BAIRD, 1860, Ann. Nat. Hist., 3 ser., V, No. 28, April, pp. 329-331.—DIESING, 1860, Sitzungsber. k. Akad. Wiss. Wien., XLII (1860), No. 28, p. 662.—VON LINSTOW, 1878, Compendium der Helminthologie, p. 59.—C. PARONA, 1889, Ann. Mus. civico, Storia nat. Genova, 2 ser., VII (XXVII), 10 Oct., pp. 751-761, figs. 1-3, pl. XIII, figs. 1-16.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 68.

DIAGNOSIS.—Intermediate lips and lateral cervical alae absent; lips of nearly equal size, dorsal lip slightly broader than ventro-lateral lips; dentigerous ridge?; body attenuated toward both extremities; cuticle with fine transverse striae; intestinal caecum 11^{mm} long, arises about 17^{mm} from mouth, and extends cephalad parallel to oesophagus.

Male: 85 to 115^{mm} long; tail in a spiral; caudal papillae symmetrical, one pair postanal, near the cloaca, four pairs praeanal; spicules very short.

Female: 85 to 144^{mm} long, with maximum diameter of 3.5^{mm}; vulva about two-thirds the length from the anterior extremity (Baird), one-third the length from the anterior extremity (Parona); eggs segment to morula in the uterus.

Types: In British Museum.

Habitat: Stomach of Dugongs.

Host.	Locality.	Collector.	Authority.
Dugong dugon	Penang	Owen	Owen, 1838, p. 30.
Dugong dugon	Red Sea	Rüppell	Baird, 1859, pp. 148, 149.
Dugong dugon	Assab	Ragazzi	Parona, 1889.

HISTORICAL REVIEW.—According to Baird (1859, p. 148), Professor Owen in 1831 prepared a specimen of an *Ascaris* from the stomach of a Dugong, and deposited the same in the museum of the College of Surgeons, London; Baird also refers to the Catalogue of the Physiological Series of Comparative Anatomy, which was published by the college in 1833, in a way which leads the reader to assume that Owen named the species *Ascaris halicoris.* This catalogue is not at our disposal, but as Baird adds (1859, p. 149) that "*Ascaris halicoris*, though named long ago, has never been fully described or figured," it may safely be assumed that Owen's name was a *nomen nudum*, and hence not entitled to further consideration.

Rüppell, according to Baird, "found the same species of worm in the stomach of the same species of animal. He very briefly notices this in describing a Dugong which he found in the Red Sea," but merely mentions that the entozoa "were found in a clustered glandular apparatus in the stomach and were 5 inches long." His description of the Dugong was sent in a letter to Dr. Sömmering, and is dated from the island of Dahalac, on the Abyssinian coast of the Red Sea, in the month of January, 1832. This paper was published in the first volume of the Museum Senckenbergianum, in 1834."

Owen (1838, p. 30), in discussing the stomach of the Dugong, refers to his specimens with the sentence: "And in each case the gland was infested by *Ascarides*, hereafter to be described, which left impressions upon the spiral membrane."

Owen (1839, p. 136) again refers to this parasite, in discussing the accessory glands of the digestive system of entozoa, as follows:

The second example of an accessory digestive gland occurs in a species of *Ascaris* infesting the stomach of the Dugong. Here a single elongated caecum is developed from the intestine at a distance of half an inch from the mouth, and is continued upward, lying by the side of the beginning of the intestine, with its blind extremity close to the mouth; from the position where the secretion of this caecum enters the intestine, it may be regarded as representing a rudimental liver. (See the Preparation, No. 429A, Mus. Coll. Surgeons, Phys. Catalogue, p. 121.)

Brandt (1846, p. 192) simply mentions the worms found by Rüppell and Owen in connection with the ascarides of Steller's sea cow.

Later Brandt (1849, p. 100) briefly refers to these parasites as follows:

In ventriculo ceterum nec non glandulae cavo et duodeno invenit (Stellerus) lumbricos candidos (Ascarides) numerosos ½ longos. Simile quid observarunt Ruppelius (Museum Senkenb., I, p. 106) et Owenius (Zoolog. proceed., P. VI, p. 30) in Halicore.

It is evidently this passage upon which the citation by some authors of the occurrence of *A. halicoris* in *Rhytina stelleri* (=*Hydrodamalis gigas*) has been based. It is clear, however, that from the data at hand there is no justification for assuming that the parasites from the two hosts are identical.

Diesing (1851, p. 191) next cites this parasite as "*Ascaris Dugonis* Brandt" among his *species inquirendae*, referring to the articles by Rüppell and Brandt (1846 and 1849). The name was not used by Brandt; it is to all purposes a *nomen nudum*, as the description reads only "Longit. corp. 5."

From a nomenclatural standpoint the parasite was not described until 1859, when Baird (1859, pp. 148, 149, pl. LVI) figured it, and gave the following description:

ASCARIS HALICHORIS Owen.

Caput nudum, epidermide stricte adnata; os labiis rotundatis, porrectis; corpus, in utroque sexu, extremitatibus magis attenuatis; extremitate caudali brevi, subulata. nuda.

Long. feminae, 3¼ unc.; maris, 2¼ unc.

The body is of a whitish color, thickest in the center, gradually tapering to each extremity. The body is strongly striated across; in the female, apparently all its length; in the male, till nearly about half an inch from its posterior extremity. This latter portion is smooth or slightly striated lengthways. In the female the vagina is situated at about two-thirds of its length from the anterior extremity. The spicula of the male appear very short. The intestine, as described by Professor Owen, has a caecum developed from it at the distance of about half an inch from the mouth, and is continued upward, lying by its side, and terminating in a blind extremity near the mouth. The specimens, now in the British Museum, are shorter than those noticed by Rüppell.

(The figures will explain this structure.)

In the collection of the British Museum.

Baird's (1860, pp. 329–331) second article is practically a reprint of his first discussion (1859).

Diesing's (1860, p. 662) diagnosis is based upon Baird's (1859) description; Stossich (1896, p. 68) gives a citation of this worm by Diesing (1861, Sitzungsber. k. Akad. Wiss. Wien, XLVII, p. 277), but we have been unable to verify the reference.

Von Linstow (1878, p. 59) gives both *Halicore cetacea* and *Rhytina stelleri* as harboring *A. halicoris*, but does not cite his authority for the latter host.

Parona (1889) appears to be the next to discuss *Ascaris halicoris.* He studied specimens ot ascarides collected by Vincezo Ragazzi in two Dugongs ("Halicore cetacea") in Assab. After an historical review of the parasite he describes the anatomy of Ragazzi's specimens, the description differing in some particulars from the diagnosis given by Baird. According to Parona the females measured 85 to 144^{mm} in length; with a maximum diameter of 3.5^{mm}; the males measured 85 to 115^{mm} in length. The head is apparently without intermediate lips, and no mention is made of labial dentition. A caecum is present running parallel to the oesophagus, as described by Owen; in a female 135^{mm} long this caecum opens into the intestinal tract 17^{mm} from the mouth and measured 11^{mm} in length. The vulva was about on the border between the first and second thirds of the body, 42^{mm} from the anterior extremity in a specimen 124^{mm} long, 45^{mm} in one 135^{mm} long, and 40^{mm} in one 110^{mm} long. Baird states that of his specimens "the vagina is situated at about two-thirds of its length from the anterior extremity." The position of the vulva is the great point of difference between the descriptions of the worms studied by Baird and

Fig. 71.

Fig. 70.

Fig. 72.

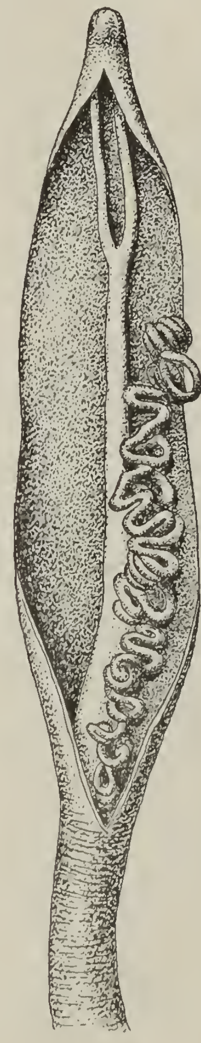

Fig. 73.

Parona. Whether Baird accidentally measured from the tail instead of the head, we do not care to state; such an error would be possible, but hardly probable. That such a variation in the position of the vulva would occur, seems improbable. The vaginal canal measured 6.5^{mm} in length, the double uteri 29^{mm}.

Baird described the cuticle of the female as transversely striated the entire length of the body, while the striae of the male extended only to within half an inch of the end of the tail; Parona, on the other hand, found the striation of the male present on the tail as well as on the other portions of the body.

Unfortunately Parona's figures of the tail of the male are rather unsatisfactory. He states that the tail is spirally wound; that the spicules are short, not protruding more than 2^{mm}, and that five symmetrical pairs of papillae are present. Judging from his figure, four pairs of these papillae are praeanal and one pair postanal.

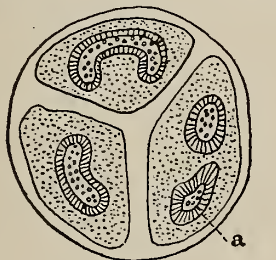

Fig. 74.

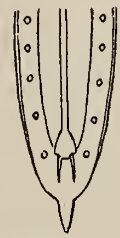

Fig. 75.

Stossich (1896, p. 68) places *Ascaris halicoris* among the doubtful species; his diagnosis is evidently based upon Parona's work, and he cites both *Halicore indica* and *Rhytina stelleri* as hosts.

II. Intermediate lips present.

9. ASCARIS OSCULATA Rudolphi, 1802, det. Schneider, 1866.

(Figs. 76–92.)

? 1802, *Ascaris osculata* RUDOLPHI, Arch. f. Zool. und Zootomie, II, II, pp. 14, 15.—RUDOLPHI, 1809, Entozoorum hist. nat., II, I, pp. 135–136.—RUDOLPHI, 1819, Entozoorum synopsis, pp. 39, 651–652.—BELLINGHAM, 1844, Ann. and Mag. Nat. Hist., XIII, p. 169.—DUJARDIN, 1845, Hist. nat. des Helminthes, p. 164.—DIESING, 1851, Systema helminthum, II, p. 169.—BAIRD, 1853, Cat. Entoz. Brit. Mus., p. 18.—BASTAIN, 1866, Phil. Trans. R. Soc. London, CLVI, pp. 545–638, pl. XXVI, figs. 6–12.

? 1803, *Fusaria osculata* (RUDOLPHI, 1802), ZEDER, Anleitung z. Naturg. Eingeweidew., p. 105.

1866, *Ascaris osculata* RUDOLPHI, 1802, of SCHNEIDER, Monographie d. Nematoden, p. 44, with fig., pl. I, fig. 13.—KRABBE, 1878, Oversigt K. Danske Videnskab. Selskabs Forhand., p. 45, pl. I, fig. 1.—CÓBBOLD, 1879, Parasites, pp. 313, 314, figs. 59*a–b*.—VON LINSTOW, 1880, Arch. f. Naturg., 46 Jhg., I, pp. 44, 45.—VON MARENZELLER (1882–83), Internat. Polarforsch. Wien., p. 18.—NEHRING, 1884, Sitzungsber. Gesellsch. naturf. Freunde Berlin, no. 4, p. 59.—BRAUN (1891), Arch. d. Fr. Naturg. i. M., p. 110.—JÄGERSKIÖLD (1893), Akadem. Afhandl. Stockholm, pp. 10–16, pls. II, fig. 12, IV, 35, V, 39.—VON LINSTOW, 1892, Jahr. Hamb. wiss. Anstalten, IX, 2, pp. 8, 9, pl. II, figs. 11–16.—JÄGERSKIÖLD. 1894, Zool. Jahrb. VII, pp. 457–463, pls. XXV, fig. 12, XXVII, 35, 36, XXVIII, 38.—VON LINSTOW, 1895, Archiv. f. mikr. Anat., XLIV, pp. 528–531, pl. XXXI, figs. 1–14.—STOSSICH, 1896, Boll. Soc. ardiatica Sci. nat. Trieste, XVII, pp. 37–38.

DIAGNOSIS.—Intermediate lips present; lateral cervical alae absent; lips large, of about equal size, with an inner lateral dentate projection, but without dentigerous ridge. Immediately back of the head for about 0.13^{mm}, the anterior border of the each cuticular ring covers the posterior border of the ring immediately in front; beyond this peculiarly formed differentiation the posterior margin of each cuticular ring covers the anterior margin of the next ring. Cuticular bands 8 μ broad without finer striation. Oesophagus composed of two portions; distal portion generally with caecal appendage; oesophageal and intestinal caeca present.

Male: 34 to 70^{mm} long by 1.5^{mm} in diameter; tail hooked or curled ventrally, with narrow or broader alae; 8 to 11 pairs of postanal papillae; of these 1 to 4 are near the tip; one pair of double papillae and several (3 or more) pairs of single papillae nearer the cloaca; 30 or more pairs of praeanal papillae arranged on each side somewhat irregularly or in two rows; spicules equal 3.7^{mm} (von Linstow), 6 to 8^{mm} (Stiles and Hassall) long.

Female: 40 to 80^{mm} long by 1.5 to 2^{mm} in diameter; vulva on a prominent transverse ridge about one-third the distance from the anterior end. Eggs spherical, 67 to 83 μ segmenting to the morula stage in the uterus.

Habitat: Stomach of marine mammals.

Host.	Locality.	Collector.	Authority.
Cystaphora cristata	Greenland	Olrik	Krabbe, 1878, p. 45.
Erignathus barbatus	Iceland	Thienemann	Diesing, 1851, p. 169.
Erignathus barbatus	Baffins Bay	Dr. Leach	Baird, 1853, p. 18.
Erignathus barbatus	Greenland	Olrik	Krabbe, 1878, p. 45.
Erignathus barbatus	Specimens from Vienna Museum.		Stiles and Hassall, 1899, p. 157.
Eumetopias stelleri	Bering Sea	Lucas, 1896	Stiles and Hassall, 1899, p. 158.
Halichoerus grypus		Creplin	Diesing, 1851, p. 169; Krabbe, 1878, p. 45.
Halichoerus grypus	Specimens from Kiel Museum.		Linstow, 1880, p. 44.
Halichoerus grypus	Rügen	Nehring	Nehring, 1884, p. 59.
Monachus albiventer	Specimens in Vienna Museum.		Diesing, 1851, p. 169.
Monachus albiventer	Specimens from Vienna Museum.		Stiles and Hassall, 1899, p. 157.
Odobenus rosmarus	Greenland	Olrik	Krabbe, 1878, p. 45.
Otaria jubata	Patagonia	(?)	Parona, catalogue MS.
Phoca foetida	Specimens in Greifswald Museum.		Diesing, 1851, p. 169.
Phoca groenlandica		Bremser	Rudolphi, 1819, p. 651.
Phoca groenlandica	Greenland	Gieseke	Diesing, 1851, p. 169.
Phoca groenlandica	Iceland	Thienemann	Diesing, 1851, p. 169.
Phoca groenlandica			Schneider, 1866, p. 44.
Phoca groenlandica	Greenland	Vahl, Morch, Olrik, Pfaff.	Krabbe, 1878, p. 45.
Phoca groenlandica	Specimens from Vienna Museum.		Stiles and Hassall, 1899, p. 158.
Phoca pantherina	Greenland	Gieseke	Diesing, 1851, p. 169.
Phoca pantherina	Specimens from Vienna Museum.		Stiles and Hassall, 1899, p. 157.
Phoca vitulina	Greifswald	Rudolphi	Rudolphi, 1809, p. 135; 1819, p. 59.
Phoca vitulina	(?)	Wewetzer	Rudolphi, 1809, p. 135.
Phoca vitulina		Bakker	Rudolphi, 1819, p. 651.
Phoca vitulina	Specimens of collection of Siebold, British Museum.		Bellingham, 1844, p. 169; Baird, 1853, p. 18.
Phoca vitulina	Öresund	Kinckowstrom	Jägerskiöld, 1894, p. 457.
Phoca vitulina	Specimens from Vienna Museum.		Stiles and Hassall, 1899, p. 157.
Stenorhynchus leptonyx	Antarctic, South Georgia Land.	Hamburg Museum	Linstow, 1893, p. 89.
Seal, gen. ?, sp. ?	Faroe	Müller	Krabbe, 1878, p. 45.
Seal, gen. ?, sp. ?	Iceland	Steincke	Do.
Seal, gen. ?, sp. ?	Greenland	Jörgensen	Do.

SUMMARY.—This worm, found in the stomach of the sea lion of Bering Sea, is identical with the form described by Rudolphi in 1802, as defined by Schneider in 1866. It is also found in Iceland, Greenland, and elsewhere. In detail its history is as follows:

HISTORICAL REVIEW.—Rudolphi (1802, pp. 14, 15) was evidently the first to describe *Ascaris osculata;* his article is not at our disposal at present. The following year Zeder (1803, p. 105) placed Rudolphi's species in the genus *Fusaria*, giving the following short diagnosis, taken from Rudolphi:

Osculata Fusar. capitis corpore angustioris valvulis orbicularibus marginatis, canda brevissima acuta.

Habitat in ventriculo phocae vitulinae.

Rudolphi (1809, p. 135, 136) next describes the worm as follows:

7. ASCARIS OSCULATA. R.

Ascaris: *Capitis valvulis orbicularibus marginatis; corpore aequali, linea laterali non exstante, cauda acuta.*

Hab.: Inter ventriculi *Phocae vitulinae* plicas specimina complura Novembri offendi.

Descr. Vermes quinque ad decem lineas longi, tenues, albi aut flavescentes.

Caput corpore parum angustius, valvulis tribus orbicularibus magnis, distincto marginatis, et sub vermis motu formam mutantibus, ut cum Taeniarum osculis suctoriis (unde nomen triviale desumsi) quodammodo conveniant. Corpus utrinque subattenuatum, antrosum fere tenuius. Cauda brevissima acuta. Genitalia feminae ut in reliquis; maris duplo minoris spicula exserta non vidi. Tubus cibarius pro more.

Obs. 1. Vermes phocae ante biduum occisae vividissimi, vasculo aquae repleto et furno (mane et modice tantum calefacto) imposito commissi, nycthemeron, 36 horas et ultra vixere.

Obs. 2. Cl. Hellwig specimen a cl. quondam Wewetzer, Med. Cand. in Phoca vitulina, nescio quo loco, repertum mecum communicavit, meis duplo majus, crassiusculum, cujus pars postica anteriore omnino crassior est, ceterum vero, quantum in verme mortuo conspicere licet, huc pertinere videtur, ut Ascaris nostra forsan ad sectionem quintam amandanda sit.

Later (1819, pp. 39, and 651–652) he mentions that it was at Greifswald that he found his specimens; that Bakker found specimens which were larger than his, and

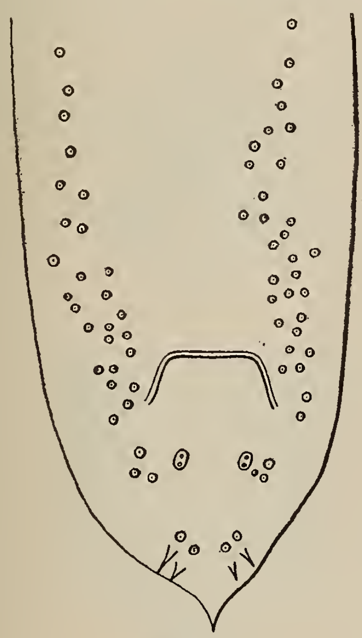

Fig. 76.

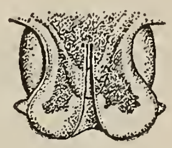

Fig. 77.

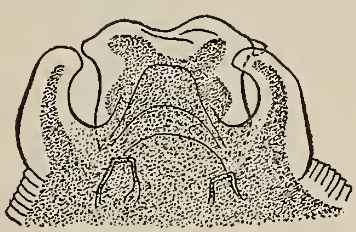

Fig. 78.

that Bremser found specimens in *Phoca groenlandica*, of which the male was 15, the female 18 to 24 lines long. In describing the worms, Rudolphi adds:

Caput valvulis majusculis marginatis, suborbicularibus, a quibus nomen desumsi, instructum. Corpus posteriora versus minus attenuatum; cauda crassa, maris inflexa, apice brevissimo acuto, ante quem spicula duo longissima, incurva; cauda feminae recta obtusa cum brevissimo et tenui apice acuto. Membrana lateralis in apice colli latior obtusiuscula, tum tenuis decurrens, brevi tenuissima et fere invisibilis.

Specimina mea pusilla comparavi, et horum quoque reperi, quibus pars posterior crassior est, reliqua conveniunt.

Bellingham (1844, p. 169) mentions the presence of *A. osculata* in the oesophagus and posterior nares of *Phoca vitulina*, but makes no further observations on the species.

Dujardin (1845, p. 164) takes his description from Rudolphi (1809 and 1819) and does not appear to have seen this form. Diesing (1851, p. 169) adds nothing in the way of anatomical characters, but gives several additional hosts, namely, *Phoca pantherina* [=?], *P. gryphus* (=*Halichoerus grypus*), *P. hispida* (=*P. foetida*), *P. barbata* (=*Erignathus barbatus*), and *P. monachus* (=*Monachus albiventer*).

Baird (1853, p. 18) cites *A. osculata* in the collection of the British Museum, the specimens coming from the stomach of *Phoca vitulina* (collection of Siebold) and of *P. barbata* (=*Erignathus barbatus*), collected by Leach at Baffins Bay.

Schneider (1866, p. 44) appears to be the first to clearly define this worm and to figure it (see figs. 76 and 77); his diagnosis reads:

C. Lippen ohne Zahnleiste mit Aurikeln und Zwischenlippen.

14. ASCARIS OSCULATA. R.

♀ 50^{mm}. ♂ 40^{mm}.

Eckzahn klein und stumpf, hinterer Rand der Aurikeln beginnt mit einem convexen Bogen. Rinne tief. An der Basis der Lippen und Zwischenlippen unter der Haut läuft rings herum ein car-

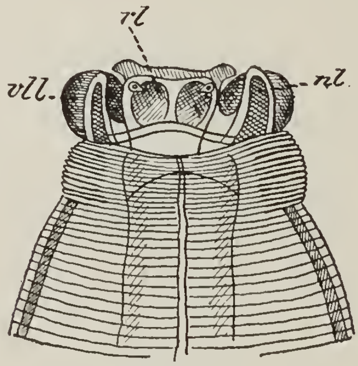

Fig. 79.

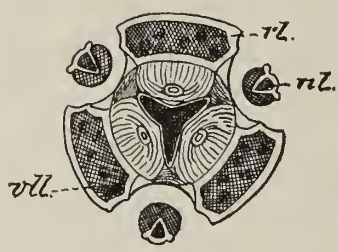

Fig. 80.

Fig. 81.

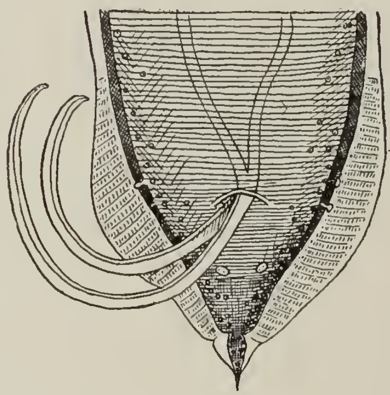
Fig. 82.

minrother Pigmentstreif. Schwanz des ♂ 8 Papillen hinter dem After, 1 und 2 mit kegelförmiger Pulpa, 7 und 8 bilden eine Doppelpapille, dann folgen vor dem After 20 und mehr Papillen unregelmässig zu 2, 3, und 4, und zuletzt eine Reihe Papillen. Im Ganzen 70 gezählt.

Phoca groenlandica. Darm.

Bastain (1866) in his extensive discussion of the anatomy of nematodes refers a number of times to a worm determined as *A. osculata.* One of his figures of the anterior extremity shows three lips, but no intermediate lips; he states that the intestinal caecum is present, but the oesophageal caecum absent. It is not at all improbable that Bastain had some other form, possibly *A. decipiens*, as suggested by von Linstow, rather than *A. osculata.*

Krabbe (1878, p. 45) mentions the worm from various hosts. It was found ten times in *Phoca groenlandica*, in Greenland, by Vahl, Mørch, Olrik, and Pfaff; in

Iceland, by Hallas; twice in *Phoca barbata* (= *Erignathus barbatus*), by Olrik, in Greenland; three times in *Halichoerus grypus*, locality not given; once in *Cystophora cristata*, by Olrik, in Greenland; twice in *Trichecus rosmarus* (= *Odobenus rosmarus*), by Olrik, in Greenland, and five times in undetermined seals, on Faroe, by Müller; Iceland, by Steinche, and Greenland, by Jörgensen and Müller. As many as 200 to 300 were occasionally found in a single seal, the proportion of males to females being about 2:3.

While Schneider gives the measurements of the male as 40^{mm}, of the female 50^{mm}, Krabbe found the males attaining 60^{mm}, the females 80^{mm} in length. He was unable to observe the carmine pigment ring mentioned by Schneider.

Cobbold (1879, pp. 313, 314), states that *Ascaris osculata* seems to be present in full-grown seals of every kind. In 1862–1864 he conducted a series of experiments with the eggs of this worm, rearing embryos both in salt and fresh water, but the feeding of the young worms to various animals led to no result. He watched the

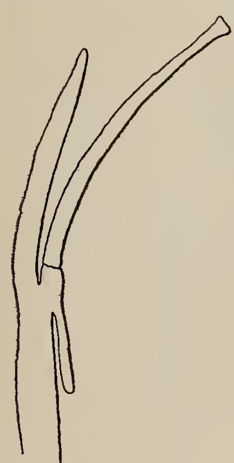

Fig. 83.

Fig. 84.

Fig. 85.

growth of the embryos until they had acquired well-marked digestive organs and a length of one twenty-fifth of an inch, their size when emerging from the egg shell in the water having been about one one-hundred-and-fiftieth of an inch only. His figure of the female shows a characteristic prominent transverse ridge at the position of the vulva, about on the border of the first and second anterior thirds of the body.

Von Linstow (1880, pp. 44, 45) records the same species from the stomach of *Halichoerus grypus* (Zool. Mus. Univ., of Kiel, No. 9). His observations on the dorsal lip differ somewhat from Krabbe's, as he found the margin provided with teeth; the rounded lateral projections belong to an inner layer and lie in the same plane with the outer surface.

Von Marenzeller's (1882–83, p. 18) article is not at our disposal.

Nehring (1884, p. 59) states that he found numerous specimens in a *Halichoerus* shot at Goehren (Rügen) in 1882; he also found an *Ascaris* in 1884, in *Halichoerus grypus;* the parasites were not determined definitely, but Karsch stated to him that they were closely related to *A. osculata*.

Von Linstow (1892, p. 89) records *Ascaris osculata* from stomach of *Stenorhynchus leptonyx*, in Süd-Georgien, Antarctic (Hamburg Museum, No. 15326). The cuticula is regularly striated at distances of 7 to 8 μ; the cervical papillae are situated 0.85^{mm} from the anterior end; the lips are large and without any dentigerous ridge; the dorsal lip measures externally 0.091^{mm} long by 0.12^{mm} broad, and on its inner anterior surface it is prolonged laterally on each side in an angular projection. Immediately back of the lips the cuticle possesses deep folds. In both sexes the tail is conically pointed. The oesophagus is 1/8.4 as long as the body. Oesophageal and intestinal caeca are present. The males attained 40^{mm} in length by 1.5^{mm} in diameter; spicules equal and

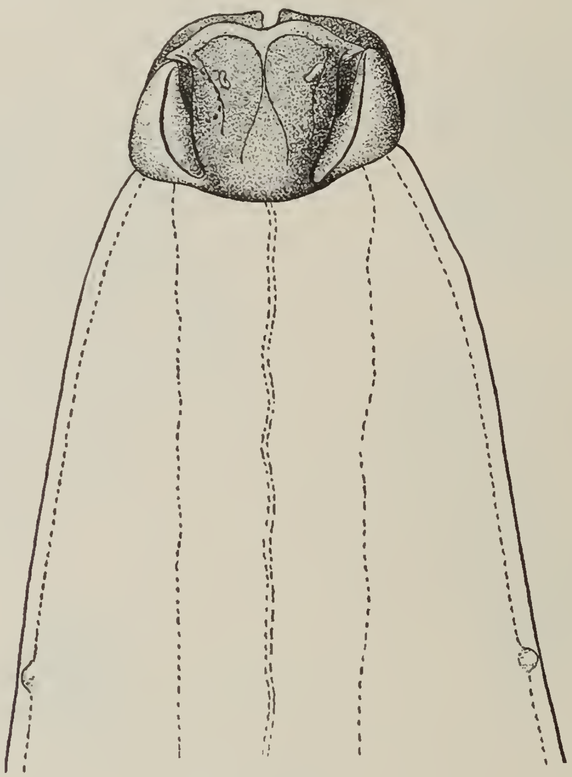

Fig. 86.

very long (3.7^{mm}); tail 1/91 as long as body; caudal bursa present; about 45 pairs of caudal papillae are present, of which about 15 pairs are figured as postanal, one pair of large double papillae being present about halfway between the cloca and tip of the tail. The females attain 54^{mm} in length by 1.58^{mm} in diameter; the vagina is situated about one-third the length from the head; eggs measure 83 by 67 μ.

Jägerskiöld's (1893) article is not at our disposal at present. In his second paper (1894, pp. 457–463) Jägerskiöld discusses specimens collected by Klinckowström from the nasal cavity of *Phoca vitulina* at Öresund. He finds the vulva situated one-third the length of the body from the head, and describes the oesophageal and intestinal caeca as present (fig. 83); his other statements are chiefly regarding the microscopic anatomy and histology of the intestinal tract and glands; the excretory pore is found closely back of the ventral intermediate lip.

Von Linstow (1895, pp. 528–531) contributes an histological discussion of some portions of the worm; he believes that Bastain's (1866) specimens were probably *A. decipiens* rather than *A. osculata*.

Stossich (1896, pp. 37, 38) gives a short diagnosis of the worm, including *Ascaris bulbosa* Cobb (see p. 111) as synonym.

In Leidy's collection we find a bottle (No. 259=U.S.N.M., No. 5051) containing nematodes with the label "*Ascaris osculata, Macrorhinus angustirostris*, Dr. Chapman," which we cited in a former publication (Stiles & Hassall, 1894, p. 340.) We have as

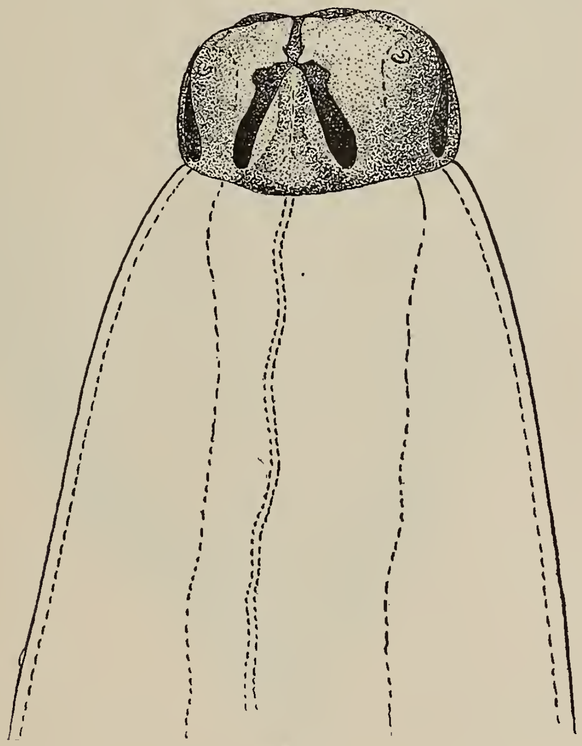

Fig. 87.

yet been unable to find where Leidy published this determination, or whether he published it at all. A reexamination of the parasite has resulted in changing the determination to *Ascaris decipiens* (see p. 112).

Since finishing this report we have received several bottles of parasites from the Vienna Museum, which we have examined with the following results: One bottle labeled "*Ascaris osculata, Phoca barbata*" contained both *A. osculata* (B. A. I., No. 2831) and *A. decipiens* (B. A. I., No. 2841). One bottle with label "*Ascaris osculata, Phoca vitulina*" we have redetermined as *A. decipiens* (B. A. I., No. 2832). A bottle (B. A. I., No. 2833) labeled "*Ascaris osculata, Leptonyx monachus*" is correctly determined. A bottle (B. A. I., No. 2834) labeled "*Ascaris osculata, Phoca pantherina*" contains very poorly preserved specimens, but the determination is evidently correct. A bottle labeled "*Ascaris osculata, Phoca groenlandica*" contains both *A. osculata* (B. A. I., No. 2835) and *A. decipiens* (B. A. I., No. 2843).

SPECIMENS FROM EUMETOPIAS STELLERI.—In the material brought to Washington by the seal commission are three bottles of worms taken from the stomachs of three specimens of *Eumetopias Stelleri.* The worms were collected by Mr. Lucas in August, 1896, on St. George Island, Bering Sea, and two of the lots represent very

Fig. 88.

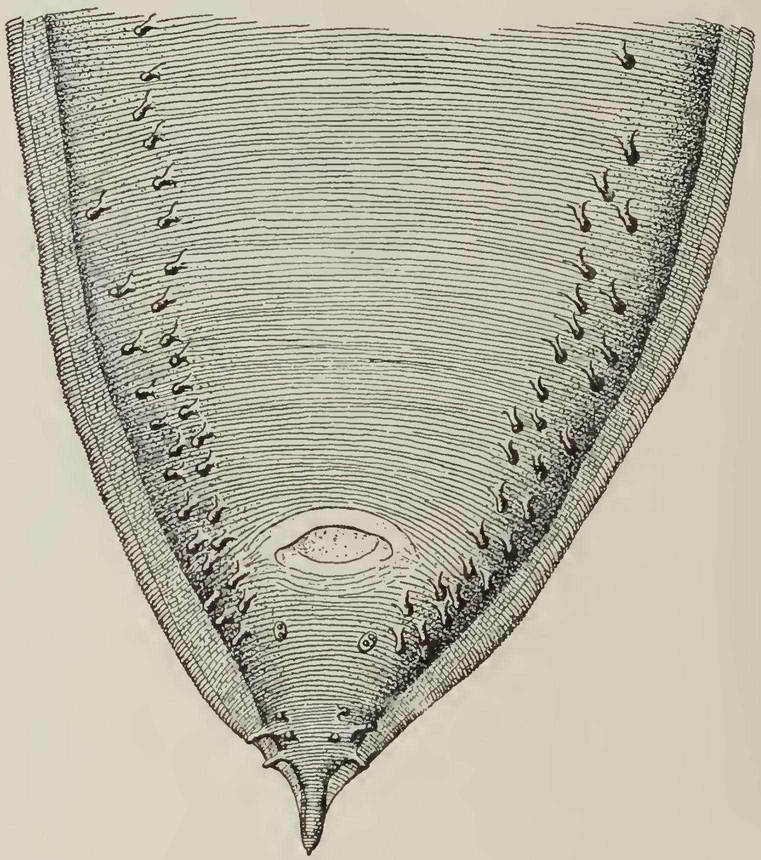

Fig. 89.

heavy infections. One lot (tag of seal commission 82) contained both *Ascaris decipiens* (U.S.N.M., No. 2822) and *A. osculata* (U.S.N.M., No. 2767), while the other two lots (tag of seal commission 84=U.S.N.M., No. 2764, and tag 85=U.S.N.M., No. 2766) apparently contained only *Ascaris osculata.*

Our determination of these worms (figs. 84, 85) as *Ascaris osculata* is based upon the following details:

Intermediate lips present (figs. 86, 87); lips with lateral projections; oesophageal and intestinal caeca present; cuticular bands without finer striae; cuticular folds back of lips (fig. 88).

Male: 9 to 10 pairs of postanal papillae (fig. 89), of which 1 to 4 are near the tip; 1 pair of double papillae and 3 to 4 pairs of single papillae nearer the cloaca; spicules very long, 6 to 8^{mm}.

Female: Prominent vulvular ridge about on border between first and second anterior thirds of body.

As the species is quite well studied from a systematic standpoint, we will not give a detailed discussion of the worm found in Bering Sea, but will confine ourselves to the following statements:

Von Linstow mentions deep cuticular folds immediately back of the lips. These folds, which are very prominent in our specimens, are due to the arrangement of the cuticular bands (fig. 88). For a distance of about 0.13^{mm} back of the lips the anterior border of each band extends for some distance over the posterior border of the band immediately in front of it, while on the rest of the body the posterior border of each band extends only very slightly over the anterior border of the band immediately distal to it. The portion of the body to which the lips are attached is thus differentiated into a peculiar and quite characteristic manner. On the body the cuticular bands are about 8 μ broad, but the finer intermediate striation is lacking. The cervical papillae are found about 0.9^{mm} from the head.

We find considerable variation in the arrangement of the caudal papillae in the males, but the arrangement of four pairs of papillae near the tip of the tail and a pair of double papillae between these and the cloaca appear quite constant.

The prominent transverse vulvular ridge figured by Cobbold is quite characteristic. We also find that the eggs (68 to 72 μ) segment to the morula stage in the uterus.

10. ASCARIS LOBULATA Schneider, 1866.

(Figs. 90–92.)

? 1819, *Ascaris delphini* RUDOLPHI, see page 162.

1866, *Ascaris lobulata* SCHNEIDER, Monographie der Nematoden, p. 44, one fig. ♂ tail.—KRABBE, 1878, Oversigt K. Danske Videnskab. Selskabs Forhand, 1, p. 47, pl. I, fig. 2.—JÄGERSKIÖLD, 1894, Zool. Jahrbüch, VII, p. 467, pl. XXVIII, fig. 37.—STOSSICH, 1896, Boll. Soc. adriatica Sci. Nat. Trieste, XVII, p. 43.

DIAGNOSIS.—Intermediate lips present; lateral cervical alae ?; lips similar to those of *A. osculata*, but stronger; the anterior lobes of the pulpa extend into the lateral projections; cuticular striation? Oesophagus composed of two portions; posterior portion unusually short in proportion to anterior portion; oesophageal and intestinal caeca present. Excretory organ similar to that of *A. osculata*.

Male: 40^{mm} long; tail with 12 pairs of postanal papillae, of which 1 pair is conical and lateral, but varying in position; 1, 2, 3 in a row near the tip; 4 to 12 irregularly arranged in groups of two and three; praeanal papillae in a single row; spicules?

Female: 50^{mm} long; vagina about one-fourth the length of the body from the head; eggs?

Habitat: Intestinal tract of marine mammals.

Host.	Locality.	Collector.	Authority.
Platanista gangetica			Schneider, 1866, p. 44.
Platanista gangetica	Houghly River, near Calcutta	Reinhardt	Krabbe, 1878, p. 47.
Platanista gangetica	Specimens from Kopenhagen Museum		Jägerskiöld, 1894, p. 467.

HISTORICAL REVIEW.—For the history of *Ascaris delphini* see page 162. Schneider (1866, p. 44) originally described *Ascaris lobulata* with the following diagnosis:

C. Lippen ohne Zahnleiste mit Aurikeln und Zwischenlippen.

15. Ascaris lobulata n. sp. ♂ und ♀ 40mm.

Rinne tief. Die Spitze des Eckzahns bildet einen rechten Winkel. Die Loben reichen in die Auriculae. Vulva? Schwanz des ♂ leicht gekrümmt, auf der Bauchseite glatt. 12 Papillen hinter dem After, eine an unregelmässiger Stelle mit conisch verlängerter Pulpa seitlich. 1, 2, 3 hinter einander nahe an der Spitze, 4–12 unregelmässig zu 2 und 3 neben einander, vor dem After eine Reihe Papillen.

Delphinus gangeticus. Crassum.

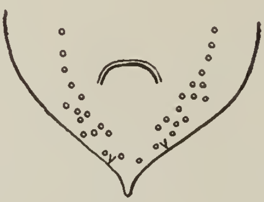

Fig. 90.

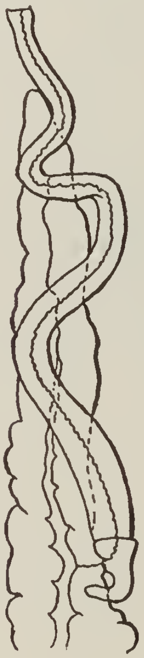

Fig. 91.

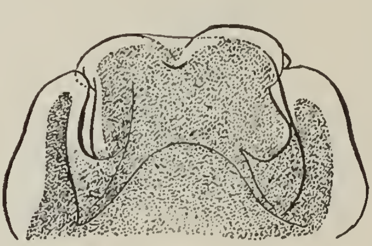

Fig. 92.

Krabbe (1878, p. 47) examined specimens deposited in the museum of the University of Kopenhagen; they were collected on the Galathea expedition of Professor Reinhardt from the buccal cavity of dolphins of the Ganges in Hooghly River near Calcutta. The lips (fig. 91) resemble those of *Ascaris osculata*, but are more strongly built.

Jägerskiöld (1894, p. 461) examined specimens from the buccal of *Platanista gangetica*, which he received from Levinsen, of the Kopenhagen Zoological Museum. These may possibly have been the same specimens which Krabbe studied, but Jägerskiöld does not state so. He found the vulva 6mm from the head in a female 25mm long. The excretory organ agrees with the same organ in *A. spiculigera* and *A. osculata;* the posterior division of the oesophagus (fig. 92) is unusually short, and possesses a caecum; the intestinal caecum is also present.

Stossich (1896, p. 43) takes his diagnosis from the other authors and evidently did not examine specimens.

III. Data concerning the intermediate lips are wanting.
   a. Spicules unequal.

11. ASCARIS DUSSUMIERII Beneden, 1870. Sp. inq.

1845, "*Ascaris simplex* RUDOLPHI, 1809" misdetermined, DUJARDIN, 1845, Hist. Nat. Helminthes, pp. 220–221.

?1860, *Conocephalus typicus* DIESING, see p. 127.

1870, *Ascaris Dussumierii* BENEDEN, Bull. Acad. R. Belgique, 2 ser., XXIX, No. 4, p. 362–363. Dujardin's specimens renamed.

DIAGNOSIS.—Intermediate lips?; lateral cervical alae absent; head obtuse, 0.4^{mm} broad; lips small, body whitish, quite thick, slightly more attenuated toward the head than toward the tail. Cuticle with cuticular bands 20 to 30 μ broad, giving the margin of the worm a serrate appearance. First portion of the oesophagus 5 to 5.5^{mm} long, 0.5^{mm} broad; followed by a second portion, which is sigmoid, 1.5^{mm} long 0.4^{mm} broad; intestinal and oesophageal caeca ?

Male: 79^{mm} long by 2.2^{mm} in diameter; tail curled, with lateral alae and 8 to 10 (pairs?) papillae; spicules unequal, one 27^{mm} (2.7^{mm}?) the other 15^{mm} (1.5^{mm}?) long.

Female: 70 to 100^{mm} long by 2 to 2.5^{mm} in diameter; tail very short; vulva in anterior half of body 25 to 40^{mm} from anterior end. Eggs globular, smooth, 41 to 43 μ. Anus 0.2^{mm} from tip of tail.

Habitat: Intestine of marine mammals.

Host.	Locality.	Collector.	Authority.
Dolphin (gen. et sp?)	West of Maldive Islands	Dussumier	Dujardin, 1845, p. 221.

SUMMARY.—Dujardin (1845) determined some worms, collected by Dussumier, as *Ascaris simplex;* as the form differs essentially from *A. simplex* of other authors van Beneden (1870) proposed to make it a distinct species, *A. Dussumierii;* von Linstow (1888) thinks the worm may belong to some other genus than *Ascaris;* Stossich (1896) considers it identical with *A. simplex.* The question can not be definitely decided without a reexamination of the type specimens, but judging from the description we are suspicious that Dujardin's form is identical with *Ascaris typica.* In detail the history of the species is as follows:

HISTORICAL REVIEW.—Dujardin (1845, pp. 220, 221) proposed the subgenus *Anisakis* in the genus *Ascaris* for forms in which the spicules are unequal. He cites as members of this subgenus *A. distans* Rudolphi, which he had evidently not examined, and the supposed "*A. simplex* Rudolphi" (=*A. Dussumierii*) which he had studied. We designate this latter form as type of the proposed subgenus. Dujardin's diagnosis reads as follows:

ANISAKIS.

III^{e} Sous-genre.

Mâle ayant deux spicules inégaux.

77 *Ascaride des Dauphins.* *Ascaris simplex*—RUDOLPHI. Entoz., II, 1, p. 170, et Synops, p. 60 [49], No. 53.

Corps blanchâtre, assez épais, trente-six à quarante fois aussi long que large, un peu plus aminci en avant; tête obtuse, large de 0^{mm}, 4 à trois lobes très-petits; sans aucune trace d'ailes ou membranes latérales; oesophage long de 5 à 5^{mm}, 5, un peu renflé en massue et large de 0^{mm}, 5, suivi d'un *ventricule mince flexueux,* long de 1^{mm}, 5, large de 0^{mm}, 4; intestin épais, large de 1^{mm}; queue très-courte, obtuse; tégument à stries transverses, très-prononcées, distantes de 0^{mm}, 02 à 0^{mm}, 03, et comme denté en scie latéralement.

Mâle long de 79^{mm}, large de 2^{mm}, 2; partie postérieure enroulée et munie de deux ailes ou membranes latérales, étroites, soutenues par huit à dix papilles à la face ventrale; deux spicules *inégaux*, un peu arqués, larges de 0^{mm}, 04, l'un long de 27^{mm}, l'autre long de 15^{mm}.

Femelle longue de 70 à 100^{mm}, large de 2^{mm}, à 2^{mm}, 5, à queue conoïde très-courte; anus à 0^{mm}, 2 de l'extrémité; vulve située en avant du milieu (à 25 ou 40^{mm} de la tête); utérus très-ample, long de 28 à 30^{mm}, dirigé en arrière, commençant par une partie presque filiforme (vagin), longue de 5 à 8^{mm}, puis devenant cylindrique, large de 1^{mm}, 8, dans une longueur de 10 à 17^{mm}, et se divisant enfin en deux branches parallèles contiguës, larges de 1^{mm}, longues de 7 à 10^{mm}, qui se retrécissent à la fois pour se continuer chacune avec l'oviducte et l'ovaire filiforme correspondant, dont les replis nombreux occupent toute la partie postérieure du corps, à partir de la vulve; œufs globuleux, lisses, larges de 0^{mm}, 041 à 0^{mm}, 043.

Je décris ainsi des helminthes assez nombreux de la collection du Muséum de Paris, étiquetés comme trouvés par M. Dussumier dans un dauphin, no 5, à l'ouest des îles Maldives, en 1830, et je ne doute pas qu'ils ne soient identiques avec ceux que Rudolphi a décrits sous ce même nom comme trouvés dans le premier estomac d'un marsouin (*Delphinus phocæna*).

Van Beneden (1870, pp. 362, 363) did not consider Dujardin's determination as correct, and proposed to call the worms *A. Dussumierii.*

No one appears to have restudied the species or to have found it again, but von Linstow (1888, p. 3) agrees with van Beneden that the determination by Dujardin is incorrect, and he even doubts whether the worm belongs to the genus *Ascaris*. Stossich (1894, p. 17), on the other hand, accepts Dujardin's determination as correct.

In the absence of specimens it is impossible to give a definite opinion upon the form, but we incline to the view that *A. Dussumierii* may perhaps be identical with *A. typica* and that Dujardin made an error in his decimals in the length of the spicules.

b. Unidentifiable forms.

12. ASCARIS DELPHINI Rudolphi, 1819.

1801, "Ascarides" of Lebeck, Neue Schriften Naturforsch. Freunde Berlin, III, p. 281.

1819, *Ascaris delphini* Rudolphi, Entozoorum synopsis, pp. 54, 296. Refers to Lebec's specimens.—Dujardin, 1845, Hist. Nat. Helminthes, p. 221.—van Beneden, 1870, Bull. Acad. Roy. Belgique, 2 ser., XXIX, p. 359.

1851, *Ascaris delphini gangetici* Diesing as synonym sub *A. simplex*, Systema helminthum, II, p. 155.=*Ascaris delphini* Rudolphi, 1819.

? 1866, *Ascaris lobulata* Schneider, see p. 159.

1878, "*Ascaris simplex* Rud.," von Linstow, Compendium der Helminthologie, p. 60, as parasite of *Platanista gangetica*.

Diagnosis.—Over an inch long.

Habitat: Mouth and stomach of dolphin of the Ganges.

Host.	Locality.	Collector.	Authority.
Platanista gangetica	Near Calcutta	Lebeck	Lebeck, 1801, p. 281.

Lebeck (1801, p. 281) found some ascarides in a specimen of "*Delphinus gangeticus*" (=*Platanista gangetica*) taken in November, 1797, near Calcutta. Regarding the parasites he simply states: "Sowohl in seinem Munde als Magen, waren viele lebendige und über einen Zoll lange Ascarides—L. wie auch im letztern Nellu-Körner."

Rudolphi (1819, pp. 54–296) named these worms *Ascaris delphini*, but did not study them; he suspects that they are identical with *Ascaris simplex*. Dujardin (1845, p. 221) simply mentions the worms, while Diesing (1851, p. 155) refers them to *A. simplex* under the trinomial synonym "*Ascaris Delphini gangetici*," while van

Beneden (1870, p. 359) again reverts to "*Ascaris delphini*," citing Lebeck's reference as to the occurrence of parasites in the dolphin of the Ganges *Platanista gangetica* (*Delphinus gangeticus*). Von Linstow (1878, p. 60) cites *Ascaris simplex* as parasite of *Platanista gengetica*, but undoubtedly he refers to the supposed synonym *A. delphini*. Stossich (1896, p. 17) also makes *A. delphini* a synonym of *A. simplex* and cites *Platanista* as host.

It is impossible to identify this worm, but Schneider has described *A. lobulata* from the same host (p. 159), and the two forms may possibly be identical.

13. ASCARIS RYTINAE Diesing, 1851.

1751, "Lumbrici candidi" of STELLER, Nov. Comment. Acad. Sci. Imp. Petropol., II, ad Ann. 1749, p. 311.

1846, "Ascarides" of BRANDT, Bull. Physico-Math. Acad. Imp. Sci. St. Petersbourg, V, p. 192. Refers to Steller's specimens.

1851, *Ascaris rytinae* DIESING, Systema helminthum, II, p. 190. Species inquirenda; refers to Steller and Brandt.

1851, *Ascaris rhytinae Stelleri* in synonymy, DIESING, Systema helminthum, II, p. 190.

1878, "*Ascaris rhytinae* BRANDT," in VON LINSTOW, Compendium der Helminthologie, p. 59.—STOSSICH, 1896, Boll. Soc. adriatica Sci. nat. Trieste, XVII, p. 69.

DIAGNOSIS.—Length 6 inches.

Habitat: Stomach and duodenum of the Northern extinct sea cow.

Host.	Locality.	Collector.	Authority.
Hydrodamalis gigas	Bering Sea	Steller	Steller, 1751, p. 311.

SUMMARY.—Our entire knowledge of this worm is based upon the statement by Steller (1751) that specimens were present in the stomach and duodenum of the now extinct sea cow. Brandt (1846) thought they must be ascarides since Rüppel and Owen found ascarides in the stomach of the dugong. Diesing named the worm more than a century after Steller found it. The parasite is unidentifiable. In detail the history of the worm is as follows:

HISTORICAL REVIEW.—Steller (1751, p. 311) in his "De bestiis marinis" found some worms of the stomach and duodenum of a sea cow on July 12, 1742, taken in the Bering Sea. He refers to the parasites in the following passage:

> Interior ventriculi tunica a lumbricis candidis ½ pedem longis, quibus totus ventriculus, pylorum et duodenum scatebat, perforata erat, et lumbrici in glandulae canum, vsque penetrauerant, glandula discissa copiosum, succum sundebat. Non licuit posthac plures ventriculos examinare ob id, quod necessario auxilio carebam, nec cum paucis animal semel innenire iacens in dorsum vertere possem, propterea dubito, an haec glandula res constans, vet potius morbidum quid fuerit.

Brandt (1846, p. 190–192) in referring to the ectoparasites mentioned by Steller (1751, pp. 298, 324, 330), and for which he (Brandt) proposed the genus *Sirenocyamus* and the specific name *S. Rhytinae*, also cites the worms found by Steller; he believed them to be "*Ascarides*," but did not name or describe them. He also refers to the worms found by Rüppel and Owen, but does not name or describe them. Diesing (1851, p. 190) cites "*Ascaris Rhytinae* Brandt" among the *species inquirendae;* the term is practically a *nomen nudum*, the only description being "Longit. ½″," and refers to the worms found by Steller in July, 1742; von Linstow (1878, p. 59) mentions the parasites as "*Ascaris rhytinae* Brandt." Stossich (1896, p. 69) also refers to the same worms as a *species inquirenda*, giving the length as 160 mm.

As Steller's sea cow is now extinct it can never be demonstrated what species Steller found. The names *A. rytinae* and *A. rhytinae* may, therefore, be buried, and all time used in speculating as to the affinities of this worm with corresponding parasites in other hosts may be considered lost.

14. "ASCARIS CAPSULARIA."

Ascaris capsularia is a name applied to immature nematodes, supposed to be ascarides, and found in fish. Numerous supposed species have been separated under distinct specific names, generally taken from the names of the hosts, the generic names *Agamonema*, *Nematoideum*, or *Ascaris* being used by various authors. Personally, we must confess our inability to distinguish at present these numerous forms from each other or to determine from the published descriptions of the worms which forms should be considered synonyms, which forms should be looked upon as distinct, and which forms should be associated with this, that, or the other adult *Ascaris*. We do not deny that other authors are correct in their interpretations of these larval worms, but we would suggest that a thorough study of the exact food habits of fish-eating mammals in connection with this subject would aid in solving the problem of the life history of many of these parasites.

III.—Family STRONGYLIDAE.

DIAGNOSIS.—Nematoda with body elongate, cylindrical, rarely filiform. Mouth is probably always provided with six papillae, of which the four submedian are generally salient in form of nodules or conical points. In some cases the mouth is in the axis of the body; in others, turned dorsally or ventrally, and occasionally provided with a chitinous armature. Oesophagus more or less swollen in posterior portion, but without forming a distinct oesophageal bulb. Males provided with a caudal bursa, open or closed, entire or divided, with one or two spicules. Females with one or two ovaries; vulva anterior or posterior to middle, in some cases near the anus. Eggs deposited during segmentation, in some cases containing embryo.

Type: *Strongylus*, O. F. Müller.

Subfamily SCLEROSTOMINAE.

DIAGNOSIS.—Strongylidae; meromyaria; mouth with more or less complete chitinous armature. Male with two equal spicules; caudal bursa with rays, the postero-median and postero-external being united in a common base. Female with two ovaries, except in *Ollulanus*.

Type: *Sclerostoma*, Blainville, 1828.

Genus UNCINARIA Frölich, 1789.

1789, *Uncinaria* FRÖLICH, Der Naturforscher, XXIV, pp. 137–139. Type, *Uncinaria vulpis* Frölich, 1789.

1843, *Agchylostoma* DUBINI, Annal. univers. di medic. Milano, CVI, April, pp. 5–13. Type, *Agchylostoma duodenale* Dubini, 1843.

1845, *Ancylostoma* CREPLIN, Archiv. f. Naturg., 11 Jhg., I, p. 325. For *Agchylostoma* Dubini, 1843.

1845, *Dochmius* DUJARDIN, Histoire naturelle d. helminthes, pp. 267–275. Type, *Dochmius trigonocephalus* (Rudolphi, 1809) = *Uncinaria vulpis* Frölich, 1789.

(1846), *Anchylostoma* DELLE CHIAJE Rendicon. dell Accad. delle Sci. Napoli, V, p. 339.

1851, *Anchylostomum* DIESING, Systema helminthum, II, p. 321–322. For *Agchylostoma* Dubini, 1843.

1855, *Ancylostomum* KÜCHENMEISTER, Die in und auf d. Körper d. lebenden Menschen vorkommend. Parasiten, I, p. 297.

1861, *Monodontus* MOLIN [nec *Monodonta* Lamarck, 1799], Il Sottordine degli Acrofalli, pp. 11–43. Type, *M. semicircularis* Molin, 1861.

DIAGNOSIS.—Sclerostominae with anterior extremity curved dorsally; mouth round to oval, opening obliquely, limited by a transparent border and followed by a chitinous buccal capsule; the dorsal portion of the capsule is shorter than the ventral, and is supported by a conical structure the point of which sometimes extends into the cavity; ventral at the base of the buccal capsule are found two teeth; toward the inner free border the ventral wall bears on each side of the median line chitinous structures or teeth often recurved in shape of hooks; the inner dorsal wall may also bear teeth.

Type, *Uncinaria vulpis* Frölich, 1789.

This is an extremely important genus from a medical standpoint as it contains a parasite (*U. duodenalis*) which causes a serious disease in man, and two parasites (*U. vulpis* and *U. stenocephalus*) which cause serious trouble in young dogs.

Lucas found five specimens of worms of this genus in a 3 months old fur seal which had starved to death.

15. UNCINARIA sp.

(Figs. 93–96.)

DIAGNOSIS.—Body white. Buccal capsule apparently with a single pair of rather weak anterior ventral recurved teeth, and with posterior ventral chitinous lamellae.

Male: 6.5^{mm} long; caudal bursa very similar to that of *U. duodenalis*, spicules very slender, equal, 0.5^{mm} long.

Female: 12^{mm} long; tail acuminate; vulva slightly posterior to the middle of the body. Eggs elliptical 124 to 132 μ by 84 to 88 μ.

Habitat: Intestine of fur seal (*Callorhinus ursinus*) Bering Sea. Type: U.S.N.M., No. 2815.

Our material of this form does not permit a detailed study of the mouth, and on this account we hesitate to place the worm specifically. No other species of *Uncinaria* is known for marine mammals.

Fig. 93.

Fig. 94.

Fig 95.

The few specimens which Lucas collected certainly could have been of no importance in the economy of the host, but as *Uncinaria* is a blood sucker of the worst type, and as allied species produce serious troubles in man and dogs, analogy would imply that a heavy infection of the seal would produce similar troubles in that host. Analogy would also imply that the development of the parasite is direct, without intermediate host, and that a crowded condition of the rookeries would render an epizootic probable. Under these circumstances the worm might play an important rôle in the mortality of the seal pups, more especially if the latter were deprived of food by reason of the killing of their mothers by pelagic sealing.

SUPPLEMENTARY NOTE TO THE *UNCINARIA* OF THE FUR SEAL.

During the season of 1897 Lucas collected a number of specimens of *Uncinaria* from seals, and fully verified the prophecy made above. In connection with the study of the new material, the seal commission has requested us to prepare a monograph of the genus *Uncinaria*, discussing the subject from a medical as well as from a zoological standpoint. This monograph is now in course of preparation, but it is impossible to complete it in time for incorporation in this report, owing to the absence of one of our number from the country.

In compliance with request, we will finish the work later and submit it for publication as a supplement to this present article. We here add only the following very brief summary:

From our studies this far we are inclined to look upon the seal *Uncinaria* as a new species, but are not willing to commit ourselves until further comparison with

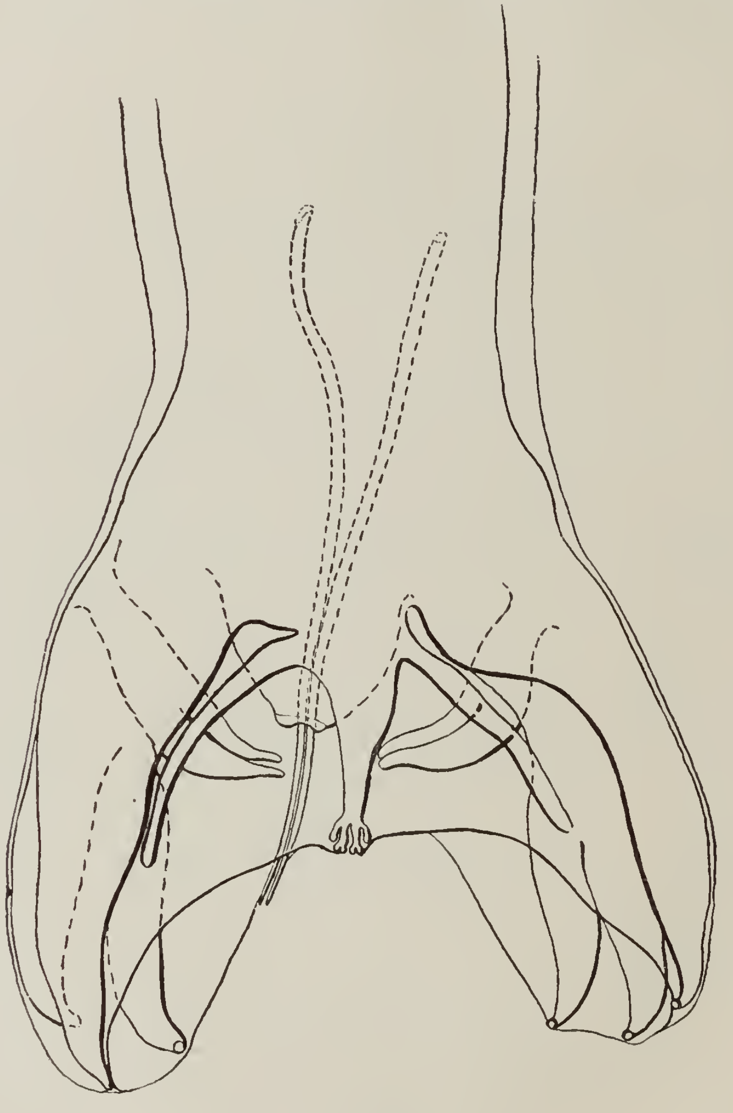

Fig. 96.

types of other species. Should our present view on this point be confirmed by our later study, we shall dedicate the species to its original collector, Mr. F. A. Lucas.

There is at present no reason to assume that the uncinariosis of the seal will differ essentially from the same disease in man, dogs, and cats. The injury to the host caused by worms of this genus results (1) from loss of blood and (2) from the inability to absorb nourishment, due to the diseased condition of the intestinal mucosa. Whether the parasites produce a specific poison which affects the host is still an open question; the intense inflammation of the small intestine can easily be explained by the wounds produced by the buccal armature.

We at present see no possible outlook either in the line of treatment or prevention, so far as this disease in the seals is concerned. In man thymol is a specific. It is difficult to disinfect against the eggs of the genus.

The symptoms and pathological lesions in various animals will be described in the later paper.[1]

Life History.—In the case of two species (*U. vulpis* and *U. duodenalis*) it has been experimentally demonstrated that these worms are autoecious parasites—that is, that they require no intermediate host for their development. The life cycle, which will be given more in detail later, is essentially as follows: The eggs laid by the parasitic females are in the first stages of segmentation; upon being passed with the faeces they develop into a rhabditiform embryo, the time required varying from twelve hours to twelve days or more, according to the conditions of the medium in which they are found, the temperature and the accessibility of air; the eggs find their most favorable conditions in the superficial portion of rather compact faecal matter. The embryos, which measure about 0.3 mm. in length, take nourishment, and after about two or three days undergo the first ecdysis, during which the pointed tail is partially lost. A second ecdysis begins about five to seven days after the escape from the egg, and the worm is soon ready to enter upon its parasitic life; it has lost its rhabditiform character and with its ability to take food during its free life. About five days after entering their host (by means of drinking water or contaminated food) the worms submit to a third ecdysis, during which a provisional buccal capsule is formed. A final (fourth) ecdysis then occurs, four to ten days later, which transforms the parasite into its definite form. About four to five weeks appear to be necessary for the development from the egg to the fully mature stage.

There is no reason to assume that the life history of the seal *Uncinaria* will be materially different from the life history of *U. vulpis* and *U. duodenalis*, but slight variations in the length of the different stages may occur because of the colder climate.

IV.—Family BOTHRIOCEPHALIDAE.

Diagnosis.—Cestoda; head provided with two groove or slit-like suckers; rostellum wanting; uterus with special pore; genital pores generally dorsal or ventral.

Type. *Bothriocephalus* Rudolphi, 1808.

Subfamily BOTHRIOCEPHALINAE.

Diagnosis.—Bothriocephalidae with distinct external segmentation; head with two elongate slit or groove-like suckers.

Type. *Bothriocephalus* Rudolphi, 1808.

Genus BOTHRIOCEPHALUS[1] Rudolphi, 1808, emend. R. Blanchard.

Diagnosis.—Bothriocephalinae with two suckers; penis, vulva, and uterus open ventro-median.

Type. *B. latus*[2] (Linnaeus, 1758) Bremser.

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[1] See pp. 77–82 of this volume, where the subject is discussed by Lucas.

[2] We fail to see how this generic name can be held for the group to which it is now assigned; certainly *B. latus* can not be taken as the type of *Bothriocephalus*. We refrain from attempting to straighten the synonymy, as a number of names are involved and a proper interpretation of the genera demands a most cautious revision of the entire family.

16. BOTHRIOCEPHALUS sp.

(Figs. 97–100.)

In the material collected by Lucas we find several specimens of a *Bothriocephalus* taken from the fur seal. Lucas states that tapeworms were found in about 40 per cent of the seals examined.

To properly place this parasite would require an extensive study of the family Bothriocephalidae, and for this we have not the necessary time at our disposal at

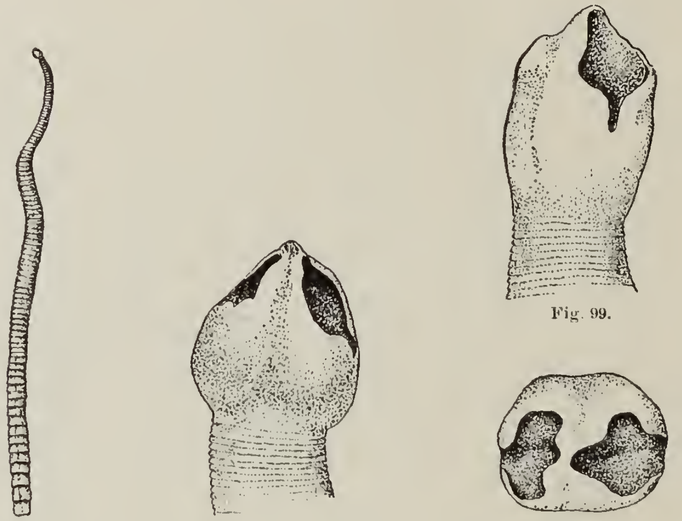

Fig. 97. Fig. 98. Fig. 99. Fig. 100.

present. We will simply remark that analogy would point to the fish as the source of infection by this worm.

The specimens collected by Lucas have been entered in the Helminthological collection of the United States National Museum as Nos. 2765, 2768, 2769, 2817.

V.—COMPENDIUM OF PARASITES, ARRANGED ACCORDING TO THEIR HOSTS.

This compendium covers only the genera *Ascaris*, *Uncinaria*, and *Bothriocephalus;* for all other parasites see von Linstow (1878 and 1889) and van Beneden (1870 and 1889.)

MARINE MAMMALS.

We have personally examined those forms marked with an asterisk (*) under the various hosts. We can not, of course, guarantee the original determinations of the hosts, but taking the determinations given on the labels or by other authors we have corrected the names to those now used in mammalogy. In all cases of doubt we have been guided by the advice of Dr. F. W. True, of the United States National Museum.

270. Balaenoptera rostrata.
Ascaris simplex.
271. Balaenoptera sibbaldii Gray.
Ascaris simplex.

265b. BELUGA LEUCAS see DELPHINAPTERUS LEUCAS.
CALLORHINUS URSINUS.
Ascaris decipiens.
Uncinaria sp.
Bothriocephalus sp.
271b. CLYMENIA see PRODELPHINUS.
197. CYSTOPHORA CRISTATA.
Ascaris decipiens.
Ascaris osculata.
Bothriocephalus anthocephalus.
Bothriocephalus elegans.
Krabbea variabilis (*Bothriocephalus variabilis*).
265b. DELPHINAPTERUS LEUCAS (Pallas).
Ascaris Kükenthalii.
Ascaris simplex.
263. DELPHINUS AMAZONICUS see INIA GEOFFROYI.
257. DELPHINUS DELPHIS Linnæus.
Ascaris typica.
256. DELPHINUS PHOCAENA see PHOCAENA PHOCAENA.
DELPHINUS sp.
DOLPHIN, genus? species? Maldive Islands.
Ascaris Dussumierii.
DOLPHIN, genus? species?
Ascaris typica.
DOLPHIN, genus? species?
Ascaris simplex.
254. DUGONG DUGON.
Ascaris halicoris.
198. ERIGNATHUS BARBATUS.
Ascaris decipiens.
Ascaris osculata.
Bothriocephalus anthocephalus.
Bothriocephalus cordatus.
Bothriocephalus hians.
Bothriocephalus lanceolatus.
Krabbea variabilis (*Bothriocephalus variabilis*).
EUMETOPIAS STELLERI.
Ascaris decipiens.
Ascaris osculata.
195. HALICHOERUS GRYPUS.
Ascaris decipiens.
Ascaris osculata.
254. HALICHORE CETACEA see DUGONG DUGON.
254. HALICHORE DUGONG see DUGONG DUGON.
255. HYDRODAMALIS GIGAS. Extinct.
Ascaris rytinae.
266. HYPEROODON ROSTRATUM (Chemnitz).
Ascaris simplex.
263. INIA BOLIVIENSIS, see INIA GEOFFROYI.
263. INIA GEOFFROYI (Desmarest).
Peritrachelius insignis, see p. 107.
LAGENORHYNCHUS ALBIROSTRIS, Gray.
Ascaris simplex.
196. LEPTONYX MONACHUS see 195a MONACHUS ALBIVENTER.
MACRORHINUS ANGUSTIROSTRIS.
Ascaris decipiens.
253. MANATUS EXUNGUIS see MANATUS INUNGUIS.

253. MANATUS INUNGUIS.
Heterocheilus tunicatus see p. 107.
MESOPLODON BIDENS (Sowerby).
Ascaris simplex.
MESOPLODON SOWERBIENSIS, see MESOPLODON BIDENS.
195a. MONACHUS ALBIVENTER.
**Ascaris osculata.*
Bothriocephalus hians.
265. MONODON MONOCEROS Linnæus.
Ascaris simplex.
194. ODOBENUS ROSMARUS.
Ascaris bicolor.
Ascaris decipiens.
Ascaris osculata.
Bothriocephalus cordatus.
203b. OTARIA JUBATA.
Ascaris osculata.
Ascaris patagonica.
Ascaris simplex.
200. PHOCA ANNELLATA see PHOCA FOETIDA.
198. PHOCA BARBATA see ERIGNATHUS BARBATUS.
197. PHOCA CRISTATA see CYSTOPHORA CRISTATA.
200. PHOCA FŒTIDA.
Ascaris decipiens.
Ascaris osculata.
Bothriocephalus hians.
Krabbea fasciata (*Bothriocephalus fasciatus*).
199. PHOCA GROENLANDICA.
**Ascaris decipiens.*
Ascaris osculata.
PHOCA GRYPHUS see HALICHOERUS GRYPHUS.
203a. PHOCA HISPIDA see PHOCA FOETIDA.
PHOCA LARGHA Pallas.
**Ascaris decipiens.*
PHOCA MONACHUS see MONACHUS ALBIVENTER.
201. PHOCA PANTHERINA=?
**Ascaris osculata.*
202. PHOCA VITULINA.
**Ascaris decipiens.*
Ascaris osculata.
Bothriocephalus elegans.
Bothriocephalus hians.
Bothriocephalus [or *Krabbea?*] *tetrapterus.*
Krabbia variabilis (*Bothriocephalus variabilis*).
256. PHOCAENA COMMUNIS see PHOCAENA PHOCAENA.
256. PHOCAENA PHOCAENA (Linnæus).
"*Ascaris capsularia*" in the stomach.
Ascaris simplex.
Bothriocephalus stemmacephalus.
264. PLATANISTA GANGETICA (Lebeck).
Ascaris delphini sp. inq.
Ascaris lobulata.
?*Ascaris simplex.*
PORPOISE, genus?, species?, Chiloe Islands.
Ascaris simplex.

271b. PRODELPHINUS sp.
Ascaris typica.
255. RHYTINA STELLERI see HYDRODAMALIS GIGAS.
203. SEAL, genus?, species?, Antarctic.
Ascaris similis.
Bothriocephalus [*or Krabbea?*] *antarcticus.*
SEALS, genera? species?, Faroe.
Ascaris decipiens.
Ascaris osculata.
SEALS, genera?, species?, Greenland.
Ascaris decipiens.
Ascaris osculata.
SEALS, genera?, species?, Iceland.
Ascaris decipiens.
Ascaris osculata.
STENORHYNCHUS LEPTONYX.
Ascaris osculata.
194. TRICHECHUS ROSMARUS see ODOBENUS ROSMARUS.

FISH.

For the parasites of fish, see von Linstow, 1878 and 1889, and Stossich, 1894.

GADUS MACROCEPHALUS.
**Ascaris decipiens.*
POLLACHIUS CHALCOGRAMMUS see THERAGRA CHALCOGRAMMA.
THERAGRA CHALCOGRAMMA.
**Ascaris decipiens.*

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DESCRIPTION OF FIGURES.

Fig. 1. Dorsal lip of *Ascaris decipiens*, showing the basal portion, the anterior bilobed projection and the dentigerous ridge. x 100. After Krabbe, 1878, pl. I, fig. 3.

Fig. 2. Tail of male specimen of *Ascaris decipiens*, ventral view, showing the cloaca, the six pairs of postanal papillae, and some of the praeanal papillae. x 100. After Krabbe, 1878, p. 46, fig. 1.

Fig. 3. Dissection of a male specimen of *Ascaris bulbosa* (=*A. decipiens*) from *Erignathus barbatus*: "*b.*, bulb of the oesophagus; *d.*, intestine; *de.*, ductus ejaculatorius; *eo.*, excretory organ; *h.*, testicles; *mb.*, bursal muscle; *sf.*, lateral line; *sl.*, vas deferens; *ss.*, vesicula seminalis ("Samenschlauch"). x 2. After Cobb, 1888, pl. V, fig. 29.

Fig. 4. Ventral view of tail of *Ascaris bulbosa* (=*A. decipiens*) from *Erignathus barbatus*, showing the cloaca and the caudal papillae. x 80. It will be noticed that postanal papillae 5 + 6 are double; otherwise this figure agrees essentially with Krabbe's figure given above (fig. 2). After Cobb, 1888, pl. V, fig. 30.

Figs. 5 and 6. Two variations of the anterior portion of the intestinal tract of *Ascaris decipiens* from *Halichoerus grypus*. Cf. figs. 16 and 17. Fig. 5 shows the two portions of the oesophagus, the oesophageal caecum, the proximal portion of the intestine and the intestinal caecum. Fig. 6 shows the two portions of the oesophagus without formation of an oesophageal caecum, and the proximal portion of the intestine with intestinal caecum. Zeiss 2/A2. After Jägerskiöld, 1894, pl. XXVIII, figs. 40 and 41.

Figs. 7 and 8. Two female specimens of *Ascaris decipiens* from the Alaskan fur seal and the hair seal. The transverse ridge on the ventral surface designates the position of the vulva. Natural size. Original.

Fig. 9. Male specimen of *Ascaris decipiens* from the Alaskan fur seal, showing the curved, flatted tail. Natural size. Original.

Fig. 10. Transverse section of the head of *Ascaris decipiens* from the Alaskan fur seal, showing three lips with their sense-papillae; the triangular lumen of the oesophagus, with apex extending between the ventral lips. The section is slightly diagonal. Zeiss 4/8, stage. Original.

Fig. 11. Apex view of the cuticle of the lips of *Ascaris decipiens* from the Alaskan fur seal. The excretory pore is seen between the ventral lips. Zeiss 4/8, stage. Original.

Fig. 12. Dorsal view of the anterior portion of *Ascaris decipiens* from the Alaskan fur seal, showing the dorsal and ventral lips and the cervical papillae. Zeiss 4/16, stage. Original.

Fig. 13. Ventral view of the anterior portion of *Ascaris decipiens* from the Alaskan fur seal, showing the ventral lips and cervical papillae. Zeiss 4/16, stage. Original.

Fig. 14. Apex view of the lips of *Ascaris decipiens* from the Alaskan fur seal, showing the anterior double-lobed projections; the excretory pore is seen between the ventral lips. Freehand drawing under a magnifying glass. Original.

Fig. 15. Transverse section through anterior extremity of the lips of *Ascaris decipiens* from the Alaskan fur seal, showing the double-lobed projections with dentigerous ridge. Zeiss 4/4, stage, afterwards reduced one-half. Original.

Figs. 16, 17. Two views of the proximal portion of the intestinal tract of *Ascaris decipiens* from the Alaskan fur seal. Cf. figs 5 and 6. Zeiss 4/a*10, stage, afterwards reduced one-half.

Fig. 18. Lateral view of tail of male of *Ascaris decipiens* from the Alaskan fur seal, showing carinated dorsal ridge, lateral alae, concave ventral surface, sense papillae, and spicules. Zeiss 4/16, stage. Original.

Fig. 19. Ventral view of tail of male of *Ascaris decipiens* from the Alaskan fur seal, showing somewhat the swollen lateral alae, the cloaca, and sense papillae. Original.

Fig. 20. A young *Ascaris* found in the stomach of the Alaskan fur seal, and corresponding to "*A. capsularia.*" Zeiss 4/a*10, stage, afterwards reduced one-third. Original.

Fig. 21. Anterior extremity of same. Zeiss 4/8, stage, afterwards reduced one-third. Original.

Fig. 22. Posterior extremity of same. Zeiss 4/8, stage, afterwards reduced one-third. Original.

Fig. 23. Dorsal lip of *Ascaris simplex*, showing basal portion with bilobed anterior projection and dentigerous ridge. After Krabbe, 1878, pl. I, fig. 4.

Fig. 24. Ventral view of tail of male specimen of *Ascaris simplex*, showing cloaca and sense papillae. The postanal papillae are divided into two groups; four pairs of conical papillae near the tip; one and a half pairs of sessile papillae near the cloaca; the praeanal papillae near the cloaca are less prominent than those situated further cephalad. x 100. After Krabbe, 1878, p. 48, fig. 2.

Fig. 25. *Ascaris simplex* from *Otaria jubata*. Natural size. After von Linstow, 1888, pl. I, fig. 1.

Fig. 26. Dorsal view of dorsal lip of *Ascaris simplex* from *Otaria jubata*. After von Linstow, 1888, pl. I, fig. 2.

Fig. 27. Apex view of lips of *Ascaris simplex* from *Otaria jubata*: *a.*, upper lip; *b.*, mouth; *c.*, ventral lip. After von Linstow, 1888, pl. I, fig. 3.

Fig. 28. Egg of *Ascaris simplex* from *Otaria jubata*. After von Linstow, 1888, pl. I, fig. 4.

Fig. 29. Proximal end of intestinal tract of *Ascaris simplex* from *Balaenoptera sibbaldii*, showing two divisions of the oesophagus and proximal end of the intestine. Zeiss 2/A*2. After Jägerskiöld, 1894, pl. XXVIII, fig. 42.

Fig. 30. One of Diesing's original figures of "*Conocephalus typicus*" (=*Ascaris typica*). The drawing shows a partially dissected female, with the umbrella-like structure on the head which was mistaken for a generic character; the intestine and one of the longitudinal lines are visible in the body cavity; the vulva is distal to the middle of the body; an error has undoubtedly been made in the original drawing in the structure of the genital tract, since the vagina and body of the uterus should be comparatively short. After Diesing, 1860, fig. 10.

Fig. 31. Dorsal lip of "*Ascaris conocephalus*" (=*Ascaris typica*), showing the structures described in the text. x 100. After Krabbe, 1878, pl. I, fig. 5.

Fig. 32. Ventral view of tail of male specimen of "*Ascaris conocephalus*" (=*Ascaris typica*), showing the caudal papillae as described by Krabbe. x 100. After Krabbe, 1878, p. 50, fig. 3.

Fig. 33. Ventral view of dorsal lip of "*Peritrachelius typicus*" (=*Ascaris typica*), showing the structure described in the text. x 125. After Drasche, 1883, pl. III, fig. 6.

Fig. 34. Dorsal view of dorsal lip of "*Peritrachelius typicus*" (=*Ascaris typica*), showing the structures described in the text. x 125. After Drasche, 1883, pl. III, fig. 7.

Fig. 35. Inner surface of ventro-lateral lip of "*Peritrachelius typicus*" (=*Ascaris typica*), showing the structure described in the text. x 280. After Drasche, 1883, pl. III, fig. 1.

Fig. 36. Inner surface of right ventro-lateral lip of "*Peritrachelius typicus*" (=*Ascaris typica*), showing the structure described in the text. x 280. After Drasche, 1883, pl. III, fig. 2.

Fig. 37. Apex view of lips and mouth of "*Peritrachelius typicus*" (=*Ascaris typica*), showing the relative position of the lips and the absence of intermediate lips. x 125. After Drasche, 1883, pl. III, fig. 5.

Fig. 38. Ventral view of tail of male specimen of "*Peritrachelius typicus*" (=*Ascaris typica*), showing the cloaca and caudal papillae as seen by Drasche. x 60. After Drasche, 1883, pl. III, fig. 9.

Fig. 39. Male specimen of *Ascaris typica* from Leidy's collection (U.S.N.M., No. 5015) determined by Leidy as "*Ascaris simplex.*" Natural size. Original.

Fig. 40. Female specimen of *Ascaris typica* from U.S.N.M., No. 5015. Natural size. Original.

Fig. 41. Dorsal view of anterior portion of *Ascaris typica* from U.S.N.M., No. 5015, showing dorsal lip, ventro-lateral lips, and cervical papillae. Zeiss 4/16, stage. Original.

Fig. 42. Ventral view of anterior portion of *Ascaris typica* from U.S.N.M., No. 5015, showing ventral lips and cervical papilae. Zeiss 4/16, stage. Original.

Fig. 43. Apex view of isolated cuticle of lips of *Ascaris typica* from U.S.N.M., No. 5015, showing general form of lips and the dentigerous ridge. The cuticle of the dorsal lip is somewhat misplaced. Zeiss 4/4, stage, afterwards reduced one-half. Original.

Fig. 44. Oesophagus of *Ascaris typica* from U.S.N.M., No. 5015, divided into an anterior straight portion and a posterior sigmoid portion. Intestinal and oesophageal caeca are absent. Zeiss $4/a^{*}_{10}$. Original.

Fig. 45. Lateral view of tail of male of *Ascaris typica* from U.S.N.M., No. 5015, to show the structures described in the text. Zeiss 4/16, stage. Original.

Figs. 46–47. Ventral view of the tails of two male specimens of *Ascaris simplex* from U.S.N.M., No. 5015, showing the unequal spicules and variations in the position of the caudal papillae. Zeiss 4/16, stage. Original.

Fig. 48. Eggs of *Ascaris simplex* from U.S.N.M., No. 5015, in various stages of segmentation. Zeiss 4/4, stage. Original.

Fig. 49. A young specimen of *Ascaris typica* from U.S.N.M., No. 5015, partially surrounded by its larval cuticle. Zeiss $4/a^{*}_{10}$.

Fig. 50. Anterior extremity of a young specimen of *Ascaris typica* which has cast part of its larval cuticle. Zeiss 4/8, stage. Original.

Fig. 51. Caudal extremity of a young specimen of *Ascaris typica* before the larval cuticle has been cast. Zeiss 4/8, stage. Original.

Figs. 52–56 are given in text.

Fig. 57. Dorsal lip of *Ascaris patagonica*, showing the double dentigerous ridge and other structures given in the diagnosis. After von Linstow, 1880, pl. III, fig. 1.

Fig. 58. Male of *Ascaris Kükenthalii*. Natural size. After Cobb, 1888, pl. III, fig. 1.

Fig. 59. Male of *Ascaris Kükenthalii*, opened on the left side to show the anatomy: *b.*, bulbus of the oesophagus; *dc.*, "end portion of the intestine" (or ductus ejaculatorius?); *cd.*, rectum; *co.*, excretory organ; *h.*, testicle; *kmd.*, smaller portion of the intestine; *l.*, glandular organ; *m.*, mouth; *mb.*, bursal muscles; *md.*, intestine; *msp.*, muscles of a spicule; *oc.*, oesophagus; *sl.*, vas deferens; *sp.*, spicules; *ss.*, vesicula seminalis ("Samenschlauch"). After Cobb, 1888, pl. III, fig. 7.

Fig. 60. Tail of male of *Ascaris Kükenthalii*, opened ventrally to show the anatomy: *a.*, anus; *de.*, ductus ejaculatorius; *dlm.*, dorsal longitudinal muscle; *cd.*, rectum; *h.*, testicle; *mb.*, bursal muscle; *sf.*, lateral line; *sfb.*, broadened portion of lateral line; *sl.*, vas deferens; *sp.*, spicules; *ss.*, vesicula seminalis ("Samenschlauch"). x 2. After Cobb, 1888, pl. III, fig. 5.

Fig. 61. Ventral view of tail of male of *Ascaris Kükenthalii*, showing the cloaca and caudal papillae as as seen by Cobb. After Cobb, 1888, pl. III, fig. 3.

Fig. 62. Apex view of head, showing the position of the lips: *pe*, excretory pore. x 50. After Cobb, 1888, pl. III, fig. 11.

Fig. 63. Female specimen of *Ascaris Kükenthalii*. Natural size. After Cobb, 1888, pl. III, fig. 2.

Fig. 64. Anterior extremity of *Ascaris Kükenthalii*, opened ventrally to show the anatomy: *ag.*, terminal duct of excretory organ; *co.*, excretory organ; *esf.*, constriction of lateral field; *gco.*, duct of excretory organ; *m.*, mouth; *md.*, intestine; *nr.*, neural ring; *om.*, muscle; *rn.*, dorsal nerve; *sf.*, lateral line. x 2. After Cobb, 1888, pl. III, fig. 4.

Fig. 65. *Ascaris similis*, natural size, after Baird, 1853, pl. I, fig. 1*a*. Baird states that this is a male, but it is more probably a female.

Fig. 66. Head of male, magnified, showing three lips; intermediate lips are absent. After Baird, 1853, pl. I, fig. 1*d*. After Baird, 1853, pl. I, fig. 1*b*.

Fig. 67. *Ascaris similis*, natural size, after Baird, 1853, pl. I, fig. 1*c*. Baird states that this is a female, but it is more probably a male.

Fig. 68. Head of female, magnified, after Baird, 1853, pl. I, fig. 1*d*.

Fig. 69. Tail of female, magnified, after Baird, 1853, pl. I, fig. 1*e*.

Fig. 70. *Ascaris halicoris*, after Baird, 1859, pl. LVI, fig. 2.

Fig. 71. Head of *Ascaris halicoris*, showing the three lips; intermediate lips are absent. After Baird, 1859, pl. LVI, fig. 2*a*.

Fig. 72. Tail of *Ascaris halicoris*, after Baird, 1859, pl. LVI, fig. 2*b*.

Fig. 73. Anterior portion of *Ascaris halicoris*, dissected to show the oesophagus, intestine, intestinal caecum, and a portion of the genital organs. After Baird, 1859, pl. LVI, fig 2*c*.

Fig. 74. Transverse section of head of *Ascaris halicoris*, showing the relative position of the three lips and the absence of intermediate lips. After Parona, 1889, pl. XIII, fig. 3.

Fig. 75. Ventral view of tail of *Ascaris halicoris*, after Parona, 1889, p. 760, fig. 2.

Fig. 76. Tail of male of *Ascaris osculata* from *Phoca groenlandica*, showing cloaca and caudal papillae. Ventral view. x 90. After Schneider, 1866, p. 44.

Fig. 77. Inner view of dorsal lip of *Ascaris osculata* from *Phoca groenlandica;* the intermediate lips are not figured. x 90. After Schneider, 1866, pl. I, fig. 13.

Fig. 78. Dorsal lip of *Ascaris osculata*, showing intermediate lips. x 100. After Krabbe, 1878, pl. I, fig. 1.

Fig. 79. Dorsal view of anterior end of *Ascaris osculata* from *Stenorhynchus leptonyx*, showing: *rl.*, dorsal lip; *vll.*, ventro-lateral lip; *nl.*, intermediate lip; the folds of the cuticle near the lips are visible. After von Linstow, 1892, pl. II, fig 11.

Fig. 80. Transverse section of lips near the base, showing the relative position of lips and intermediate lips of *Ascaris osculata* from *Stenorhynchus leptonyx*. After von Linstow, 1892, pl. II, fig. 14.

Fig. 81. Transverse section of same near the apex. After von Linstow, 1892, pl. II, fig. 15.

Fig. 82. Ventral view of tail of male of *Ascaris osculata* from *Stenorhynchus leptonyx*, showing lateral caudal alae, caudal papillae, and two spicules. After von Linstow, 1892, pl. II, fig. 16.

Fig. 83. Oesophagus of *Ascaris osculata* from *Phoca vitulina*. Zeiss $2/A_2$. After Jägerskiöld, 1894, pl. XXVIII, fig. 38.

Fig. 84. Male of *Ascaris osculata* from *Eumetopias Stelleri*. Natural size. Original.

Fig. 85. Female *Ascaris osculata* from *Eumetopias Stelleri*. Natural size. Original.

Figs. 86 and 87. Dorsal (fig. 86) and ventral (fig. 87) views of anterior extremity of female *Ascaris osculata* (U.S.N.M., No. 2767) from *Eumetopias Stelleri*. Zeiss 4/16, stage. Original.

Fig. 88. Margin of anterior extremity of *Ascaris osculata* from *Eumetopias Stelleri*, to show the peculiar cuticular folds. Zeiss 4/8, stage. Original.

Fig. 89. Ventral view, tail of male of *Ascaris osculata* (U.S.N.M., No. 2766) *Eumetopias Stelleri*, showing narrow lateral alae, caudal papillae, and cloaca. Original.

Fig. 90. Ventral view, tail of male of *Ascaris lobulata* from *Platanista gangetica*, showing cloaca and caudal papillae. x 90. After Schneider, 1866, p. 44.

Fig. 91. Dorsal lip, inner surface, of *Ascaris lobulata*, from *Platanista gangetica*. x 100. After Krabbe, 1878, pl. I, fig. 2.

Fig. 92. Oesophagus and anterior portion of intestine of *Ascaris lobulata*, showing the long anterior portion of the oesophagus, the short posterior portion with oesophageal caecum, and the intestine with intestinal caecum. Zeiss $2/A_2$, extended tube. After Jägerskiöld, 1894, pl. XXVIII, fig. 37.

Fig. 93. Adult male *Uncinaria* sp. from the intestine of an Alaskan fur-seal pup, U.S.N.M., No. 2815. Natural size. Original.

Fig. 94. Adult female *Uncinaria* sp. from the intestine of an Alaskan fur-seal pup, U.S.N.M., No. 2815. Natural size. Original.

Fig. 95. Anterior end of *Uncinaria* sp., U.S.N.M., No. 2815, showing the mouth, buccal capsule, and oesophagus. Zeiss 4/16, stage. Original.

Fig. 96. Dorsal view of caudal extremity of fig. 93, showing the bursa with its rays, and the two spicules. Zeiss 4/8, stage. Original.

Fig. 97. *Bothriocephalus* sp., U.S.N.M., No. 2768, from the intestine of the Alaskan fur seal. Natural size. Original.

Figs. 98-100. Head of same, enlarged. Zeiss $4/a^{*}_{10}$, stage. Original.

VIII.—THE EARLY HISTORY OF THE NORTHERN FUR SEALS.

THE BEASTS OF THE SEA, BY GEORGE WILLIAM STELLER.

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PREFACE.

Steller's work, published in 1751 in the memoirs of the Imperial Academy of Sciences in St. Petersburg for the year 1749, is a posthumous publication. The greater part of the work was finished in 1742, and Steller himself died, while on his way from Siberia to St. Petersburg, in November, 1745. He was the naturalist (a volunteer) of the Russian expedition sent out to explore the northwest coast of North America and to ascertain definitely whether it was or was not joined to Asia, and to search for the imaginary island known as Compagnie Land.

The following pages contain a translation of those parts of Steller's report which treat of the *Manatee*, or sea cow (Vol. II, pp. 289–330), and the natural history of the sea bear (fur seal) (pp. 346–359), sea lion (pp. 361–366), and sea otter (pp. 382–398). The measurements and descriptions of the last three are omitted, inasmuch as they can be made better and with more scientific accuracy in our own times. But as the sea cow is extinct, and as nearly all knowledge of it is to be obtained from Steller's account, that portion of his work is given in full.

Circumstances have combined to render the work of translation difficult; not only is Steller's account written in the zoological Latin of the eighteenth century, but, as printed, it contains errors and omissions due to the fact that it was published after Steller's death, and consequently without revision. Finally, it has been necessary to rely on a type-written copy, the original not being accessible to the translator.

Thanks are due to President David Starr Jordan and to Professor Oliver Peebles Jenkins for much kind assistance with the technical, scientific, physiological, and anatomical parts of the work.

SEA BEASTS.[1]

No one who has studied various lands doubts that the vast ocean contains many animals which to-day are unknown, and that there are very many regions in the ocean

[1] The full title of Steller's work is as follows: De | Bestiis marinis | Avctore | Georg. Wilhelm. Stellero | Novi | Commentarii | Academiae Scientiarum | Imperialis | Petropolitanae | Tom. II | ad annum MDCCXLIX | Petropoli | Typis Academiae Scientiarum | MDCCLI.

where the curious and venturesome inquiries of Europeans have not yet penetrated; and so no one has been able to examine their contents. Thus it stands with the animals of the sea as compared with the animals of the land. Some live anywhere and everywhere, and through long association come to vary their species in accordance with differences of climate and food, not only in respect to size and color, but also in respect to the softness and thickness of their hair; but when transferred to a different climate, after a long interval of time they lose again their specific difference and revert to the first. So European horses when transferred to Siberia become perceptibly smaller and hardier; and, on the other hand, when taken to India or China they become so much slighter and smaller that after a lapse of time they form a peculiar species. Yakut cattle when transported to Kamchatka become not only larger, but more prolific; and this is the case also with cattle that are sent to the port of Archangel. With English sheep that are taken to Sweden on account of the excellence of their wool, not only the wool changes after a short time, but also their size. If one did not observe this, it would seem that the species of animals increased gradually in Siberia alone; for example, the squirrels on the Obi are large, and covered with long, ashy gray fur; Obdoric squirrels are one-third smaller, and covered with short but thicker fur; Bargusian squirrels are covered with black, and Werchoian squirrels are mottled with black and ash-colored fur. All this difference, as far as concerns size and thickness of fur, is due to climate, and as far as concerns the color it is due to the food. Where evergreen larches, or, as they are commonly called, spruce and pines, grow, there the fur is a bright, ashy gray; where the larches are deciduous, there they grow with black fur.

Among animals the seal (*phoca*) is the only one which lives not only in every part of the ocean, but in the Baltic Sea, the Caspian Sea, and lakes which have no communication with the sea, as in Lakes Baikal and Oron; it is found everywhere at all times of the year. Notwithstanding, this difference occurs, that the ocean seal (*phoca oceanica*) is more common and is distinguished in color from all the rest; it is covered with muddy gray fur, and on the back of its body it has a large spot that is chestnut colored and covers one-third of the whole hide.

Now, I divide seals into three varieties on the basis of size. (1) The largest, which is greater in size than a bull, grows only in the eastern ocean from the degrees 56 to 59 north latitude, and is called by the Kamchatkans "*Lachtak*." (2) Those of medium size are all as large as a tiger, and are marked with many smaller spots. (3) The smallest ones — the ocean seal, for example — are found in the Baltic Sea, as well as in the port of Archangel, in Sweden, Norway, America, and Kamchatka, and in fresh-water lakes. They are monochroüs; that is, of one color; for example, those found in Baikal are of a silvery gray color. If we inquire why this sort of amphibian alone lives in every ocean and lake, I reply, because it lives upon a sort of food which is to be had everywhere in the world, and upon flesh. But the case of the sea cow (*Manatee*) is different. It feeds only upon certain sorts of sea weeds not found everywhere, and on account of the structure of its body can not live everywhere even in shallow places. But the sea otter, although it lives upon crustaceans and shellfish, can not find this sort of food everywhere beneath a certain depth of water on account of its closed *foramen ovale;* and hence it inhabits the rocky, rugged, shallow shoals of America, of the islands in the channel, and of the land of Kamchatka. The sea lion and the sea bear are migratory animals, and seek the recesses of the sea and uninhabited islands in the same way as geese and swans, so that there they may get rid of their fat, copulate, and give birth, and when that is done they return home in the same way as birds.

The amphibious *Bieluga*, a most voracious animal, selects those places where there are long inlets of the sea; they generally wander about very widely, where they can drive the fishes together and devour them more quickly in larger numbers — such places as are at the mouth of the Ud and Ochotsk and the arm of the sea at the mouth of the river Olutora. The walrus, from his love of ease, seeks out desolate and uninhabited places, and because of his fatness selects a cold place in the midst of ice, and because he finds these conditions at any time of the year at the mouth of the river Obi, Yenisee, Lena, and Kolima, and around Cape Tschutschi, he is fond of those regions. The right whale (*balaena*), because it is fond of peace, chooses those parts of the sea less frequented by ships, and since those places are for the most part in the north, whales live there and select those regions for sleep, for giving birth to their young, and for breeding.

Accordingly, the reason why other amphibious animals inhabit not all but only some certain regions of the ocean, must be looked for in the nature of the animals themselves. For some the food that they eat, for others their love of ease, for others still different characteristics fix their boundaries and determine their dwelling-places.

But all sea animals have something, either in appearance or in habits, in common with land animals, on account of which even at first sight they are compared by the common people to these animals, and thus get their names. So the host of natural philosophers talk about bulls, horses, wolves, and, dreaming of allegories, bring in monks and other men. It has seemed to me worth mentioning that Ruthenian sailors when they first saw the manatee called it "*Korova Morskaia*," with exactly the same propriety as the English and Dutch called it a "sea-cow;" "*Sivutcha*" they called "sea-lion," and "*Kot*," "sea-bear." Not noticing the criteria offered by nature, they less appropriately called the "sea-otter" "*Bobr Morskoi*." But all these animals became known only half a century ago; in fact, Marcgraf makes mention of the sea otter, but somewhat briefly and obscurely. The navigator Dampier, a tireless explorer, speaks of the sea lion and the sea bear; and many learned men, and Dampier as well, mention the manatee. But I must admit that the accounts given by the scholars are fragmentary and imperfect and for the most part fabulous and false. Dampier, on the other hand, has by many parasangs excelled them with a most accurate description, as good as could be expected from an unlearned man.

But one must not suppose that these places do not contain more great and wonderful animals that are still unknown, besides those which I shall describe. For if weather, time, and place had favored my desire I should have enriched natural history with many curiosities of that sort, as indeed I desired when I took the risk of this journey to parts so distant and unexplored. Thus, for instance, I describe the traces of a certain unknown animal upon the island of Shumagin, and I insert a sketch of a sea ape, and with this imperfect account I must content myself and others.

In what order I shall next year examine the shores of the sea near the mouth of the river Kolima time will tell. My zeal is fired by those mammoth skeletons and the slight accounts of them. And I do not doubt that the American shores are to become better known to us, and with them this wonderful subject as well. As long as things escape us and perish unknown with our consent, and through our silence are counted as fabulous—things which may be seen with little labor in the very land where we, with all our inquisitiveness, live—it is not strange that these things, which we are prevented from observing by the great sea that lies between, have remained to the present time unknown and unexplored. In the farther confines of Asia and the Russian Empire I learned that the "*Suhac*" of the Scythians was regarded as fabulous. I also learned that in the Desert of Azof, and in that where the Saporozkiensian Cossacks live, the one-horned goat bears the same name—an animal very common and very well known upon their tables. There is likewise a Scythian wolf, black in color, and described by Aristotle as longer than the common wolf but with shorter legs, exceedingly fierce and savage. There is also in the neighborhood of Voronesch and Astracan an animal that barks like a dog. It is sly and bloodthirsty and will attack people lying asleep or steal whatever it can from the household stores. This may be the hyena of ancient times. And I desire nothing more than that, after I have explored Siberia, the authorities may think well to intrust to me the exploration of the deserts—provided no one else undertakes it; and I hope that if my efforts prove acceptable I may be sent into exile for several years on their account, that I may spend there a long time, which I prophesy will prove but too brief.

THE MANATEE.

The following is a description of the manatee, or, as it is called by the Dutch, *Vacca marina* (sea cow), by the English, "sea cow," and by the Russians, "*Morskaia Korova;*" the description is made from a female killed on the 12th of July, 1742, on Bering Island, which lies in the channel between America and Asia. It had, according to the English scale of measurement, the following dimensions:

	Inches.
Length from the extremity of the upper lip to the extreme right *cornu* of the caudal fork	296.00
From the extremity of the upper lip to the nares	8.00
From the narial septum (*columna narium*) to the anterior angle of the eye	13.50
From the anterior angle to the posterior angle of the eye	.80
Distance between the eyes at the anterior angles	17.40
Distance between the eyes at the posterior angles	22.20
The breadth of the narial septum (*columna narium*) at its base	1.50
Height of the nares	2.50
Breadth of the nares	2.50
From the extremity of the upper lip to the angle of the mouth (*oris froenum*)	15.50
From the extremity of the upper lip to the shoulder	52.00
From the extremity of the upper lip to the opening of the vulva	194.00
Length of the vulva	10.20
Length of the tail from the anal sphincter to the region of the caudal fin	75.50
Circumference of the head above the nostrils (*supra nares*)	31.00
Circumference of the head at the eyes	48.00
Circumference of the neck at the nape (*nucha*)	82.00
Height of the end of the snout	8.40
Circumference of the body at the shoulders	144.00
The greatest circumference about the middle of the abdomen	244.00
The circumference of the tail at the origin (*insertio*) of the fin	56.00
Distance between the extreme points of the caudal fin (this is the breadth of the fin)	78.00
Height of the fin	8.80
The whole length of the inner lip, which is villous and rough, like a brush	5.20
Width of the same	2.50
The width of the exterior upper lip, which stands obliquely to the lower jaw and is covered all over with rather long, white bristles	14.00
Height of the same	10.00

	Inches.
The breadth of the lower lip, which is hairless, black, smooth, and slopes toward the sternum, and is heart-shaped	7.40
Height of the same	6.80
From the lower lip to the sternum	54.00
The diameter of the mouth at the angle (*oris froenum*)	20.40
From the pharynx to the end of the oesophagus	32.00
The width, or rather length, of the stomach	44.00
The whole intestinal tract, from pharynx to anus	5,968.00
(And so it is 20½ times as long as the whole animal.)	
From pudenda to anal sphincter	8.00
Diameter of the trachea below the glottis	4.20
Height of the heart	22.00
Width of the heart	25.00
Length of the kidneys	32.00
Width of the kidneys	18.00
Length of the tongue	12.00
Width of the tongue	2.50
Length of the nipples	4.00
Width of the humerus	14.50
Length of the ulna	12.20
Length of the skull from nares to occiput	27.00
Width of the occiput	10.50

DESCRIPTION OF THE EXTERNAL PARTS.

This animal belongs practically to the sea, and is not amphibious, although some authorities have so narrated; but they have misunderstood the stories of some others who tell of its feeding upon vegetation about the shores of the sea and rivers. But by this was meant not the vegetation of the land, but seaweed that grows out in the water on the shore of the sea. This seemed quite an unwelcome fact (that it fed on seaweed) and most absurd to Celsius Clusius, who had seen a whole hide stuffed with straw; but it is found to be so also in the case of the living beast (strange as it is true), if one will but have regard to its form, movements, and habits.

It is covered with a thick hide, more like unto the bark of an ancient oak than unto the skin of an animal; the manatee's hide is black, mangy, wrinkled, rough, hard, and tough; it is void of hairs, and almost impervious to an ax or to the point of a hook. It is an inch thick, and a transverse section of it is very like unto ebony both in smoothness and in color. This exterior cortex, however, is not skin (*cutis*), but cuticle (*cuticula*); but in the dorsal region it is smooth. From the nape to the caudal fin the surface is uneven with nothing but circular wrinkles, but the sides are exceedingly rough, especially about the head, and bristling with many cup-shaped prominences like stemless mushrooms (*pezicas*). This cuticle which surrounds the whole body like a crust is frequently an inch in thickness; and it is composed of nothing but tubules, in the same way as we observe in the Spanish cane or *Mambu* of the Indians and Chinese (*ac in arundine videmus Hispanicove Mambu Indorum et Sinensium*). The structure of these tubules is perpendicular to the skin. Longitudinally they can not be torn or separated from one another. The tubules are implanted in the lower part of the skin; they are roundish, convex, bulbous, and hence pieces of the skin that are torn off from the cuticle are full of tubercles like Spanish bark, and the underlying cutis is excavated with a great many very small holes, like a thimble (*netricum digitale*), which were before the receptacles of the bulbous tubules of the cuticle. Now, these tubules rest upon one another very closely; they are tenacious, wet, and tumid, and they do not appear when the cuticle is cut horizontally, but the surface is smooth, as the hoofs of certain animals when they are cut. But as soon as it is hung up in pieces and exposed to the sun and becomes dry, it has perpendicular fissures and can be broken like bark, and then this tubulous structure comes clearly to view. Through these tubes a thin, serous mucus is exuded, in larger quantities on the sides and about the head, and in smaller quantities on the back. When the animal has lain for some hours upon the dry shore, the back becomes dry, but the head and sides are always wet.

Now, this thick cuticle seems given to the animal for two purposes principally: (1) That, inasmuch as the animal is compelled, for the sake of getting a living, to live continuously in rough and rugged places, and in the winter among the ice, it may not rub off the skin, or that it may not be beaten by the heavy waves and bruised with the stones, and when pursued it is protected by this coat of mail; (2) that the natural heat may not be dissipated in the summer by too profuse perspiration (*nimium transpirando*), or completely counteracted by the cold of winter. And that would be natural, for it has to live, not in the depths of the sea as other animals and fishes, but it is always compelled in feeding to expose half of its body to the cold.

I have observed in the case of many that were cast up dead upon the shore of the sea, that the cuticle had been broken off on one side or the other, and that that had been the cause of their death; and this happens principally in the winter time, from the ice.

And I observed many times in animals that had been captured and drawn on shore with a hook, that great pieces of cuticle had been pulled off in consequence of the violent thrashing of its body and tail and its resisting with its front feet, and that the broken piece of cuticle that covered the arms and caudal fin was like a hoof; all this goes to make my opinion stronger. Cuticle of exactly the same sort covers the whale (*balaena*), although no mention is made of it by the authorities; and almost the whole of the cuticle was rubbed off from a whale that was washed up dead upon our island on the 1st day of August, for during several days it had been tossed about by the waves, this way and that, and bruised upon the rocks before it came to our shore.

While this cuticle is wet it is tawny black, like the skin of a smoked ham, but when it is dry it is wholly black. In certain animals it is marked with rather large white spots and zones, and this color penetrates clear to the cutis. This cuticle about the head, eyes, ears, breasts, and under the arms, where it is rough, is thickly infested by insects, and it frequently happens that they perforate the cuticle and wound even the cutis itself. When this happens, large, thick, warty prominences arise from the lymph of the cutis, or from the broken glands that preserve the oil, as it were, in the little cells, in the same manner as in whales, and oftentimes make the above-mentioned places foul.

Under the cuticle lies the cutis surrounding the whole body. This is 2 lines thick, soft, white, very firm in strength and structure just like that of the whale, and it can be put to the same uses.

In comparison with the huge mass of the rest of its body the head is small, short, and closely connected with the body; in figure it is a square oblong, widening from the top toward the lower jaw. The top itself is flat and covered with a black cuticle, exceedingly scraggly and a third part thinner than the rest of the cuticle and more easily torn off. The head slopes from the occiput to the nares and slopes again from the nares to the lips. The end of the snout is 8 inches high and grows rapidly thicker from the nose to the occiput.

The opening of the mouth (*rictus oris*) is not underneath (*supinus*), but in a line with the sides; but the exterior upper lip is so large, broad, and oblique to the angle of the mouth, and lengthened out so much above the inferior mandible, that to one who looks at the head alone the opening seems to be located underneath.

The opening of the mouth itself is not very large in proportion to the animal, nor is it necessary that it should be, as it lives on seaweed.

The lips, both the upper and the lower, are double and divided into external and internal lips.

The external upper lip, finishing the end of the snout obliquely, is like a half circle; it is flat, tumid, thick, 14 inches broad, 10 inches high, in color a glossy white, and overgrown with a great many little hills or tubercles, from the center of each one of which grows a white, translucent bristle 4 or 5 inches long.

The internal upper lip is 5 inches long and 2½ inches wide. It is everywhere detached from the external lip, and fastened to it only at the base; it overhangs the palate, and it looks like a calf's tongue, all villous and rough like a brush. It closes the mouth firmly above; it is movable, and by its own motion serves to tear off the seaweed and bring it into its mouth; for it feeds in the same way as horses and cattle, by protruding its lips and bending them outward.

The lower lip is likewise double; the external lip is black, and smooth, and without bristles; it is roughly heart-shaped and like a chin, if we may so call it; it is 7 inches wide and 6.8 inches high.

The internal lower lip is separated likewise from the external; it is villous and is not visible when the mouth is closed, because the external lip reaches out and covers it; and being set opposite the internal upper lip it closes the mouth firmly.

When the lower mandible is applied to the upper, the space which intervenes when both are closed is filled up with a dense array of very thick white bristles 1½ inches long. These bristles prevent anything from falling out of the mouth while the animal masticates, or from being washed out with water which flows into the mouth and is driven out again through the opening when the mouth is closed.

The bristles are as thick as a dove's quill; they are white, hollow inside, bulbous below, and, even without the aid of a microscope, they show clearly the structure of the human hair.

If the animal lies prone upon its belly, the end of its snout on a line perpendicular from the nares to the lips is 8 inches high and is rounded in front, like a ball, from the nose to the ends of the lips and also to the lateral regions of the upper jaw. It grows thicker and increases rapidly in circumference. The external lips are very prominent, thick and swollen, and perforated with a great many large pores, like a cat's, from each one of which grows a strong white bristle; these bristles are perceptibly stouter the nearer they are tc the opening of the mouth itself. Of the bristles those were especially noticeable for thickness which grow between the lips of either jaw. They take the place of teeth in pulling off the seaweed and prevent anything from falling out of the mouth while the animal masticates. The inferior maxilla is shorter than the superior; it alone is movable, but the lips of both maxillae move, as do the lips of cattle. With these the submarine plants which they tear off from the rocks with their arms are so cut off from the hard, uneatable roots and stems that they seem to be cut off with the edge of a dull knife. When the tide comes in these roots and stems are washed ashore, and lying there in great heaps on the seashore they betray to the visitor the present quarters of these guests; inasmuch as the stems of sea plants are tougher and thicker than those of land plants, the lips are made much stronger and harder than are the lips of any of the land animals; therefore the lips are also inedible, and can not be softened by boiling or in any other way. The internal structure of the lips is so arranged that when cut they are like a checkerboard, consisting of very small squares; there are countless very small, thick, red, rhomboid or trapezoid squares, with which others that are white, tendinous, full of cells like network and containing liquid oil, are interspersed in equal numbers. These lips when boiled in water very easily yield a great amount of oil, and when this oil is tried out the white cells appear like so much tendinous network. The purpose of this structure seems to me to be a threefold one: (1) That the strength and density of the lips may be increased, and that they may not be so easily exposed to any danger from without; (2) that the heavy lips may be more easily raised and moved, inasmuch as the origin and insertion of the muscles (*caput et caudae horum musculorum*) are so disposed that the origin of the muscles is set obliquely to the opening of the mouth, and the insertion of the muscles obliquely to the top of the head; so that with their beginnings and ends the lips make, as it were, a wreath of muscles; (3) that by means of this structure the lips may be moved with a sort of spiral motion, and that, since the head on account of the continuous thick crust can be moved only with difficulty, it may not be necessary for them to move the whole body as often as they wish to pull off the tenacious seaweed.

They masticate differently from all other animals; not with teeth, which they lack altogether, but with two strong white bones, or solid tooth masses, one of which is set in the palate and the other is fastened in the inferior maxilla, and corresponds to the first.

The insertion itself, or connection, is entirely anomalous, and would be expressed by no known name; *gomphosis* we can not call it, because the bones are not fastened in the maxillae, but each is held by many papillae and pores, pores and papillae alternating, in the palate and in the inferior mandible. Besides, in front it is inserted into the papillary membrane of the internal upper lip, and at the sides in the grooved edge of the bone, and at the back, with a double process, into the palate and inferior maxilla, and is in this way made firm.

These molar bones are perforated below with many little holes, like a thimble (*netricum digitale*), or like a sponge, in which the arteries and nerves are inserted in the same way as in the teeth of other animals. Above they are smooth and excavated with many winding, wavy canals, and between them are eminences which in mastication fit into the canals of the corresponding bone so perfectly that the seaweed (*fuci*) is ground and mashed between them as between a fuller's beams or between millstones. I have had a drawing made of these bones, which will explain more clearly what is less intelligible from the description.

The nose is situated in the farthest tip of the head, as in the horse; there are two nostrils, and a thick cartilaginous column 1½ inches wide between them. The nostrils themselves are 2 inches long and just as wide in diameter. They are flat, and stretch back with many curves or labyrinths. Inside, the nostrils are very wide, wrinkled, and covered over with a nervous membrane, which is perforated with many black pores. From each pore grows a bristle as thick as cobbler's waxed-end, a half inch long; they are easy to pull out, and they take the place of *vibrissae* in other animals.

The eyes are situated exactly half way between the end of the snout and the ears in a line parallel with the top of the nostrils, or just a very little higher. They are very small in proportion to so huge a body, being no larger than a sheep's eyes. They are not provided with shutters, or lids, or any other external apparatus, but protrude from the skin through a round opening, scarcely a half inch in diameter. The iris of the eye is black, the ball livid; the canthi of the eye are not seen except when the skin is cut away around the opening of the eye. At the inner canthus of the eye there is a cartilaginous crest (precisely like that of the sea otter), which, when necessity arises, covers over the whole eye and takes the place of a nictitating membrane adapted to warding off and removing any injury that might chance to fall while the animal feeds. This cartilaginous crest in the back part constitutes one wall of the lachrymal sac, with which it is joined by a common nervous membrane. When the lachrymal sac is cut a great amount of sticky mucus is found in its cavity. The sac itself would easily hold a chestnut, and inside it is enveloped in a glandular membrane.

The ears outside open only with a small hole, like the seal's. There is not the slightest trace of an external ear, and the holes can be seen only by examining very closely; for the opening of the ears can not be distinguished from the rest of the pores, and would scarcely admit the quill of a chicken's feather. The internal canal of the ears is smooth and covered with a highly polished black skin, and when the muscles of the occiput are separated from it, as they may easily be, it betrays itself by its own color and can be seen.

The tongue is 12 inches long and 2½ inches wide, and is like that of an ox. It is pointed at the end and the surface is rough with short papillae like a file. It is so deeply hidden away in the fauces that to many the animal has seemed to be without a tongue; for drawn as far forward as it may be by the hand, it still can not be made to reach the *froenum*, but will fall short of it by 1½ inches. If it were longer, as in other animals, it would be in the way in mastication.

The head, like the neck, is ill defined, and joins the body in such a way that a line of distinction is nowhere visible, as is the case with all fishes; but what obscurely suggests a neck is shorter by one-half than the head itself, and is cylindrical and more slender than the occiput in circumference. Notwithstanding, it is not only constructed with movable vertebrae, but has its independent action, a motion observed in the living animal only when it feeds; for it bends its head in the same way as cattle on dry land, but the thick and shapeless cuticle makes the quiet or dead animal look as though it were provided with an immovable neck, for no trace of vertebrae is to be seen at all.

From the shoulders toward the umbilical region it grows rapidly wider, and from there on to the anus it again grows rapidly slender; the sides are roundish and paunched like a belly which is swollen with a great mass of intestines, and elastic and puffed up like an inflated skin, and diminishes in size from the umbilical region toward the anus, and again from the mammæ toward the neck.

When the animals are fat, as they are in spring and summer, the back is slightly convex; but in winter, when they are thin, the back is flat and excavated at the spine with a hollow on either side, and at such times all the vertebrae with their spinous processes can be seen.

The ribs rise on both sides in an arch to the back, and where they are joined to the vertebrae of the back by *amphiarthrosis*, as they are in a man, they extend downward like a bow, and in the place where they are joined on both sides to the vertebrae they make a double hollow on the back.

At the twenty-sixth vertebra the tail begins, and continues with thirty-five vertebrae. The tail grows perceptibly thinner toward the fin. It is not so much flat as rather somewhat quadrangular, for all the vertebrae of the tail have two epiphyses [zygapophyses] and four processes. Of these the lateral processes are broad, flat, and blunt at the point. The spinous process on the dorsal side or spine (*processus superior in dorso seu spina*) is sharpened; the lower one is a broad, flat bone, like unto a Greek lambda. This is joined by a cord to the main body of the tail and is fastened to it with very strong ligaments and tendons. As a result of this quadruple position the muscles of the tail fill these cavities of the vertebrae and the angles between the processes, and so the tail itself gets the form of a square oblong with obtuse angles.

For the rest the tail is thick, very powerful, and ends in a very hard, stiff, black fin, which is not divided into rays, but solid, and is in substance like prepared whalebone, and consists of nothing but layers, one upon the other, as if one solid piece. This fin is frayed out for a distance of 9 inches from the extremity, and is something like the fins of fishes that are spined with a ruder sort of spines. The fin itself that ends the tail is 78 inches wide or long, 7.3 inches high, and 1.5 inches thick, and is inserted in the muscles of the tail as if by *gomphosis*, or a triangular canal.[1]

The fin of the tail is somewhat forked, and both cornua, differently from the tail fins of larger sea fishes, as the shark and the like, are of the same magnitude. In this respect it agrees with the whale. And so the caudal fin is parallel with the sides, as is the case of the phocaena and balaena, and not with the back, as is the case with most fishes. With a gentle sidewise motion of its tail it swims gently forward ; with an up-and-down motion of the tail it drives itself violently forward and struggles to escape from the hands of enemies who are trying to draw it in.

The strangest feature of all, in which this animal differs from all other animals both of land and sea and from amphibia, is its arms, or, if you please, its front feet; for two arms, 26.5 inches long, consisting of two articulations, are joined immediately to the shoulders at the neck. The end of the humerus is joined to the scapula by *arthrodia*.

The ulna and radius are like a man's; the ulna and radius terminate bluntly with tarsus and metatarsus. There are no traces of fingers, nor are there any of nails or hoofs; but the tarsus and metatarsus are covered with solid fat, many tendons and ligaments, cutis and cuticle, as an amputated human limb is covered with skin. But both the cutis, and especially the cuticle, are much thicker, harder, and drier there, and so the ends of the arms are something like claws, or rather like a horse's hoof; but a horse's hoof is sharper and more pointed, and so better suited to digging. On the back (*supine*) these claws are smooth and convex, but underneath they are flat and hollowed out in a way, and rough with countless very closely set bristles, half an inch long and hard like a brush.

[1] There is an evident omission here, as these measurements would give the animal an absurdly narrow tail, whereas we know from the references to the power of the animal, as well as from the figures that have been preserved, that the flukes were broad and powerful. The vertebræ and their muscles lie in the fibrous mass of the flukes as if driven in.—Ed.

I have seen in one animal these claws divided into two parts, like an ox's hoof. The division, however, was no more than marked, and that only in the cuticle; this happened more by mere chance than by the will of nature, and was the more easy and the more possible as the cuticle that covered the claws was disposed on account of its dryness to crack.

Now, this Platonic man, as the eminent John Ray was pleased in jest to call him, performs with these arms various offices: with these he swims, as with branchial fins; with these he walks on the shallows of the shore, as with feet; with these he braces and supports himself on the slippery rocks; with these he digs out and tears off the algae and seagrasses from the rocks, as a horse would do with its front feet; with these he fights, and when taken with a hook and dragged from the water upon dry land he resists so vehemently that the cuticle surrounding these arms is often torn and pulled off in pieces; and finally with these the female when smitten with the sting of passion, swimming prone upon her back, embraces her covering lover and holds him and permits herself in turn to be embraced.

The two breasts are different from those of most other animals, but in place and form are exactly as in man; they are situated one under each arm; and one breast is a foot and a half in diameter, convex, rough with many spiral wrinkles, full of glands, very hard—harder than a cow's—and without any intermingling fat. But the adipose tissue that surrounds the whole body rests upon them only with the same thickness as everywhere else, but the cuticle is thinner there and softer, and more wrinkled, and the papillae are likewise surrounded with a black cuticle with circular wrinkles, but soft. Under the arm itself, or axilla, the breast hangs, and when the animal is in milk the nipple is 4 inches long and 1½ inches in diameter; in those, however, which have gone dry, or have not yet given birth, it is so short and contracted that it seems nothing more than a chance wart, for the breast is not swollen.

The milk is very rich and sweet, and in consistency is very much like sheep's milk, and very often it was my wont to get the milk in large quantities from dead ones in the same way as from cows. The nipple is very much wrinkled and a little higher than the rest of the breast. When the glands are cut they give out milk which is like that which I collected by squeezing the papillae. Ten or twelve lacteal ducts open into each papilla. The breasts when boiled are a little harder than beef, and give out the odor of game, but mild.

They come together after the human fashion, the male above and the female below. The penis of the male is 32 inches long, and with its sheath is bound firmly in front to the abdomen, and reaches clear to the navel—in a word, it is very coarse and obscene to look upon, very much like that of a horse, and ends with the same sort of a gland, only larger.

The female pudenda lie 8 inches above the anus. The opening of the vulva is almost a triangle, and wider above, where the clitoris lies, and narrower toward the anus. The opening itself would without difficulty admit five fingers together. The clitoris is about 1½ inches long. It is cartilaginous and surrounded with a very strong, smooth skin, and is uneven, with many short wrinkles that fold together. The skin is variegated with yellow and white, and so is the vulva. The labia vulvae are very rigid and hard. The urethra empties into the vulva about 5 inches from the opening of the vulva. Below this is stretched a strong, crescent-shaped membrane, partly muscular and partly tendinous, which separates the vulva from the *vagina uteri*, properly so called, with a sort of vestibule, and makes a kind of hymen. But the aperture between the cornua of this membrane is so large that the penis of the male can without any difficulty enter the vagina. The vagina itself is 9½ inches long and covered with a very strong, fibrous membrane, which is ribbed longitudinally and hollowed out upon its surface with many furrows; between these furrows are seen a great many glands not larger than a pin's head, which secrete the mucus with which the vagina is covered all over. Next appears the uterus itself, spherical in shape, in size as large as the head of a cat. When I cut it open it was covered with mucus in the same way as the vagina, and wrinkled with a great number of folds half an inch wide. The substance of the vagina was so hard that I could scarcely cut it with a knife. The ligaments of the uterus and of the fallopian tubes had precisely the same structure as those of a horse.

The anus is situated 8½ inches below the pudenda. It is closed by a sphincter that is not very tightly contracted. In diameter it is 4 inches wide. The sphincter is white; the inside coating of the rectal intestine is smooth, slippery, olive-gray, just as in horses, where it is sometimes black, sometimes white spotted.

DESCRIPTION OF THE INTERNAL PARTS.

I opened the heads of four animals, and with the greatest painstaking I searched for the stones, incorrectly so called, of the manatee. But so far was I from being able to find anything in the least like a stone or bone that from this I decided that either those bones were not found in all of them, or were found only in certain climates, or, what seemed more probable, that Schröder and others who describe these bones as having the form of a ball, had, like too superficial and untrustworthy compilers, given it this round form after the analogy of the bezoar stone, and that they had never with their eyes seen stones or bones of the manatee as they described; and so we should rather understand that they meant the masticatory bones, or those white tooth masses to be found in the palate and inferior maxilla; and this was the more likely, as the description given by the eminent Samuel von Dale in his Pharmacologia coincides with my own; and his description also corresponds to these masticatory bones. For he gives, perhaps from autopsy (*ex αὐτοψία*), because he did not understand the mechanism of these bones, the following description: "The stone of the manatee is a white crustaceous bone similar to ivory, taken from the head, and it is of various forms," by which he no doubt meant to indicate the openings and meanderings of various forms to be seen upon the surface of both bones.[1]

The cranium is very solid; it has but little cerebrum, and the cerebrum is not separated from the cerebellum by any bony plate. Of the rest I could observe nothing striking.

The oesophagus or gullet is very capacious. Inside it is surrounded with a very tough, white, fibrous membrane, and with many perpendicular wrinkles and folds it goes to the stomach, and there, before it ends, it concludes with a large number of little triangular appendices one line long, which turn back upward toward the oesophagus. The use of these is, I think, that they may hinder the reflux of the food

[1] These bones are undoubtedly the ear bones, and that Steller failed to find them is due to the fact that he looked for them *inside* the cranial cavity. The ear bones of Rytina are not unlike those of the existing Manatee.—Ed.

back into the gullet, and at first sight they refute the preposterous opinion that has been held in regard to the animal's being a ruminant.

The oesophagus is inserted into the stomach nearly at the middle, as in the horse and the hare.

The stomach is of stupendous size, 6 feet long, 5 feet wide, and so stuffed with food and seaweed that four strong men with a rope attached to it could with great effort scarcely move it from its place and drag it out.

The coats of the stomach could not by any means be separated; together they were 3 lines thick. A very strange fat omentum 2 lines thick surrounds the stomach. In the upper part it adheres firmly at the middle to the membranous coat of the stomach; for the rest, it is detached and seems more to warm the stomach with its own heat than to hold it in place. The inner coat of the stomach is white, smooth, and not wrinkled nor villous. But what was most peculiar, and perhaps incredible to many, is that I found contained in the stomach, and not far from the entrance of the oesophagus into the stomach, an oval gland as large as a man's head, and grown fast to it something like a large aneurism between the muscular and fibrous (*nervosa*) coat; this gland opened through the villous coat with many pores and openings and exuded into the cavity of the stomach a great quantity of whitish liquid, in consistency and color like pancreatic juice. I had as a witness of this curious phenomenon the assistant surgeon, Bettge. What the character of this juice was I discovered by a double chance experiment; when I inserted a silver tube through the pores of the inner coat, in order to discover by blowing into them the excretory ducts, the tube came out black, as is wont to happen when silver touches sulphurous acid. I observed the same thing when I ordered Archippus Konovalow, the helper of the assistant surgeon, to take out the contents of the stomach with his hands, and when this was done a silver ring that he had upon his finger was stained with the same color.

The inner coat of the stomach was perforated by white worms half a foot long, with which the whole stomach, pylorus and duodenum, swarmed; and the worms had penetrated clear into the cavity of the glands. The gland when cut poured out a great quantity of juice. After that I could not examine any more stomachs, because I lacked the necessary assistance; and with the few men I had I could not, if I found an animal lying anywhere, turn it over upon its back; and therefore I am in doubt whether this gland is a constant thing or rather the result of some disease.

The pylorus was so large and tumid that at first sight I took it for a second stomach and was anxious to find the two others, too, because I thought the animal was a ruminant. But when I cut into the pylorus I was otherwise informed, and from its being like the stomach I saw that it was the pylorus. But to my misfortune it happened that the pancreas along with the duct into the duodenum and the ductus choledochus were cut, for the simple reason that the stomach could not be taken out whole with the liver on account of its great size, and besides, my assistants, who had been hired for just one hour with tobacco, which took the place of money, became tired of the work. Yet I recognized that the pancreas was divided into two lobes and composed of many flat, rather large glands, and that it was, for so large an animal, comparatively small; for it did not extend in length beyond 4 inches.

There are more intestines in this animal than in any other, except, perhaps, the whale alone, which hitherto I have not been in a position to inspect. The abdominal cavity was so full that the abdomen was tumid and swollen like an inflated skin. Hence, when the common coverings and muscles of the abdomen were removed and the peritoneum received ever so slight a wound, the wind came out with such a whistle and hum as it is wont to come from an aeolipile. For the same reason the whole abdomen is covered with a very strong double, membranous, fibrous peritoneum for holding in the intestines. The peritoneum reaches from the os pubis to the sternum, and is attached on both sides to the false ribs, from each one of which strong tendons, spreading out in many rectilinear branches, run from both sides to the linea alba; and when the muscles of the abdomen on the surface of the peritoneum are removed the tendons meeting each other and crossing each other make the surface of the peritoneum tessellated like a checkerboard, and present a pleasing spectacle to the eye. Other like tendons grow from the inner side of the ribs and are seen to intertwine (*impexi*) tightly with the peritoneum on the inside, increasing its firmness as with horizontal processes. Both membranes run into a single one in the middle about the linea alba, but toward the sides they are double.

When the peritoneum is cut the intestines gush out violently, and without any outside assistance they move from their original place, because they are found always so tightly stuffed that from oesophagus to anus they make a solid pack without any open space. The thin intestines are smooth, rolled up in a great amount of fat; they are round and 6 inches broad in diameter. If only a very slight aperture should be made with the point of a knife, the liquid excrement (a ridiculous thing to behold) would squirt out violently like blood from a ruptured vein; and not infrequently the face of the spectator would be drenched by this springing fountain whenever some one opened a canal upon his neighbor opposite, for a joke.

The coecum was very large, as was also the colon, and by a ligament that extended lengthwise on either side was divided into many little cells. But the valve of the colon I could not find, search as I might. To be brief, the intestines were different from a horse's in size and capacity alone, but not in structure. And so the final product of this workshop is so like the excrement of horses, in shape, size, smell, and color, and all other attributes, that it would deceive the most expert stable boy. And I will not deny that on the first days after our arrival on the island I was ignominiously deceived; I considered it no slight marvel, but I did not make the boast to have found what the boys did in the beans (*faba; fabula* (?)), when I found the stuff frozen together and so inexplicable (*cimmelium*). Now, I, not knowing from whence it came, argued from utterly false premises to an absolutely true conclusion that America lay opposite this island and not far away (for up to that time the continent had not been seen on account of the autumnal fog). But since horses are not kept in Kamchatka, but are kept in parts of America, the fact that the dung was brought over there whole and not dissolved, was an unquestionable proof of the proximity of land.

The whole intestinal tract, from gullet to anus, when this Augean stable was thoroughly cleansed, measured fully 5,968 inches, and so the intestines are twenty and a half times as long as the whole living animal.

The mesentery is exceedingly thick and half covered with a mass of little glands, varying in size from that of the acorn to that of the walnut. The lacteal, as well as the lymphatic vessels, I could not observe because of the opacity of the very fat, thick mesentery, although I searched while the intestines were still warm, for the veins are only obscurely and darkly transparent, inasmuch as they are as thick as one's finger.

A very strong, double membrane constitutes the pleura. Inside this, one continuous muscle an inch thick is interposed and covers both sides.

The urinary bladder, 2 lines thick, was very strong, but not larger than a man's head, and smaller than the bladder of an ox.

The trachea is composed of long, cartilaginous circles or semicircles, but has an entirely anomalous structure. One continuous piece of cartilage is twisted into a spiral and covered with a strong continuous membrane, both inside and outside. But the spirals of the trachea are not everywhere equal in breadth, but in some places the edge of the upper circle is hollowed out to receive the opposite eminence of the lower circle, and so makes it crooked. And so, by the help of this double membrane that encircles the trachea, the spirals are kept from being dislocated, either inside or outside. Through this mutual intertwining the rings are prevented from being loosened laterally. By this spiral structure the trachea is separated into branches below the glottis and reaches to the bronchi, and is seen to be such in the very substance of the lungs; it is so constructed for no other reason, perhaps, than that by the continuity of these spirals the huge mass of lungs may be more easily lifted up in breathing; for neither muscles nor anything else give so much help to the motion of lungs, which are situated in the back.

The glottis is like that of an ox, but is closed by the epiglottis much more closely and firmly than is the case in the land quadrupeds, so the epiglottis is in proportion much thicker. The diameter of the trachea below the glottis is 4.2 inches.

The thyroid gland is very large, and when cut it poured out a large quantity of liquid of double consistency and color: that which came from the larger exterior glands when cut was of the color of milk, but thicker than sheep's milk, and sweet to the taste; that which came from the middle portion of the gland or receptacle for the gland was contained in a membranous sac of its own; it was glutinous and had the consistency of meal poultice; it was somewhat sweet, with a very slight taste of bitter, and was yellowish-white in color. It occurred to me only in the last animal that I opened to make a closer inspection of this gland. I am very sorry that I did not think of it sooner, and take the pains to have the trachea, with the gullet, heart, and the rest of the viscera taken out entire. But it was not possible without the help of many men to do so with an animal so huge. If I had been in a position to do that, I should have observed whether or not it unloaded this liquid through some tube into a duct of its own, or into the stomach, as Vercellonius thought, or somewhere else. I saw the duct only after it was cut, but whither it led I neither saw nor do I wish to conjecture.

As to the heart it differs in many respects from the heart of all other animals: (1) In regard to situation, the apex of the heart stands in a line oblique to the sternum, the base in a line oblique to the back. (2) As to connection, the heart does not rest against the mediastinum, but is detached on every side and has no mediastinum at all. (3) It has a pericardium (but this does not envelope the heart closely) and a sac; but it forms rather a species of cavity in the thorax and lines the thorax. Toward the back and the base of the heart the pericardium is nearer to the heart than it is anywhere else. When the animal is feeding, the heart itself, with the pericardium, hangs not quite perpendicularly but somewhat obliquely from back to sternum; and so there the pericardium takes the place of a mediastinum. Lower down toward the abdomen the pericardium is fastened to the inner wall of the diaphragm, and with it constitutes one wall; and so it rests against the pleura at the sides. (4) As to size, when placed in a scale it weighed $34\frac{3}{4}$ pounds, and was from base to apices 2 feet 2 inches long, and from the extremity of one auricle to the other $2\frac{1}{2}$ feet broad; and so it was broader than it was long. (5) As to form, it was broad and thick, rather than long, and what was the greatest peculiarity of all it ended, not like a top in one apex but, in accordance with the number of ventricles, in two apices. Now, this slit in the apex extends to one-third the length of the heart, and from there on the two apices coalesce in one and form the septum of the heart, dividing the ventricles. The left apex is just a little longer than the right and thicker in circumference. The ventricles of the heart are extended farther below the septum, each into its own apex. The chordae tendineae and the columnae carniae (*cordis trabes*) or *sulci* (furrows) exceed the equipment of the human heart, not only in size and strength but also in number. The valves are the same in the pulmonary vein, the vena cava, the aorta, and the pulmonary artery, as in a man. The base of the heart is surrounded with a great quantity of thick fat that is placed around it like packing, distributed everywhere to the thickness of half an inch. Below this the large coronary veins of the heart are seen, covered inside with little valves which I have never observed anywhere else before in any other animal. With great care I searched for the foramen ovale and for the ductus arteriosus Botalli, but in vain. When I cut through the cavity of the pericardium I found it half full of liquid, so that even by this quantity alone I was led to believe that this liquid was unnatural (*praeter naturalem*), and that at the end it had been collected into this cavity, from whatsoever source it may have been secreted, in consequence of the slow and distressing death of the animal.

The lungs are two very long, white lobes that extend to the middle of the abdomen, one on either side along the dorsal spine. They are, however, detached, and not fastened anywhere, in which respect they differ from the lungs of birds, although they agree with them in respect to their position in the back. Either lobe is covered outside with a very strong membrane, and so if one should think only of the external structure and color of the lungs one would scarcely consider them to be lungs at all.

The liver consists of two very large lobes and a third of quite peculiar form; the third is almost square and looks like a blacksmith's anvil. It is situated half way between the two larger lobes, and is raised above them and lies immediately under the sternum. Outside, the liver is covered with a very strong fibrous membrane, so that it suggests anything but a liver. Through this membrane, in the gibbous part, the branches of the coeliac vessels (*venae celiacae*) excessively tumid, shine through like a tree, blue in color. When this membrane was cut the substance of the liver appeared, in color a tawny yellow, like that of an ox, but externally soft and most delicate in structure, so that at the touch it dissolved as if putrid under my hand.

The animal has no gall bladder. But the ductus choledochus, like that of a horse, would easily admit five fingers together; and so it was very capacious; it was half a line thick and very strong, whitish outside and yellow inside, and, opening into the duodenum, it coalesces along with the pancreatic duct into one canal.

The kidneys are hidden away in a cavity of the lumbar region on either side of the dorsal spine. They are 32 inches long and 18 inches wide; they have the ordinary form of kidneys and are included in a very strong membrane; when this was removed there appeared a great number of renules of the same form, as in the seal and the sea otter, but in size they were much larger than these. They were 2 inches long and 1½ inches wide on the surface, and they were pyramidal in form toward the interior. Each one of these lobules (*renunculi*) is provided with an urethra, papillae, and artery of its own. The urethras form six larger principal branches, and at last carry down the urine through one canal to the urinary bladder. But the pelvis is like an elephant's.

I overlooked the suprarenal capsules (*capsulae atribilariae*), and also the spleen, and likewise the internal organs of generation, and many other things which occurred to me in order only when I had no longer time nor opportunity for making full observations.

BRIEF DESCRIPTION OF THE BONES.

As to the bones of the manatee, the bones of the head in respect to strength and firmness are like those of a horse, but in respect to size and thickness they surpass the bones of all animals of the land.

The bones of the head taken together are not larger than a horse's head, nor are they very different in respect to form and articulation.

The cranium is anteriorly entire, without any suture, extending toward the nasal bones[1] in two hard processes, and joining the nasal and maxillary bones by an arthrodia, while the nasals join the maxillaries by ginglimus. The nasal bones meet in a rough suture. The temporal bone joins the cranium by suture, but the occipital by coalescence, being very hard and almost like rock. The inferior maxillary in adults consists of one bone, in calves of two.

The head from the nares to the occiput is 27 inches long, and at the occiput 13½ inches wide.[2]

There are sixty vertebrae in all: Six in the neck, nineteen in the back, and thirty-five in the tail.

There are five pairs of true ribs and twelve of false.

The body of the vertebrae of the neck is narrow, in general structure like the vertebrae of the horse's neck. How much they differ in certain special features I will not indicate, as I have no books nor a horse's skeleton, nor should I trust my memory or imagination.

The spines of the dorsal vertebrae are sharp and broad, and in lean animals, as there is no thick cuticle or thick adipose tissue in the way, they are perfectly visible.

The vertebrae of the back in the region of the stomach and liver are ridged on the inside, but all the rest are rounded and lack this sharpened prominence.

The vertebrae of the tail have each four processes; the lateral processes are long and broad; the superior process is like the lateral process in width but is shorter; and the inferior processes (chevrons) are single bones like the Greek lambda in shape, and are fastened to the body of the vertebrae by a cord and held firmly with very strong ligaments. All the vertebrae are joined together longitudinally by a great number of very strong, broad tendons, and are everywhere so covered up that because of them the bones can not be seen.

The five pairs of true ribs are joined to the sternum with cartilage. Both the true and the false ribs are all solid and very heavy and thick.

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[1] Really the frontals.—ED.

[2] Given in the previous table as 10½.—ED.

The sternum in the upper portion where the ribs are fastened on is cartilaginous; in the lower portion toward the notch of the heart (*scrobiculum cordis*) it is bony to a distance of a foot and a half.

In place of the innominate bone of the hip there are two bones, one on each side in size and form like the ulna of the human skeleton, and joined with very strong ligaments to the thirty-fifth vertebra on one side and to the os pubis on the other. It has no clavicles.

The arms consist of two bones, tarsus and metatarsus.

DESCRIPTION OF ITS HABITS AND NATURE.

I should have abstained from an extended description of this animal if I had not observed that there are in existence some brief and imperfect histories of the manatee, swarming with fables and false theories after the manner of the last century and the century before, in which the writers of natural history saw only through a lattice what they might have seen with their eyes; when investigating the unknown habits of animals, their character, and a thousand other things that have nothing to do with their subject, they only involved the best known facts in more than Cimmerian darkness.

Therefore I have endeavored to give a clear and succinct idea of its external form and that of the structure of its internal parts by stating its agreement and disagreement with others, next by explaining the mechanism and nature of the animal, and after that the use of its parts for food, medicine, and other things, and finally to add in perfect truth what I observed with my own eyes in regard to the movements, nature, and habits of the living animal.

Various things combined to cause me many disappointments. The weather at the time when the animals were captured was almost constantly rainy and cold; my observations had to be made in the daytime; then there were the tides of the sea; and the droves of blue foxes (*isatides*) would spoil everything with their teeth and steal from under my very hands; they carried away my maps, book, and ink when I was studying the animal and worried me when I was writing; the great size of the animal itself and the bulk of its parts were also a hindrance, as I had to be both observer and workman, as all the rest were anxious about the construction of a ship and our liberation from the island. At my own expense I could hire them for barely an hour at evening time for some of the simpler assistance, and in their ignorance and dislike for the work they would tear everything to pieces, and acted according to their own inclinations; so the injury they wrought and the loss they caused ought to be commended in that they did not desert me entirely. Not a single gut could I get out entire, nor unfold if I had got it out, so as to do anything worth while; so that for all the pleasure I got from certain observations I had twice as much trouble and annoyance in consequence of those useful things which I had to leave alone. So I beg of my kind readers, when they have finished reading this feeble description, that they will judge it by my will and my zeal rather than by the circumstances.

I had prepared a skeleton of a manatee calf, and I had taken the cutis with the cuticle separated from it and stuffed it with grass to bring it home with me; but when I saw that on account of the small size of our craft this was impossible I wanted to bring with me at least the spoils (skin), but even this wish was vain. I intended to do the same with the sea lion, the sea bear and the sea otter, but I was reckoning without my host, for in Kamchatka there is no hope of getting everything.

But let me cease from narrating my complaints and my hindrances.

The manatee is not the sea cow of Aristotle, for it never comes upon dry land to feed. And it is of little consequence whether it is the same or not, for it is not this animal that he described; indeed, he never saw it and never heard anything about it to tell. In the second place, I remark that Lopez Francisco Hernandes themselves saw the animals, and that Clarissimus Clusius and Ray, misinformed by them, have affirmed many things of the animal that are inconsistent with truth and autopsy.

1. The animal has no hair at all that can properly be called hair. It has bristles rather, or hollow quills, and these are found only around the mouth and under the feet.

2. The head of this animal is not that of a calf, as Cl. Clusius says; not that of an ox, as Hernandes was pleased to describe it; but in the character of its covering it is like no other animal, but has its own peculiar appearance.

3. The feet are entirely without claws, but skin covers them as it does the bone of an amputated limb, so that the animal moves upon a skin that is rough with bristles.

4. As to the fact that Hernandes attributes to this animal nails like those which men have, in order to make it more like the Platonic man, that is equally false, for the animal has no fingers at all any more than nails, unless perchance the hoof of a horse, to which it bears a certain resemblance, impresses anyone as being like a human nail.

5. And so, by the way, it is evident even from this how much obscurity envelops this subject if we start with false premises and arrive at worse conclusions. For instance, all authors with one consent agree that this animal ascends rivers and feeds upon the grass that it may manage to get along the banks, for they may perhaps have heard from the people that it feeds on herbs; but those are not land herbs, but seaweeds.

Nor does the statement have the appearance of truth, that they are in the habit of lying upon the rocks and of coming up on the land, even if I say nothing of the fact that the structure of the animal is totally unfitted for moving on dry land. Indeed, it happened that as the tide went out the waves receded from under one of the animals sound asleep and left him high and dry upon the shore; but he was helpless and unable to get away, a pitiable object, at the mercy of our cudgels and axes.

That this animal should be tamed seems more likely than do the anecdotes that are given of its remarkable sagacity, since even the untamable can be tamed through its stupidity and greediness. It happened to me on one unlucky occasion that I could watch the habits and ways of these beasts daily for ten months from the door of my hut, and I will briefly note down the observations that I made with great care.

These animals are fond of shallow sandy places along the seashore, but they like especially to live around the mouths of rivers and creeks, for they love fresh running water, and they always live in herds. They keep the young and the half-grown before them while they feed, but they are careful to surround them on the flank and rear and always to keep them in the middle of the herd. When the tide came in they came up so close to the shore that I often hunted them with my stick or lance, and sometimes even stroked their backs with my hand. If they were badly hurt, they did nothing but withdraw to a distance from the shore, and after a short time they would forget their injury and come back. Most commonly whole families live together in one community, the male with one grown female and their tender little offspring. They appear to me to be monogamous. The young are born at any time of year, but most frequently in autumn, as I judged from the new-born little ones that I saw about that time. From this fact, as I noticed that they copulated by preference in the early spring, I concluded that the foetus remained more than a year in the womb. From the shortness of the [uterine] cornua (*ex cornuum brevitate*), and from the fact that there are only two mammæ, I infer that they have but one calf, and I have never seen more than one with the mother at a time.

These animals are very voracious and eat incessantly, and because they are so greedy they keep their heads always under water, without regard to life and safety. Hence a man in a boat, or swimming naked, can move among them without danger and select at ease the one of the herd he desires to strike—and accomplish it all while they are feeding. When they raise their noses above the water, as they do every four or five minutes, they blow out the air and a little water with a snort such as a horse makes in blowing his nose. As they feed they move first one foot and then the other, as cattle and sheep do when they graze, and thus with a gentle motion half swim and half walk. Half of the body—the back and sides—projects above the water. While they feed, the gulls are wont to perch upon their backs and to feast upon the vermin that infest their skin, in the same way as crows do upon the lice of hogs and sheep. The manatees do not eat all seaweeds without distinction, but especially (1) *Crispum Brassicae Sabaudieae*, with cancellate leaf [sea-cabbage]; (2) that which has the shape of a club; (3) that which has the shape of an ancient Roman shield; (4) a very long seaweed with a wavy ruffle along the stalk. Where they have stopped, even for a day, great heaps of roots and stems are to be seen cast upon the shore by the waves. When their stomachs are full some of them go to sleep flat on their backs, and go out a distance from the shore that they may not be left on the dry sand when the tide goes out. In winter they are often suffocated by the ice that floats about the shore and are cast upon the beach dead. This also happens when they get caught among the rocks and are dashed by the waves violently upon them. In the winter the animals become so thin that, besides the bones of the spine, all the ribs show. In the spring they come together in the human fashion, and especially about evening in a smooth sea. But before they come together they practice many amorous preludes. The female swims gently to and fro in the water, the male following her. The female eludes him with many twists and turns until she herself, impatient of longer delay, as if tired and under compulsion, throws herself upon her back, when the male, rushing upon her, pays the tribute of his passion, and they rush into each other's embrace.

Their capture used to be effected with a large iron hook whose point resembled an anchor's fluke. The other end was secured by a very long, stout rope to an iron ring. A strong man took this hook and entered the boat with four or five others, and while one held the rudder three or four rowed gently toward the herd. The spearman stood in the prow of the boat holding the hook in his hand, and struck as soon as he was near enough. As soon as this was done, thirty men standing on the shore with the other end of the rope in their hands held the animal, and in spite of its frantic efforts at resistance they dragged him laboriously toward the shore. The boat was held steady by another rope, and the men wore the animal out by constant blows, until, tired and rendered thoroughly passive by the spears, it was finished by their knives and other weapons and drawn to land. Great pieces were cut from the animal while still alive, but all that he did was to work his tail vigorously and to brace himself with his fore feet, so that great pieces of skin were often torn off. Besides, he breathed heavily, as with a groan, and the blood from the wounded back spurted up like a fountain. As long as he kept his head under water the blood did not flow out, but as soon as he raised his head to breathe the blood leaped forth anew. This happened because the lungs, being situated at the back, were wounded first, and as often as they were filled with air they increased the force of spurting blood. From this I have concluded that the circulation of the blood in this animal, as in the seal, is in a double fashion—in the open air, through the lungs, but under water, through the *foramen ovale* and *ductus arteriosus*, although I did not find both. But I think it happens that they breathe differently from fishes, so that they can better swallow solid food, rather than for the sake of promoting circulation (*propter deglutitionem solidorum potiusquam propter circulationem promovendam*).

The full-grown, very large animals are more easily taken than the young ones, because the young move about far more vigorously, and even if a whole hook should be fixed in one of them it can get free by tearing the hook out of the skin. We saw this done more than once.

But if one animal is caught with the hook and begins to plunge about rather violently those near him in the herd are thrown into commotion as well and endeavor to assist him. To this end some of them try to upset the boat with their backs, others bear down upon the rope and try to break it, or endeavor to extract the hook from the back of their wounded companion with a blow from their tails, and several times they proved successful. It is a very curious evidence of their nature and of their conjugal affection that when a female was caught the male, after trying with all his strength, but in vain, to free his captured mate, would follow her quite to the shore, even though we struck him many blows, and that when she was dead he would sometimes come up to her as unexpectedly and as swiftly as an arrow. When we came the next day, early in the morning, to cut up the flesh and take it home, we found the male still waiting near his mate; and I saw this again on the third day when I came alone for the purpose of examining the entrails.

As to voice, the animal is dumb and utters no sound, but only breathes heavily and seems to sigh when wounded. I will not venture to assert how much their eyes and ears are worth. Anyway, they see and hear but little, because they keep their heads under water. At all events, the animal himself seems to neglect and despise the use of these organs.

Of all those who have written about the manatee, no one has given a fuller or more careful account than that most curious and painstaking explorer, Captain Dampier, in his travels, published in English in London in 1702. As I read it I could find no fault with it, although a few statements did not correspond with our animal.[1] For instance, he says that there are two species of manatees, in one of which the eyes are better than the ears, and in the other of which the ears are better than the eyes. What he says about the manner of hunting the animal, namely, that the Americans approach without any noise and without speaking, so as not to frighten the manatee,

[1] It is of course to be remembered that Dampier was speaking of the true manatees *Trichechus inunguis* and *T. latirostris*.

is no doubt true of places where they are caught in great numbers and have learned by long experience that men are dangerous to them. It was the same way with the otter, seal, and blue fox (*Isatis*), which lived in this desert island and never saw a man before and never were disturbed while lying at their ease. They were slain with no trouble at all when we first came to Bering Island, but now they have become just as wild as those living in Kamchatka, and take flight at once as they discover, not only with their eyes, but even with their sense of smell, the approach of an enemy.

It sometimes occurred that these animals were cast up dead by storms around the cape called Kronotskoi, as well as about Avatcha Bay. Because of the food they eat they are called by the inhabitants, in their language, "*Kapustnik*" (Kraut Esser; weed eaters); this I learned after my return in 1842.

Now, I must tell the uses to which the parts of this animal are put. The skins, which are very thick, firm, and tough, are used by the Americans, according to Hernandes, for the soles of shoes and for belts. I understand that the Tschuktschi use the skins for boats; that they stretch it with sticks and use it in the same way as the Koriaks use the skins of the largest sort of seals, called "*Lachtak*."

The fat underlies the cuticle and the skin and covers the whole body to the depth of a span, and in some parts is almost 9 inches thick. It is glandulous, stiff, and white, but when exposed to the sun it becomes yellow like May butter (*butyri maialis*). Its odor and flavor are so agreeable that it can not be compared with the fat of any other sea beast. Indeed, it is by far preferable to that of any other quadruped. Moreover, it can be kept a very long time, even in the hottest weather, without becoming rancid or strong. When tried out it is so sweet and fine flavored that we lost all desire for butter. In flavor it approximates nearly the oil of sweet almonds and can be used for the same purposes as butter. In a lamp it burns clear, without smoke or smell. And, indeed, its use in medicine is not to be despised, for it moves the bowels gently, producing no loss of appetite or nausea, even when drunk from a cup; and, in my opinion, it would do calculous persons more good than the masticatory bones or so-called stones (*lapides*) of the manatee. The fat of the tail is harder and stiffer and so more delicate when tried out. The flesh has a grain somewhat tougher and coarser than beef, and is redder than the flesh of land animals; and what is remarkable, even in the hottest days it can be kept in the open air for a very long time without any bad odor, even though all full of worms. I attribute this to the fact that the animal lives entirely upon seaweed and sea plants. These weeds contain a smaller proportion of sulphur and more sea salt and nitre. This salt prevents the loss of sulphur and the softening and decaying of the flesh, preserving it in the same way as salt or brine sprinkled upon meat; but they work even more powerfully, as these salts are more intimately mingled with the substance of the flesh and are combined more permanently with the sulphurous parts (or particles of sulphur?) (*cum sulphureis partibus fortius cohaereant*).

Although the flesh needs to be cooked longer, yet when done it has an excellent taste, not easy to distinguish from that of beef. The fat of the calves resembles fresh lard, so that you can hardly tell the difference; but their flesh is just like veal. When boiled it soon becomes tender, and if the boiling is continued it swells up like young pork so that it takes up twice as much space in the pot as it did before boiling; but the muscles of the abdomen, back, and sides are far better. The flesh does not really refuse to be salted, as many have thought, but the salt only modifies it, so that it becomes quite like corned beef and very excellent in flavor.

The internal organs—heart, kidneys, and liver—are very tough, and we did not try to do much with them, because we had a great abundance of meat without.

A full-grown animal weighs about 8,000 pounds, or 80 hundredweight, or 200 Russian "*pud*." There is so large a number of these animals about this one island that they would suffice to support all the inhabitants of Kamchatka.

The manatee is infested with a peculiar insect something like a louse, which is wont to occupy and inhabit in great numbers especially the wrinkled arms, the udder, the teats, the pudenda, the anus, and the rough hollows of the skin. When they bore through the cuticle and the cutis, here and there wart-like prominences are produced by the lymphatic moisture that exudes. So these insects attract the gulls to perch upon the backs of the animals and hunt this dainty with their sharp beaks, thus rendering the animals, which are worried by the vermin, a friendly and welcome service.

These insects are for the most part half an inch long, articulated, six-footed, translucent, white or yellowish. The head is oblong, sharp, larger than a millet seed. In front extend two short, jointed little antennæ half a line long. In place of a lower mandible it has two slender, two-jointed little arms like a shrimp, very sharp and pointed on the end. Furthermore, in accordance with the number of his feet, he is composed of six articulations, convex on the back, and one-third of a line wide. But the ring of the thorax is twice as wide, and they grow narrower toward the tail. The ring of the thorax resembles the half of a lentil. On the sides of this a pair of thick claws grows, with two joints each. Each claw ends in a flexible point, by means of which it holds fast to the skin of the manatee; the rest of the legs are rather slender, all ending in prickly points, and gradually shorter. The last two are the shortest, and, growing out from the orbicular ring of the tail, form the end of the body itself and steer the insect as it moves.

THE HABITS AND CHARACTERISTICS OF THE SEA BEAR.

Dampier has given us a description of this animal, called *Kot* by the Russians, which is, to be sure, brief and imperfect; but he mentions its characteristics so definitely and plainly and so clearly at first sight that I can not doubt that the animal is his "sea bear."

Report, as I gather from the account of the people, has declared that the sea bear, as it is called by the Rutheni and other people, is different. They say it is an amphibious sea beast very like the bear, but very fierce, both on land and in the water. They told, likewise, that in the year 1736 it had overturned a boat and torn two men to pieces; that they were very much alarmed when they heard the sound of its voice, which was like the growl of a bear, and that they fled from their chase of otter and seals on the sea and hastened back to land. They say that it is covered with white fur; that it lives near the Kuril Islands, and is more numerous toward Japan; that here it is seldom seen. I myself do not know how far to believe this report, for no one has ever seen one, either slain or cast up dead upon the shore.

This is certain, whether we consider the appearance of the body or the habits of the beast, it is more nearly related and more similar to no other land animal than to a bear.

They are never seen in the gulf of the Penshin Sea nor in the land of Kamchatka, nor do they go on shore in the Kuril Islands except very seldom; they are not taken except on three Kuril Islands, and from there to the mouth of the river of Kamchatka, in the so-called Bobrovi [sea otter] Sea, from latitude 50° to 56° N. These bears pass by the Kuril Islands in the early spring, and in September they are taken in small numbers about the mouth of the river called Shupanova and from there to Cape Kronotski in greater numbers. Here, to be sure, between the two capes, Kronotski and Shipunski, the sea is quieter and there are more inlets and recesses; hence the animals delay here longer as they pass by and more of them are caught. Almost all that are caught in the spring are females, and have the young almost ready for birth within them. The fœtuses, when removed, are called "*Viporotki*." All that are found are put on the market. They are no longer to be seen anywhere from the first of June to the end of August, when, with their young, they return to the south. For many years these migratory animals have been a source of wonder and speculation to the people who have been interested in hunting them. For, whence did these animals come in early spring? Whither were these very fat, these pregnant beasts, going in countless droves? What are the reasons for this migration? Why do they return with their offspring in the fall so thin, dry, and weak? And whither are they going?

From the fact that the animals come very fat from the south in early spring and return thither in the fall, it was naturally inferred that they had taken no long journey, and that their winter quarters could not be very far distant, else they would become too thin upon the way. And from the fact that they were all going toward the east and were never seen beyond Cape Kronotski or the mouth of the Kamchatka River, either going east or returning home, they concluded that there must necessarily be some land, either island or mainland, near the land of Kamchatka and in a line with Cape Kronotski.

Among amphibious sea beasts these are the migratory animals, like geese, swans, and other sea birds, or like catanadromous trout among fishes; the blue foxes, hares, and mice occupy this place among quadrupeds. Now the migration of the blue fox is undertaken because food becomes scarce. Birds and fishes migrate to lay their eggs or to indulge undisturbed their sexual instincts, and, because their strength is reduced or their feathers shed, and hence they are unable to flee from their foes until these can grow once more, solitary places are chosen by birds and quiet lakes by fishes. Accordingly, for a similar reason, these northern places are chosen by the sea bears; and these desert islands, lying in great numbers between America and Asia from 50° to 56° north latitude, are chosen for the following reasons.

That the mothers may bear their young there upon the land and after parturition recruit their strength; further, that the young may there be brought up and nourished and may grow strong enough in three months to follow their parents home in the autumn. The pups are fed with their mother's milk for two months. The mothers have nipples corresponding in form, size, and position with those of the sea otter, and they are situated near the pudenda. They bear one pup at a birth, very seldom two. After parturition they gnaw the umbilical cord off from the pups with their teeth, as dogs do, and lick it till it is dry, so as to keep the blood soft until it heals; and they devour the afterbirth greedily. The pups are born with their eyes open, and their eyes are as large as those of a calf. When they are born they have thirty-two teeth started out on a level with the gums; but there are four larger canine teeth, ferocious and suitable for battle, still hidden in the gums. These come out after the fourth day. When the pups are born they are covered with shining black fur all over. But the fourth or fifth day after birth the fur under the front legs changes color perceptibly and takes on the color of the hair of Pliny's goat; and after a month the belly and sides become speckled with an intermixture of hairs of the same color. At birth the males are much larger and darker. and in the years that follow they get a blacker coat than the females. These latter become almost wholly ashy gray, but have rusty spots under the forelegs. The females differ so much from the males in size, weight, and strength, that a careless observer might almost take them for a different species, so timid and so little ferocious are they.

The parents love their young exceedingly. The females, after parturition, lie in crowds upon the shore with their pups and spend much time in sleeping. The pups, however, directly in the first days play together like children, and imitate their parents in playing at copulation, and practice fighting until one throws the other to the ground. When the father sees this he rises up with a growl and hastens to separate the combatants, kisses the victor, licks him with his tongue, tries with his mouth to throw him upon the ground, and makes vigorous demonstrations of his love for the youngster, who struggles bravely against it. In short, he rejoices that he has a son worthy of himself. But they are less fond of the lazy and ease-loving pups. Hence some of the young are always near the father, others near the mother. The males are polygamous; one often has eight, fifteen, or even fifty wives. He guards them with anxious jealousy, and goes into a rage if another male comes ever so little too near.

Although many thousands of them lie upon the shore together, yet it may always be observed that they are separated into families—the one male lies with his wives, his sons, and daughters, as also his yearling sons who are not yet old enough to have a harem. One family often numbers as many as 120. For this reason also they swim in the sea in shoals.

All the married ones are vigorous, but the aged and those that are too old for the warfare incident to keeping up a harem, or that are driven to it by impotence or the voluntary desertion of their wives, lead a monastic life, and pass it constantly in fasting and sleep. These married ones are the fattest of all, and without the females they come first to the island, like scouts. All the males have a strong odor, but theirs is the worst. These old animals are very cross and very savage. They live a whole month in one place without food or drink; they sleep all the time, but rage with exceeding fierceness at all who pass by. Indeed, they are so very fierce and jealous that they would a hundred times rather die than give up their place. And so if they see a man they go out to get in his way and prevent his passing; one of the others meanwhile gets his place and is ready to fight with him. When we were obliged to come into conflict with them because of the necessity of continuing our journey, we threw great stones at them. They in turn would rage at the stone thrown at them just as a dog would, and start up in defiance and fill the air with their terrible roaring. What we first attempted was to knock out their eyes and break their teeth with stones; even though wounded and blind they would not give up their place or dare to leave it; for if one of them went even a pace away, so many enemies would rise up and attack him with their teeth as he fled that he should not leave his place, that even if he escaped our hands he would be torn to pieces by his fellows. Indeed, if one leaves his place, the rest run up to prevent his flight; one attacks the other on suspicion of wishing to flee, and from a single attack so many duels originate that oftentimes for 2 or 3 furlongs by the seashore you can see nothing but duels, battles, and a thousand sights absurd but bloody, accompanied by a terrific roaring and growling. While they fight with one another they let us alone, and we are able to pass by unmolested. If two fight against one, another comes to his aid, for they can not bear to see an unequal combat. When there is fighting going on, others who are swimming in the sea lift up their heads to see the outcome of the contest, and finally they are worked into such a rage themselves that they come on shore and mix in crowds with the combatants and make the sight more awful. I often went with my Cossack and attacked one on purpose and knocked out his eyes; and when I had done that I pelted four or five others with stones. When these pursued me I took refuge near the one I had blinded. As he could not see but heard his brothers in pursuit and did not know whether they were fleeing before us or pursuing us, he would attack his fellows. Meanwhile, quite at my ease, I would sit down in some high place and watch them fighting together for some hours. The blind one would attack all that came near, whether enemies or friends, and was pursued by all as a common foe. If he fled to the sea he was pulled out again, and on land was torn by their constant blows until he lost all his strength, and falling down breathed out his angry soul amid constant groans, and became a prey to the hungry droves of blue foxes which attacked him with their teeth as he lay there still breathing.

While two often fight for an hour, they make a truce, and both lie down near one another, panting to get their breath. When they are recovered they both get up and in gladiatorial fashion take a certain place and refuse to leave it as long as the fighting continues. They duck their heads and strike back, and one tries to ward off the blows of the other. As long as they are evenly matched they strike only with their front flippers, but as soon as one gets the advantage of his adversary he tears him with his teeth and jaws, shakes him, and throws him down. Then the others, who have meantime been mere spectators, seeing this, hurry up to assist the weaker one, as if they were umpires in the fight. With their teeth they inflict wounds as large and cruel as if they were made with a saber. At the end of July a sea bear is seldom seen that is not marked with a wound. After a battle the first thing they do is to go into the water and bathe their bodies.

They fight mostly for one of three reasons: (1) The most bitter warfare is about their wives; trouble begins when one steals those of another, or even tries to take the grown daughters from the father's family. But the females get up at once and follow the one that comes out ahead. (2) They fight for their place if one takes the place of another, or if the space is too small and another, out of lust, gets too near and excites his suspicion. (3) They fight for right and justice, to settle disputes.

They are very fond of their wives and their young, and are much feared by both. They get in a towering rage with their young for the most trivial causes and practice a tyrant's right.

Often we entered the harem and stole the pups. In these cases, when flight was possible, if the mother through fear left her pups and did not snatch them up in her mouth and take them with her, but left them where we could get them, the male without entering into any quarrel with us snatched the female up in his teeth, lifted her up high, and threw her in a rage two or three times against the rocks with such violence that she lay still as if dead. But when her strength returned she would crawl like a worm as a suppliant to his feet, and kiss him, and shed tears in such quantities that they ran down on her breast as from an alembic and made it all wet. For a time he would walk back and forth roaring and rolling his eyes terribly, and would shake his head from side to side like a bear; but at length when he saw that we were going to go away with the pups, he would weep in the same way as the female, and just as copiously, so as to flood his whole breast, even to his feet, with tears. The same thing occurs when he suffers grievous wounds or some severe injury which he can not avenge. I have seen captive seals weep in a similar way.

A second reason why the sea bears in early spring go east to these desert islands is doubtless this. By rest, sleep, and a three months' fast, they must rid themselves of their burdensome fat, in the same way as land bears do in winter. For during the months of June, July, and August, they do nothing except sleep upon land, or lie at ease in one spot like a rock, and look at each other, roar, kiss, and stretch, taking neither food nor drink. One in particular I noticed lying in the same spot for a whole month. Although at different times I dissected the old males, yet I found nothing at all in their stomachs except froth and gastric juice, and no faeces in the bowels. Furthermore, I noted that meanwhile the layers of fat wasted away more and more, the size of the body becoming diminished and the skin becoming so loose that it hung like a sack and swayed with each motion of the body. The younger ones that are not so fat begin to cohabit about the first of July; they are active and run here and there, living on land and in the sea by turns. This fact convinced me still further that in accordance with his nature I should call this animal a bear.

They cohabit after the manner of the human kind, the female below and the male above, and especially near evening time do they desire to indulge their passion. An hour before, male and female cast themselves into the sea and swim around quietly together. Then they come back together, and the female lies flat on her back while the male comes up out of the sea upon her. He seizes her in his arms and indulges his passion with the greatest heat. During the coition he presses the female down and buries her in the sand by his weight so that only her head sticks out, and he himself digs into the sand with his front feet, so that he presses down and touches the female with his whole belly. For this they choose a sandy spot upon the very shore, where the waves come even to the place. So absorbed are they and so forgetful of themselves that I could stand near them for more than a quarter of an hour without being observed. And I should not have been seen even then had I not struck the male a blow, whereupon with a great uproar he attacked me so wrathfully that I got away with difficulty. But nevertheless when I gained an eminence from which I could look down he went on for another quarter of an hour with what he had begun.

These animals have three different kinds of speech. To pass away the time while they lie upon the land they cry out, and their voice is not at all different from the lowing of cows when deprived of their calves. In battle they roar and growl like a bear, and if they get the victory they utter a very sharp and often repeated note like our common crickets. But when wounded and overcome by their enemies they groan terribly or hiss like a cat or sea otter.

When they come out of the sea they shake their bodies and wipe off their breasts with their back flippers, and smooth their fur. The male places the tip of his lips to those of the female as if to kiss her. When the sun shines clear in the sky they lie down and raise their back flippers in the air and move them in the same way as a dog wags his tail. They lie sometimes on their back and sometimes on their belly like a dog, sometimes curled up in a ball, sometimes stretched out on one side with their front flippers resting on the side. But although they sleep soundly, and though a man may approach softly, nevertheless they are speedily aware of his presence and get up, whether informed by hearing or the sense of smell I know not.

The very large old ones never run away from a man or a crowd of men, but prepare at once for battle. Nevertheless, I have seen whole herds put to flight if a man whistle. The females flee in haste, and likewise whole droves of adult males, even many thousands, are driven in headlong flight to the sea, if suddenly, when they feel secure, they are attacked with a great noise. But when, as often, we drove many thousands of them before us into the ocean, those that were swimming accompanied us constantly as we walked along the shore, gazing in wonder upon their unusual guests.

They swim so rapidly that in an hour they can easily swim two German miles. If they are wounded at sea with a harpoon they draw the boat with the hunter after them so swiftly that the boat seems to fly, and they often overturn the boat and drown the hunter unless the steersman prevents it by watching and skillfully directing his course; they swim with the back sloping, and the front flippers are never seen, but the back ones sometimes project up from the water. On account of the open *foramen* they stay a long time under water. But they afterwards come up to breathe, with their strength much exhausted; they delight to swim around near the shore and swim now prone and now on their backs, but not far under water, so that I was always able to make out their course. They often raise their hind flippers out of the water. When they have breathed enough, or when they first start into the water from the land, they plunge into the water head first like a wheel, as do almost all the larger sea beasts—the otter, the lion, the balaena orca, and the porpoise.

When they climb a rock, they take hold of it with their front flippers as seals do, and drag the rest of their body behind them, bending the back like a bow and holding the head low, to give elasticity to the body. In swiftness they almost if not quite excel the swiftest runner, and the females are especially fast. There is no doubt that many of us would have been killed by them if their legs were worth as much on land as they are in water. And, indeed, it is not wise to fight with them even in a large level place, for there one can get away with difficulty. Steep places were always our refuge of safety, because they can not climb up them. They sometimes laid siege to me for more than six hours, and at length compelled me, at very great peril of my life, to ascend a precipice, and in that way to escape from the infuriated beasts.

If I were required to state how many I saw on Bering Island I should truthfully say that I could not guess—they were countless, they covered the whole shore. Not infrequently they obliged me and my Cossack, in our rambles this way and that through the entire island, to leave the shore and prosecute our journey with difficulty over the tops of the hills.

The sea otters are very much in fear of the sea bears, and very seldom come in among them, and it is the same with the seals. But the sea lions live among them in great herds and are much feared by them. They always have the best places. The sea bears do not like to stir up quarrels when the sea lions are present for fear they have these savage beasts as umpires; for they run up immediately, as I have sometimes seen. So also they dare not try to prevent their females from playing with the sea lions.

And, by the way, this is a curious fact, that the sea bears are not found everywhere on the shores of their islands, as are the sea cows, the seals, the otter, and the sea lions, but only on the southern shore, which faces Kamchatka. The reason of this is obvious—for they see this part of the island first when they come on their journey eastward from Cape Kronotski. They are not found in the northern part unless they have strayed there by mistake.

Now about the hunting of these animals. Those that we first blinded on land with stones were afterward dispatched with clubs without any artifice. But the beasts are so tenacious of life that two or three men beating only their heads with clubs could scarcely kill them with 200 blows, and frequently would have to rest and refresh themselves two or three times. When the cranium is broken into little bits and almost all the brains have gushed out, and all the teeth have been broken, he still attacks them with his flippers and keeps on fighting. I have purposely broken the skull and put out the eyes of one and then left him, and afterwards for more than two weeks he still stood alive and unmoved, like a statue, in the same place.

In the sea around Kamchatka they very seldom come ashore on the mainland, but they are wounded at sea by the natives with an iron spear called "*nosok*," which detaches from the handle and remains in the body, and this iron part of the spear, because inside it is oblique to the wound, sticks fast. It is bound to a stout thong, the other end of which is held by those sitting in the boat. But the wounded animal flees very swiftly like an arrow, and takes the boat and men along with him, until he pauses, worn out and exhausted with loss of blood. As soon as he pauses they draw him up to them by the thong and pierce him with spears, and if he attempts to upset the boat they crush his front flippers and his head with axes and clubs, lift him dead into the boat, and hasten home. By preference in spring they kill the pregnant females and the young males. But they dare not attack the large, old males, but when they see one they say "*Sipang*" (the devil), for they mean by that to call the big fellow evil and destructive. So likewise they say if they see a sea lion or a very large sea bear on land when they have no companion or weapons.

Very many sea bears die a natural death from old age on this island every year, and as many more fall in battle and die from the wounds that they have received; so that in some parts the whole shore is covered with bones and skulls, as if great battles had been fought there.

I can not omit to mention that these animals have a very large thymus gland, composed of many little glands, and rolled up in a membranous sac. I have made an incision into a branch of the main artery of the lungs, and when I inserted a little tube and blew in with my mouth I discovered that not only the ventricles of the heart but also the thymus gland swelled up. I would rather not suggest what others may conclude in regard to this, unless I could make many more experiments on other sea beasts.

Here, at the end, I will mention that it is a very curious thing what the explorer, Dampier, says of the Island Ferdinand (Juan Fernandez), below 36° south latitude; he asserts that there upon the land he found the whole shore covered with countless herds of seals, sea lions, and sea bears, in the same way as we found it in Bering Island. This does not lead me to believe that these animals come hither from those southern latitudes, for this distance would be far too great, but I gather from it two facts: first, that the sea beasts of the southern hemisphere are the same, or not very different, from those of the northern in about the same longitude; and, second, it is credible that our sea bears spend the winter at about the same degree of north latitude. Perchance some time fate will grant that since we have found their summer camping ground others may somewhere discover their winter home; if this be not the land called "*Compagnie land*," perchance it may be a land lying not far away and some time to be discovered.

I have had two pictures made, of which the former represents a male resting on a rock, as they are generally seen; and the second, a smaller female lying upon her back. I have her represented in this position chiefly for the reason that the shape of the hind leg may appear, and this could not be brought out true to nature if she were in sitting position.

As to style and arrangement of matter, pressure of duties does not permit me to spend too much time in perfecting any one thing, unless I am to allow many things to go to waste upon my hands. I therefore set out my porridge in carefully made earthen vessels. If the vessel is an offense to any one, he will perform for me and others a most friendly service if he will pour it all into a gold or silver urn. As to the fact that I have noted the minutest circumstances, I did it for this reason: that I might omit nothing that I learned from careful watching. For the rest, I guarantee that I say nothing that is not most true; an account can always be made shorter, but not longer or fuller, if it has been from the outset restricted within rather narrow limits.

HABITS AND CHARACTERISTICS OF SEA LIONS.

These beasts are indeed terrible to look upon when alive, and they far surpass the sea bear in strength and size as well as in endurance of the different parts. They are hard to overcome and fight most viciously when cornered. They also give to the eyes and mind the impression of a lion. Nevertheless, they fear so much the very sight of man that if they see one even at a distance they rush in headlong flight from the land into the sea. But if, when they are sound asleep, a man comes up near and wakes them by a blow from his stick or by a loud noise, they take to flight at once, panting like a furnace, and with their limbs shaking so with fear that they can not control them. But if one of them is cornered and all chance for flight is shut off he turns against his enemy with a great roar, shakes his head in wrath, rages, cries out, and puts even the bravest man to flight. The first time that I tried this experiment was almost the last of me. On this account this animal is never hunted at sea by the Kamchatkan tribes, because he overturns the boat of the hunters and slays them most savagely. Nor does anyone dare engage him even on land in open battle, but he is caught by guile when off his guard and quite at ease, or even sound asleep. When the beast is asleep on land, the hunter who has most confidence in his strength and swiftness, creeps silently up to it with the wind in his face and plunges into it under its fore flippers an iron or bone spear called a "*nosok*." It is made to fly out of its socket and is fastened to a thong made from the skin of this very animal. The other hunters keep the thong, which is wound several times around a rock or a stake driven deep into the ground. While the beast that has been wounded and aroused attempts to get away, the other men shoot arrows at it from a distance, or transfix it with a second spear fastened to a thong. At length when its strength is gone they pierce it with spears and kill it with clubs. But when they attack it they attack it asleep on the shore where there are few rocks; they shoot poisoned arrows, and then run away. The animal is compelled by the poison to come on shore, as the salt sea water increases the pain of the wounds; and then, if the place is a convenient one, he is stabbed, or otherwise, if left to himself, he will die of the poison in twenty-four hours. All who have the skill and daring to hunt this beast, and who have killed many, are held in great honor by their fellows, and are regarded as heroes and braves. Accordingly the love of glory, as well as the excellence of the flesh, turns many to the hunt and makes them ready for hazardous enterprises. They often load their boats with two or even three of these animals, till they threaten to sink in the water. But they are so skillful that this seldom happens in the smooth sea, even though the rim of the boat may be even with the surface of the water. They consider it a great disgrace if, through fear of death, they abandon the quarry that they have once secured, so that if their hands should not avail to bail out the water they would sink. To hunt this beast the bravest men go out to sea in their light canoes four or five German miles to the uninhabited island called Alait. And it not infrequently happens that the sailors without a compass are taken by a contrary wind four, five, or even eight days out to sea without anything to eat, and see neither island nor mainland, and have only the rising and setting of the sun and moon to direct them.

The blubber, as well as the sweet flesh, is well flavored and highly prized, and the gelatinous flippers are considered a prime delicacy. The fat is not greasy, like that of seals and whales, but is stiff, and resembles that of sea bears in color, but not in flavor and smell. The fat of the young is sweeter than mutton tallow and resembles the marrow of leg bones. From the skin they make thongs, the soles of shoes, and even shoes themselves and leggins.

They are polygamous. One male has two, three, or four females. The pups are born on land about the beginning of June—one only at a birth, and are suckled by their mothers. They come together in August and September, hence the young remains in the womb nine months, as indeed seems reasonable. They copulate like the sea bears. The males hold the females in great respect and do not treat them so harshly as the sea bears do their wives. They delight exceedingly in the caresses of the females and count their affection worthy of much more demonstrative return. The males, like the females, have a very indifferent love for the pups. The mothers when asleep sometimes crush the young at their udders by their weight and kill them, as I have often seen, and they were not the least bit disturbed when, as often, I cut the throats of the young, even before the eyes of their parents and threw the entrails to them. The pups are not so lively and active as those of the sea bears, but sleep all the time or play a little in a lazy way, and indulge in amatory sports. At eventide the mothers with the young go out into the sea and swim quietly near the shore. When the pups get tired of swimming they are wont to perch upon the backs of their mothers and rest. But the mother rolls over like a wheel and shakes the lazy pups off, and accustoms them to swimming. As an experiment I have thrown young sea bears and equally young sea lions into the water; but they were so far from being able to swim or to use their flippers well that they beat the waves irregularly with their flippers and hurried to the shore. The pups are twice as large as those of sea bears.

Although these animals are exceedingly afraid of man, yet I have seen them grow used to him and become tame by meeting him frequently without injury, and especially at that time when the pups had not yet learned to swim easily. I lived a season in the midst of a he.d of them, and for six whole days on a spot above them, where from my hut I watched their habits carefully. They lay around me in every direction; they watched my fire and what I did, and did not run away any longer even when I walked around among them, and took their pups and killed them and examined them. They practiced coition, fought jealously for their wives and for the best places, and fought most bitterly in just the same way and with the same motions and the same heat as the sea bears do. One from whom a female had been taken fought with all the rest for three whole days, and was wounded all over in more than a hundred places. The sea bears never mingle in their fights, but if a quarrel arises they run away, looking all around them. They yield them the choice of places and allow their females and pups to indulge in various sports, and dare not object. As far as possible they avoid all dealings with the sea lions, but these, uninvited and unwelcome, often mix in their quarrels. The old and decrepit among them grow white around the head, and beyond all doubt these beasts are very long-lived. They scratch their ears and head with their hind flippers, as the bears do, and stand, swim, lie down, and walk in the same way. They low like cows and the young bleat like sheep, and while I was among them it seemed to me as if I were playing shepherd and were mingling with herds of cattle. The old and worn-out emit an odor, but far milder and less offensive than that of the sea bears. They are found in this island in spring, as well as in winter and summer, but only in certain parts—those that are rocky and near precipices. Nevertheless, others come here every year along with the sea bears. I have seen them in great numbers along the American shores. They are found in Kamchatka almost all the time. They do not go above 56° north latitude. They are hunted a great deal near Cape Kronotski and around the island Ostrovnaia, around Avatcha Gulf, and from here as far as Cape Lopatka. They are found in the Kuril Islands and almost as far as Matmej Island. Captain Spangberg on his chart has named a certain island from the number of these animals that he found upon it, and from a cliff overhanging their city, the "Palace of Sivutch." The sea lion is never seen in the Penshin Sea. The reasons why these beasts come hither in June, July, and August, are for quiet, for parturition, for rearing and teaching the pups, and for copulation. Before and after this period they are found in greater numbers on the shores of Kamchatka.

As to the food of these beasts, they prey upon fish and seal especially, and also upon otter and other sea animals. The old ones eat little or nothing at all in June and July, but take their ease and sleep, and at the same time become very thin.

HABITS AND CHARACTERISTICS OF THE SEA OTTER.

These animals are very beautiful, and because of their beauty they are very valuable, as one may well believe of a skin the hairs of which, an inch or an inch and a half in length, are very soft, very thickly set, jet black and glossy. The soft underfur also among the longer hairs is black; but the tips, or the hairs from the middle on, are black, while the bases or roots are whitish, lustrous like silk, and silvery. The most valuable skins are almost perfectly black; others are found with silvery fur shining quite white all over, but they occur very rarely. Although as time goes on they change the color of their hair, they are still much more constant than the sables, and sable skins never shine with so deep a natural blackness as the otter's. The one thing to be deplored is that the skin is too thick and heavy, and for that reason is less pleasing to the eyes of the gentler sex; for the skin of an adult otter weighs, on an average, $3\frac{1}{2}$ pounds.

Rarely is an otter caught that is black all over; the head of the best grade of otters is silvery gray; the cheaper grade of otter has a head of a tawny color and yellowish fur; and the lowest grade of otter is that which has no long hair, and is clad only in short, dirty-gray fur. With these animals matters stand like this: the skins of certain animals always grow red hairs, rarely very long, while the animals themselves are stupid, sluggish, surly, sleepy; they lie forever asleep upon the icy rocks; they move slowly, and can be captured without any painstaking or ingenuity, as if they knew that because of the inferiority of their hides they were not very seriously exposed to death. Many of them, however, have most beautiful tails, covered with long, black fur. From these considerations I have come to two conclusions. (1) That the skins of sluggish animals are overgrown with only short hair, for the simple reason that in summer time, while they roll about in the sand, the longer hairs are worn off by the constant friction, and in the winter, while they lie upon the damp ice, the longer hairs stick fast to the ice, and are pulled off when the animal moves. This I have seen with my own eyes. (2) That black hair, through the influence of air and sunlight, grows lighter and feebler, and so the tail, as it is curled under the lying animal, is less exposed to friction and to the rays of the sun, and so preserves the original blackness and length of hair. The more active and cunning and fleet the animals are, the more beautiful is the fur with which they are covered, and again, unlike the others, they are captured but rarely, and that only by well-laid snares. Such animals are so careful about their own safety that if they come out on dry land alone to sleep, they look around very carefully, and, inasmuch as their eyes are not very strong when on land, they turn their noses in every direction before they go to sleep, to make sure that no man is in the neighborhood—and then, even though they perceive no sign whatever of danger, they do not get far away from the sea. They often wake up with a start, look around, and never sleep very soundly. But if whole herds sleep together on the land, the finest looking leaders [of the herd] stand on sentinel duty, and arouse the rest if any danger threatens.

The skins of females can be distinguished from those of males at the very first sight, because they have shorter, finer, more beautiful hairs on their backs and longer ones on the belly; the flesh of the females is more tender, more savory, and more delicious because of the distribution of the fat. In the former respect they are different from quadrupeds and birds, for in these classes it is the males that are covered with the more beautiful hair and feathers and the brighter colors.

They do change their hair, however, like land animals and birds, but with this two-fold difference: some lose their hair in the months of July and August, but they lose very little of it; the others change their color somewhat and come out a darker gray, and are for that reason called by the Russians and merchants "*Letnie Bobry*," and are sold at a smaller price. The most prized skins are those which are taken from animals in March, April, and May.

The adult males are called "*Bobry*," the females, "*Matka*," and the one-year-olds, which have taken on the soft, short fur, "*Koschloki*"; the cubs are called "*Medviedki*," or "little bears," because they have very long, thin, tawny hair like bears; their skins can scarcely be distinguished from the skins of the young bear, but after five months they lose their hair, and then they are called "*Koschloki*," as intermediating between the cubs and the one-year-olds, and are then covered only with soft, downy fur.

Upward of fifteen years ago, the finest skins were exchanged by the natives in the land of Kamchatka for knives and firearms, and were sold by Russian merchants for 5 or 6 rubles; those of medium quality sold for 4 rubles; those from the Yakut sold for 8 or 10 rubles. But ever since the Chinese began to appreciate and earnestly to covet these wares the finest skins of the adult animal were sold even in the land of Kamchatka for 25 and 30 rubles; those of medium quality for 17, while 1-year-olds (those called "*Koschloki*") brought 8 rubles, and cubs 1 ruble. Tails were held at a particularly high price, and were purchased for 1½ or even 2 rubles, and were much sought after for caps and mittens.

Very few are brought to Russia; almost all are taken to China, where the best ones command a price of 70 and 80 rubles. In 1735 and 1736 they were quite ready to offer 20 rolls of "*Kitaika*" for one skin, while the Russians on their return to Irkutsk obtained for it 100 rubles.

These skins, moreover, being rather heavy, are for that reason dearer to the Chinese than the skins of sables and foxes, and they are better suited to increase the weight of the too light silk gowns. In addition to their beauty they make the silk fit more closely to the body and resist the wind better; and for those reasons the Chinese make of this fur borders of a hand's breadth and put them around their robes on every side; and this has become the fashion also with both sexes, not among the tribes of Kalmuc and Siberia only, but also in Russia. In the land of Kamchatka nothing is considered a finer adornment than a dress sewed up like a sack (a "*Parka*," they call it), made out of the white skins of reindeer fawns (called "*Püschiki*") and having a border of sea otter fur around it. Mittens and caps are also made of sea otter fur.

In addition to their weight, these skins have also this disadvantage, that they retain too little heat about the body and become moist, although, because of their thickness, they do afford excellent protection against the violence of the wind.

Up to a few years ago the people there also used to make their clothes out of those skins, as they did long ago out of the skins of foxes and sables (*Zobelae*), but that custom has gone out of date now that their value has increased so much; and they are not very much aggrieved at that change of fashion, for the people there have always looked on dog skins as warmer, more beautiful, and more lasting.

The hides of the cubs have this advantage, that they heat the body less than fox skins do.

These animals are captured only on the shore of Kamchatka, from 50° to 56° north latitude. They are never seen in the Penshin Sea, nor are they observed to go beyond the third Kuril Island. From this fact, and from the hunting of the animal, the ocean from the neighborhood of Lopatka to the Promontory of Kronotski has received the name of "Bobrovi Sea." For a long time back it has been believed by the people, as well as by Russians, and asserted that this animal is not an Asiatic, but a stranger in that region and a foreigner from other lands that lie quite near Kamchatka, where they are taken every year. When the east wind blows for two days together in the winter time, they are floated over with the ice on which they have been lying, and so are caught. Those which escape death in the winter stay in the summer about the rugged and rocky shores of Kamchatka and the Kuril Islands, give birth to their young, and remain there; for they have not the strength to swim away, and, on account of the *foramen ovale* of the heart, they can not while swimming over the sea seek their food in its depths; neither can they hold out against hunger for three or four days.

The hunting of the otter is on this wise: if the winter has been cold and great quantities of ice are repeatedly blown over, there will be an abundance of sea otter not only in winter, but also, from those that survive, in the summer; and, on the other hand, from the year 1740 to 1743 there was no cold weather in this locality, no ice could be frozen about the shores and brought over there, and so the otter were few and the hunting exceedingly limited.

The region famous for the hunting of the otter twenty years ago extended from the mouth of the Kamchatka to the Tchaschma, and was more renowned for that than any other place; now, however, it is but little and rarely used. Hunters came in greater numbers about the Promontory of Kronotski, which has come to be most frequented next after the mouth of the river Kamchatka; but there also the catch has grown smaller. About Ostrovnaia, the Gulf of Avatcha, the Promontory of Lopatka, and the first three Kuril Islands they are now caught in much greater numbers than before. The Penschin Sea they do not enter, although crabs and other shellfish are to be found there in at least as great if not greater numbers than on the Kamchatkan shore. But why they do not go beyond the first three Kuril Islands, although they might easily pass from one to the other and so on clear to Japan, admits of a threefold explanation. (1) Because the sea lions and sea bears, inhabiting the desert islands in very great numbers, devour the sea otter and injure them in every possible manner, the latter are very much afraid of them and are driven away. (2) There is never any ice in those regions, and so no sea otter are ever brought. (3) The distance between America and the farther Kuril Islands is very great, and there are no islands in between, and so these animals cannot reach them by swimming. Besides, these creatures are not naturally of a roving disposition; but if they might find a suitable place designed, as it were, for them, even so the inhabitants of the first islands are so bent on hunting them that those which have managed to escape in winter rarely escape in summer. They hunt the otter in all seasons, but in most diverse manner according to the demands of the season. They are captured in greatest numbers in winter, particularly in the months of February, March, and April, but their capture is made at the expense of tremendous exertion, great daring, and not infrequently loss of human life. When in the months before mentioned the east wind blows for two or three days in succession, a vast quantity of ice is carried over from the American shore; the ice comes over even more quickly if it has been carried away in the autumn and held in the channel between the islands. While the wind blows, the hunters lie in wait in their straw-covered huts; the ice drifts in in so great quantities that it fills the surface of the sea for several miles out from land in the region of the Kuril Islands, and oftentimes connects the Promontory of Lapatka with the first island. Then the hunters, arming themselves with clubs and knives, put on their snowshoes (called "*lapki*"), and either alone or attended by dogs go out upon the ice. With their clubs they kill the otter they find in a few moments, moving continually the while that they may not break the ice. They have the skins carefully pulled off, and leave the carcasses, if they be too far from the shore. Meanwhile the dogs hunt out others. When the otter catches sight of the dog and the dog stops, the otter is brought terrified to bay, and attempts to hide, until the hunter, following the footprints of the dog, comes upon his quarry and dispatches it. So eagerly do they pursue the hunt that they often go out so far upon the ice that they get out of sight of land.

If, as often happens, the ice is brought in with a gale or tempest and a heavy fall of snow, the catch is even larger, but fraught with greater danger; for when the hunters can not look ahead nor see the holes in the ice at their feet, they must follow their dog or mere blind chance. This most venturesome chase can not be witnessed from the land without terror. The ice rises and falls with the waves; the hunters walk now upon a mountain which was but a moment before a valley or a deep pit; again they are lifted up on high, and again they sink and disappear from sight. But the best and easiest hunting takes place when the ice remains on the shore for a long time; for while the tempest lasts, the otter, not knowing whether they are on the floating ice or on the land, go inland 5, 10, and even 15 furlongs. For they are misled by the roaring of the wind in the trees and bushes and think they are going toward the sea, and that what they hear is the roar of the waves. In this way a single huntsman often kills as many as thirty or forty or more, and saves the meat as well as the skin.

While the people hunt upon the ice, they are generally very careful to observe the winds, for fear that by adverse winds they be carried, as not infrequently happens, out into the open sea. It is not a rare thing for them to float up and down with the ice upon the waves for three, four, five, and even six days, and then, with favoring fortune and favoring winds, to be brought in again and come safely to shore. When the wind blows from the other quarter the ice is drifted away. If it drifts along the shore, the hunters follow the ice continually, for while the ice is drifting away, whether by day or by night, the otter try to get back upon it again, and so the latter part of the hunt is often richer than the beginning. The hunters wear snowshoes, in order that the ice, which is often very thin, may bear their weight and keep them from breaking through. Each shoe is from 5 to 6 feet long, 8 inches wide, and is fastened to the foot with straps.

As this hunt takes place upon the ice, it is considered good news all through the Kuril Islands, Lopatka, Kronotski, and Avatcha that the ice has come. Moreover, besides the otter, seals also and sea lions are brought in upon the ice.

The hunting of the otter is planned for in the winter time, because the colder, windier, and stormier the winter the greater the catch, and the milder the winter the poorer the catch. Although in the years 1740, 1741, and 1742 great quantities of ice with great numbers of otter drifted in, still the catch was very insignificant; but the reason was that the ice was very thin and would not hold the hunters.

In summer the otter are caught in four ways. (1) While lying upon their backs asleep at sea they are speared from boats with harpoons. (2) Even when awake they may be driven about in the sea by two boats until they are tired out and then speared, for they can not live under water for more than two minutes without breathing. If pursued moderately, therefore, they swim along and soon get so out of breath that they can flee no farther and are forced to stop. (3) When the tide is out they take refuge on the rocks that rise up above the surface of the sea. There they sleep and are killed by the hunters with clubs. Before the advent of the Russians they used in the same way to come out on land to sleep on the shores of Kamchatka and the Kuril Islands; but ever since they began to be hunted for their skins to satisfy the avarice of man they are never caught upon the mainland, or very rarely, when they have come there unaware. (4) They are caught in nets. The nets are spread above the water and tied with stones to hold them firmly in position in not very deep places, where sea weed grows in great quantities, for the otter feed upon shellfish and crustaceans that live concealed in the sea weeds, and there they are caught in the nets or are killed by the hunter, who comes upon them in his boat. Sometimes they carve out wooden otters, paint them black, and set them afloat. The otter, seeing these images, swim up and indulge in various strange capers about them, and by this trick are caught. When they are caught in the nets they are so frantic that in their despair they bite off their front feet; but if a male and a female are caught together they both lacerate their skins terribly and knock out their eyes.

We killed them on Bering Island with spears, nets, and, when they were lying asleep or in the act of copulating, with clubs.

They were found there in so great abundance that from the beginning our numbers did not suffice to kill them. They covered the shore in great droves; and as the animal is not migratory, but is born and bred there, they are so far from fearing man that they would come up to our fires and would not be driven away until, after many of them had been slain, they learned to know us and run away. Nevertheless we killed upward of 800 of them, and if the narrow limits of the craft we constructed had permitted we should have killed three times as many.

As to the beauty of the animal, and particularly of its skin, this sea otter is alone incomparable, without a peer; it surpasses all other inhabitants of the vast ocean, and holds the first rank in point of beauty and softness of its fur.

As to its habits, it loves to live both in the water and on the land; but for the sake of sweet peace the otter inhabits in great droves, by preference, the great islands of the ocean. For getting food it seeks, when the tide is out, the shallow, rocky reefs overgrown with seaweed, and there devours crustaceans, mussels, clams, snails, limpets, polyps, cuttlefish. Only when forced by hunger to do so, do they eat seaweed; but they eat fish, smelt, and a little fish called in Kamchatkan idiom the "*Uiky*," which is washed in by the spring tides in countless numbers. They are also fond of meat. I have seen an otter eating the flesh of another otter which had been skinned and thrown away. It may therefore be concluded that this animal is omnivorous.

In the winter they lie some upon the ice, some upon the shore. In summer they go up the rivers and penetrate even to the lakes, where they greatly enjoy the fresh water. On warm days they seek the valleys and shady recesses of the mountains and frolic there like monkeys. They surpass all other amphibia in play and frolicsomeness and in fleetness of foot.

On the land they lie, as dogs do, with the body curled up. As they come out of the sea, like dogs they shake off all the water before they lie down to sleep; then with their paws they wash their faces, just as cats do, smooth out their bodies, straighten out their fur, turn their head from one side to the other as they look themselves over, and seem to be greatly pleased with their personal appearance. I have also seen the males play with their genital organs like monkeys. When they are engaged in sleeking their fur they are so intent upon it that they can be killed readily.

A swift runner can scarcely overtake an otter when it runs, for it runs with many windings, in a fashion to mislead. When it sees its path to the sea intercepted and finds itself exhausted and out of breadth, it puts up its back like a cat, threatens to leap upon its pursuer, and spits like an angry cat; but we, being conscious that its anger was not dangerous, were not frightened off; and when it receives a vigorous blow upon the head it falls upon the ground, covers its eyes with its paws, and keeps them so, no matter how many times it is struck upon the back. But if one hits it on the tail, which is extended out as the animal runs, it turns about and faces the striker in the most absurd fashion. But more frequently it happens that they fall down at the first blow and pretend that they are dead, and then as soon as they see that we turn our attention to others they suddenly take to flight. From this it would appear that the animal is very cunning. Oftentimes we would drive them into narrow places on purpose, without any thought of doing them any harm; we would hold our clubs ready, and they would fall down fawning and looking around in every direction. Then they would slowly slink past us like dogs, and as soon as they saw that they were out of danger they would hurry with mighty leaps to the sea.

When they stand up they keep their necks extended in line with the body, and the hinder part, because of the length of the legs, stands higher.

They swim now upon the belly, now upon one side, and again flat upon the back; they also swim standing bolt upright in the water.

They play together, and, like human beings, embrace with their arms and kiss each other. If they escape the club, they gesticulate in a very ridiculous manner, as if making fun of the hunter. With one paw raised over their eyes, as if bothered by the rays of the sun, they watch the man, continually rubbing their pudenda as they lie upon their backs, and then go off into the water, still watching the man steadily and urinating as they go, in the same way as sea bears and whales also do.

They copulate at all seasons, and so throughout the year the mothers are seen busy with their cubs. Whether they give birth twice within one season I would not venture to decide; but I have seen, and I have sometimes killed, mothers with two cubs, one of which was a year old and the other three or four months old. So much is certain, they never, or at most very rarely, give birth to more than one at a time. The first year after they are born they do not copulate, but the second year they do. The period of gestation is eight or nine months; and so they bring forth perfectly developed young, with eyes open and with all their teeth; the four canine teeth are smaller than common, just as I have observed, also, in the case of the sea bears, seals, and sea lions.

They suckle their young almost a whole year. They preserve their conjugal affection most constantly, and the male does not serve more than one female. They live together both on sea and on land. The 1-year-old cubs, the "*koschloki*," live with their parents until they set up housekeeping on their own score. Rarely, therefore, are females seen apart from cubs two or three months old, which are called "*medviedki*."

The females always give birth to their young on land. Whether in the sea or on land, they carry their cubs in their mouths; but when they sleep at sea they fold their young in their arms just as mothers do their babes. They throw the young ones into the water to teach them to swim, and when tired out they bring them to shore again and kiss them just like human beings. They toss the young out into the sea and with their paws catch them when tossed, like a ball; and with them they engage in all the delightful and gentle games that a fond mother can play with her children. When the mother sleeps on shore the cubs keep watch, clinging to her dugs or arms. They embrace their young with an affection that is scarcely credible. When hunters press upon them, whether by land or by sea, they seize their young with their mouths and never let go of them except when compelled by extreme necessity or death itself. And so they are killed often when they might have got away themselves. I have sometimes deprived females of their young on purpose, sparing the mothers themselves, and they would weep over their affliction just like human beings. I once carried off two little ones alive, and the mothers followed me at a distance like dogs, calling to their young with a voice like the wailing of an infant; and when the young ones heard their mothers' voice they wailed, too. I sat down in the snow and the mothers came close up and stood ready to take the young ones from my hand if I should set them down in the snow. After eight days I returned to the same place and found one of the females at the spot where I had taken the young, bowed down with the deepest sorrow. Thus she lay, and I approached without any sign of flight on her part. Her skin hung loose, and she had grown so thin in that one week that there was nothing left but skin and bones. This happened several times in succession. It happened one other time that, in company with Mr. Plenisner, I saw in the distance a mother otter sleeping with a year-old cub. When she caught sight of us the mother ran to her offspring, woke him up, and warned him to flee; but, as he preferred to go on sleeping rather than to run away, she picked him up in her paws in spite of himself and rolled him like a stone down into the sea.

On land they can not see very well, but their sense of smell is very keen. They ought, therefore, to be hunted from the lee side. Their sense of hearing is just as sharp.

The cry of the sea otter is very like the cry of an infant. They doubtlessly live many years. They never breed strife among themselves, but always live on the best of terms with one another. They are very much afraid of sea lions and sea bears, and they do not like the company of seals. Accordingly the places which those animals frequent are carefully avoided by the otter.

The flesh of the adult otter is much more tender and savory than that of the seal. The flesh of the female is best, for it is fatter and more tender, and the fat lies between little membranes. It is for that reason a little hard. In the case of pregnant mothers, the nearer they are to parturition the fatter they are. In this respect they are different from land animals. The flesh of the young otter is most delicious; it can not easily be distinguished from the flesh of an unweaned lamb, whether roasted or boiled, and the gravy from its preparing, in either way, is most delicious. Otter flesh was our principal food on Bering Island; it was also our universal medicine. By its use we were saved from scurvy, and no one got sick of it, although we ate it every day half raw and without bread. The liver, heart, and kidneys tasted exactly like those of the calf. The natives of Kamchatka and the Kuril Islands give the first preference to the flesh of eagles, the second to otter's flesh. The liver and kidneys they eat raw, and declare them most excellent. Not only the natives but also the Russians use scrapings from the bony base of the penis as the proper remedy to cure the tertian fever.

The skins go through the following processes before they are ready for use. (1) After the skin has been taken from the animal shreds of muscle are cut from it with a knife. This process the Russians call by the Slavonic term, "*bolon sniat.*" (2) Then the skin is stretched to its utmost; for, besides the fact that the price increases with the size, the skins thus prepared become lighter, although the fur does become less beautiful. (3) After this they straighten out the hairs with bones from the wings of gulls, and sleep upon them, naked, for several weeks to make them glossier, nicer, and more beautiful. This process the Russians call "*ryspat bobr.*" (4) While the Cossacks are getting the skins from the natives they frequently beat the skins upon the snow with sticks, and if the fur is gray, or any other color than black, they color them with alum and empetrum berries cooked to the proper consistency with fish oil. This makes them glossy black. But the fraud can be detected—pull out of a dyed skin a single hair and it will show three colors: at the end, the black of the dye; from the middle down, the native color; and, finally, the base of the hair.

While the skins are being prepared for use, the natives treat them also as follows: they smear the inside of the skin with a powder made of dried fish eggs, as the Rutheni do with simple yeast; then they roll it up and lay it away for several days, and after that they scrape it with shells and glass, and finally smooth it down with pumice stone. During this time they knead the inside with a wooden hook and with the hands until it grows soft with the fermented dough of the fish eggs and all the fat disappears and the skin comes out soft and pliable. All other skins which are sold to traders are exported without any preparation, for it has been observed that these undressed skins keep their native color better.

I have wished to report about the sea otter what I have seen as an eye-witness, and also what I have heard from the natives, in hunting them.

I have had two pictures made: Fig. 1 (Tab. XVI) represents an otter walking upon land; fig. 2 represents one swimming with her cub in the water.

VENIAMINOF'S ACCOUNT OF THE SEA BEAR.

Translated by LEONHARD STEJNEGER.

The following is a translation of Bishop Ivan Veniaminof's account of the fur seals of the Pribilof Islands, published in Wrangell's Information Regarding the Russian Provinces on the Northwest Coast of America, forming the first volume of von Baer and von Helmereen's Contribution to the Knowledge of the Russian Empire and the adjacent countries of Asia.[1]

THE SEA BEAR. *Phoca ursina. Morskoit ko*).

The sea bears are chiefly taken in the (Russian) colonies on the Commander and Pribilof islands,[2] but the most important locality for this industry is the island of St. Paul, where many Aleuts and some few Russians reside for this purpose. The method of taking the seals will be better understood if I give a short description of the habits of these animals. The sealers distinguish the sea bears as sikatchi, polusikatchi, holostiaki, matki, and kotiki.

By *sikatch* is understood a full-grown male not less than 6 years old, and either possessing or able to possess a harem. His size is about three or four times that of the female and equal to that of a 2-year-old calf; the color of the hair is dark gray, the hair from the head half way down the body being stiff and much longer than on the other parts. Polusikatchi are males 4 or 5 years of age, which, although fully able to fecundate the females, are not allowed to possess a harem. Their mane is stiff but much shorter than that of a sikatch.

Holostiaki are males from 2 to 3 years old; they have no mane and the color of the hair is lighter gray (than in the adults), especially in the spring.

Matki are the females capable of bearing young. They are only two or three times the size of the young. The color is not exactly the same in all. In some it is a reddish brown, in others grayish, and in still others reddish gray.

Kotiki are the young males and females from 4 months to a year old, including those born in the spring and killed in the fall. It is the furry pelt of these which is the most highly valued. This furry quality of the pelage particularly distinguishes the fur seals from the hair seals, sea lions, and other kinds of seals in general, rendering it preferable to all others for the fur trade.

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[1] Beiträge | zur Kenntniss | des Russischen Reiches | und der | angränzenden Länder Asiens. | —Auf Kosten der Kaiserl. Akademie der Wissenschaften | herausgegeben | von | K. E. v. Baer und Gr. v. Helmersen. | —Erstes Bändchen. | Wrangell's Nachrichten über die Russischen Besitzungen | an der Nordwestküste von Amerika. | —St. Petersburg, 1839. | Im Verlage der Kaiserlichen Akademie der Wissenschaften.—Special title: Statistische und ethnographische Nachrichten | über | die Russischen Besitzungen | an der | Nordwestküste von Amerika. | Gesammelt | von dem ehemaligen Oberverwalter dieser Besitzungen, | Contre-Admiral v. Wrangell. | —Auf Kosten der Kaiserl. Akademie der Wissenschaften | herausgegeben | und mit den Berechnungen aus Wrangell's Witterungsbeobachtungen | und andern Zusätzen vermehrt | von K. E. v. Baer. | —St. Petersburg, 1839. | Buchdruckerei der Kaiserlichen Akademie der Wissenschaften.

[2] The animals were formerly plentiful on the Farallone Rocks, out at sea, opposite the bay of San Francisco, but the Americans of the United States have extirpated them completely. A species of sea bear is also found on Guadalupe, but this inhabitant of a warmer region is smaller than its more northern relative and its color is less silvery. (Footnote by von Baer.—TR.)

At sea the sea bears feed on fish and shellfish; they have a cry like the bleating of a sheep. They pass northward into the Kamchatkan Sea through the straits between the different groups of the Aleutian Islands, especially through Unimak Pass; they are not found to the north of St. Paul. The sikatchi are the first to arrive. They always approach St. Paul Island about the 20th of April[1]—i. e., between the 18th and 23d, even if the island is still beset with ice. The sikatch takes his station on shore, at exactly the same spot he occupied the preceding year, not seldom lying down on snow and ice. Sandy shores are never chosen for breeding grounds [literally laying grounds], but always flat beaches covered with large stones and mostly on the southern side of the island. At the time of their arrival the sikatchi are usually extremely fat, but later, about the middle of July, they become lean. On land they sleep almost without interruption, and they are never heard to utter a sound except when they catch sight of a new comer. By the middle of May they begin to look out over the sea, because at that time the females begin to arrive. From now on the sikatch does not leave the shore unless it might be to intercept some female trying to leave him. Before the female has been delivered she is watched by her lord with jealous supervision, nor is she, under any conditions, allowed to leave him; later she is even permitted to go into the water, but he keeps the young as a hostage.

When the females arrive at the island every sikatch tries to get hold of as many as possible, This frequently causes bloody contests between the males, who besides endeavor to frighten their rivals by roaring loudly. Later on they steal the young from their mothers in order to entice them into their own harem.[2]

From one to one hundred and fifty females have been observed with one sikatch, the number depending entirely on the courage of the male. The sikatch is the unrestricted lord, the guardian and protector of his harem. He takes no food whatever while staying on shore; on very hot days he will drink a little sea water, discharging it however after an hour, in the form of a white foam.

The polusikatchi and holostiaki arrive later than the sikatchi. They do not always occupy the positions held the preceding season, choosing their resting place apart from that of the sikatchi, collected in large companies, and rather distant from the sea. Nor do they remain all the time in one place, like the sikatchi, often changing their position, and even from time to time returning to the sea.

The females begin arriving about the 26th day of May (very seldom on the 21st), or shortly before giving birth to their young. They do not haul out immediately, or without discriminating, but spend a day or two swimming up and down along the shore before associating with the chosen sikatch, or, as is more frequently the case, being violently seized by the enterprising male. Each harem is separated from all others by a space which is not allowed to be intruded upon by any outsider.

The arrival of the kotiki usually takes place during a southerly, or sometimes during a southwesterly wind, but rarely when it is blowing from any other direction. Nor do they all arrive at the same time, but gradually and singly; not all being assembled by the middle of June, as there are instances of yearlings having arrived as late as July. When gathered in bands, these young fur seals keep up a constant calling, day and night, particularly, as has been observed, before bad weather.

[1] All dates are "old style."—TR. [2] A misinterpretation of the "podding" of the pups.—ED.

Sealers are doubtful about the age of the female when she bears her first young, as also in regard to the age generally reached by the fur seals. The first probably takes place in the fifth year, while the age hardly exceeds 25 years.

This question, so very important (in its relation) to the sealing industry, is not yet settled.

The delivery of the female commences the 30th of May, and lasts through the whole of June and even to the 10th of July. Usually only one young is borne annually, though instances are known, however, of a mother giving birth to two pups, but always paying for it with her life.

The sikatch does not begin his conjugal attentions to the female immediately after she has been delivered, rather giving her time for complete recovery. Copulation continues for a quarter of an hour or more. The bull has intercourse but once with each female, afterward paying no attention to her whatever, she being allowed to move from the harem in whatever direction she pleases. The sikatch is able to cover from fifteen to twenty-four females in twenty-four hours. He is deprived of sleep until all the females have been fecundated, and if he sometimes seems to doze, yet the lightest step of a female trying to escape is noted, when raising himself he utters a menacing roar.

In spite of the disproportion of their bulk, it never happens that the male crushes the female. But the female of the fur seal will sometimes get crushed when covered by a young sea lion. The result of such an intercourse, if she survives, is a hybrid, having the head, feet, and hair of a sea lion together with the fur of a fur seal.

The young fur seals feed exclusively on their mother's milk from birth until leaving the island. The female never suckles her young while in the water, but comes ashore for that purpose, and attends her offspring in a resting position.

The pups do not go into the water very soon after birth. When 30 to 35 days old they commence to take to the water close to shore, in places sheltered from the wind, and always without being guided by their mothers. Having by and by become familiar with the water—that is to say when about 40 to 50 days old—they assemble in separate bands, visiting the neighboring rocks and sand banks. By August longer excursions are made, still unaccompanied by the mothers. In September the pups retire in smaller squads to warm and quiet sands, sometimes passing the entire day in such a spot where they may be joined by the young females of the preceding season. If one of the pups stays away longer than twenty-four hours the mother will go in search of it.[1]

The pups learn to swim without any guidance, but their mothers teach them how to escape from the attacks of their enemies and from other dangers. From time to time false alarms are made for this purpose, all running toward the sea, obliging the pups to hasten after them. Such exercises are generally practiced a short time before leaving the island, this comprising the entire course of education.[2]

The color of the young fur seal when born is black, but after the 10th of September it changes to gray, the old hair being shed and new growing out.

The yearlings stay in the neighborhood of the females until September, passing the time in all manner of play. Some carry a comrade into the water, others bite each

[1] Probably a misinterpretation of the actions of cows fresh from sea and looking for their young.—ED.

[2] Veniaminov had probably witnessed partial stampedes, such as that noted elsewhere in this report, and had made the above interpretation of them.—ED.

other, others again wake those which are asleep, or sport in the sea. Those born in June or July lie in a large herd encircled by the mothers, or frolic in the water if they have learned to swim. A grown male never purposely bites or injures a pup.

The taking of the fur seals commences in the latter days of September. A chilly, disagreeable day is selected for the purpose, when the wind is blowing against that quarter where the animals are lying, so that they may not discover the approaching sealers. Such weather setting in, the entire gang, old and young, men, women, and children, proceed to the hauling ground of the animals. All circumstances are minutely examined and taken into consideration before commencing work. The most courageous hunters, practiced in running over stones and rocks, lead the way, walking in single file, followed by the old people and the children; last of all comes the chief of the expedition, supervising and directing the entire party. All, without exception, are armed with clubs. The intent of such an attack is to cut off from the sea, as rapidly as possible, all animals on shore, and to drive them from the beach into the interior of the island. Halting a short distance from the shore, the old males are separated from the females and young, the former being driven back and liberated. The old females which have experienced several attacks return to the breeding places as soon as they detect an open passage, but the younger ones must be driven off. It frequently happens that they return again shedding large tears while searching for their slaughtered young. The sikatchi and old females having been removed, the others, divided into small squads, are carefully driven to the place where they are to be killed, sometimes more than 10 versts distant. Such a march, however, is very laborious for the seals and so long a journey can not therefore be completed in one day without being injurious to them. As their progression is effected by leaps and not at a walking pace many of them would meet their death on the road from overexertion. They are, therefore, permitted to halt frequently, when the quite young animals will immediately fall asleep. When brought to the killing grounds the seals are rested for an hour or more, according to circumstances, and then killed with a club.

The quite young seals, that is to say, those only 4 months of age, are killed without exception. Of those 1 year old the males are separated from the females and killed, while the latter are driven cautiously back to the beach. The 2 and 3 year old animals (holostiaki) are treated in a similar manner. All sikatchi are allowed to live.

The meat of the young seal is rather palatable and is used for food, both fresh and salted. The skins are taken off, dried, and sent to Russia. The mothers of the killed animals swim about the island during the following two or three days or more in search of their young, crying mournfully.

About the 5th of October, sometimes earlier, the sea bears leave the island in the same manner as they arrive, and always with a northerly or northwesterly wind. The quite young animals which have succeeded in escaping the sealer's club remain longer on the island than the rest, and are often seen after all others have left. Sometimes old sikatchi have been observed on the island during November and even in December, but during January and February not a single animal of this species is ever seen. It very seldom happens that two or three sikatchi appear in March, but only for a short time.

Since the discovery of the islands of St. Paul and St. George—that is, from the year 1786 until 1833—3,178,562 fur seals have been taken there. At present the skin of a young fur seal is worth 25 to 30 rubles in the Siberian market.

IX.—PELAGIC SEALING.

WITH NOTES ON THE FUR SEALS OF GUADALUPE, THE GALAPAGOS, AND LOBOS ISLANDS.

By Charles H. Townsend.

The first pelagic sealing conducted from vessels appears to have been done off the coast of Vancouver Island between 1871 and 1878. The history of this sealing is involved in obscurity, but a pelagic-sealing industry in connection with coastwise trading among Indian villages gradually sprung up, and by 1880 there were four vessels engaged. The catches made were not of much importance, and the price of skins was very low, ranging from $3 to $5. It was an outgrowth of the canoe sealing by Indians that from time immemorial had been practiced in those waters. There are no records to show that the vessels procured any important number of the skins brought to market. It is not unlikely that the coast sealing regularly practiced by the Indians was greatly stimulated during these years by the presence of the trading vessels, and that the catch was largely made in this way, the vessels themselves contributing but little toward the capture of the seals.

The annual catch of the Indians under ordinary conditions has until recently averaged between 2,000 and 3,000 skins. Subsequent to 1880 the few vessels trading in this region increased in number and became practically pelagic sealers. So far as known the crews were composed chiefly of Indians. The vessels being regarded as traders, no satisfactory records were kept as to the source of the seal skins brought to port.

In a private log kept by John D. Ford on the schooner *Undaunted*, engaged in sea-otter hunting in 1880, it is stated that 70 otters and 1,425 seals were taken. There are comparatively few references to seals, most of the log being taken up with notes on the otter hunting from day to day. The vessel left San Francisco on May 5, and returned to Victoria on September 10. The hunting was done on the south side of the Alaska Peninsula. There are references to previous sealing by members of the crew at Robben Island, in the Kurile Islands with the schooner *Caroline*, and at Cape Horn.

By 1883 there were eight or nine Canadian vessels engaged in sealing off the west coast of Vancouver Island. The average catch for vessels at this time was about 500 skins, worth about $6 each. In 1884 the Canadian vessels began sealing in Bering Sea, and one German vessel sailing from Japan began sealing in Bering Sea, where she was seized in the vicinity of the Pribilof Islands. In 1885 the average catch for Canadian vessels sealing on the Northwest coast and Bering Sea was over 1,600 skins per vessel, the average per vessel for the Northwest coast being but 547 skins. Since this time it has decreased rapidly, the catch for 1897 averaging only 149 seals per vessel. The greatest annual catch in the Northwest coast region was that of 1892, when 46,642 seals were taken.

The first pelagic sealing in Bering Sea was probably that done in 1880, when nearly 500 seals were taken by Captain Kathgard, of the schooner *San Diego*[1], 39 tons.

For a number of years the *San Diego*, with other vessels, had been engaged in walrus hunting along the northern shore of the Alaska Peninsula, and in 1880 Captain Kathgard began taking seals, the hunting being done from two boats.

The success attained led Captain Kathgard to continue seal hunting the following year, 1881, when he procured 950 seals with three hunting boats. The seals taken on this cruise were worth $10 each. Several thousand dollars' worth of walrus products were obtained on the same voyage. Captain Kathgard practiced pelagic sealing in Bering Sea for two or three years before it was taken up by anyone else. In 1883 the schooner *City of San Diego*, 48 tons, procured 2,500 skins in Bering Sea, and along the Northwest coast.[1] In 1884 the hunting of walrus was practically given up, and all the vessels hitherto resorting to Bering Sea for that purpose engaged in sealing. Most of the vessels began their work in the winter time on the Northwest coast, gradually following the seal herd northward. In February, 1886, the *San Diego* began sealing at the Farallone Islands, California, and followed the seal herd all the way to Bering Sea, where the vessel was seized by the United States Government. Captain Kathgard's catch averaged about 1,800 seals a year with three hunting boats, until his vessel was seized, when he went out of the business. From 1884 on it was the custom for sealers to begin the season's work on the Northwest coast and finish in Bering Sea.

[1] *Random extracts from log of American schooner City of San Diego*, 1883, *D. McLean, Master.*

Date.	Latitude.	Longitude.	Seals.	Date.	Latitude.	Longitude.	Seals,
1883.	N.	W.		1883.	N.	W.	
Mar. 30	37 55	125 30	13	July 17	55 34	163 30	22
Apr.	47 23	127 24	29	July 19	55 40	169 12	....
May	51 04	131 45	....	July —	55 00	169 00	293

Catch for whole season, 2,500.

At this time there were 34 vessels sealing in Bering Sea. The seals were taken from late in June to early in September, the catch frequently being 1,200 to 1,500 seals for vessels carrying from four to six boats.

Vessels were then being built especially for pelagic sealing, and the number of hunting boats carried was gradually increased. The catch of seals was over 27,000 in 1891, sealing not being permitted in Bering Sea from that time until 1894, when 31,585 seals were taken—an average per vessel of 853. The greatest annual catch for Bering Sea was made in 1895, when 59 vessels procured 44,169 seals. In 1897 16,464 seals were taken, the average per vessel being 588. Since 1894 sealing in Bering Sea

[1] This vessel should not be confused with the schooner *City of San Diego*, which was built in 1881, and first entered Bering Sea as a sealer in 1883.

has been limited to August and September, and has been prohibited within 60 miles of the Pribilof Islands, while seals have been taken with spears only.

The following extracts from the log of the *Mary Ellen*, engaged in sealing along the Northwest coast and in Bering Sea in 1884, show the course of the vessel and the catch of seals from day to day. The entire number of seals taken was 1,954:

American schooner Mary Ellen, 1884, D. McLean, master.

Date.	Latitude.	Longitude.	Seals.	Date.	Latitude.	Longitude.	Seals.
1884.	N.	W.		1884.	N.	W.	
Feb. 1, 2, 3			12	May 14	49 15	127 50	25
5	38 53		6	22	48 40	127 30	6
8	37 18		7	23	48 30	127 45	14
9	39 30	124 40	4	24	48 28	129 30	3
18	38 13	128 54		25	50 31	131 40	7
20	39 35		6	July 1	55 50	166 50	2
21, 22, 23, 27, 28			35	2			4
29	42 02		38	8	56 30	167 30	18
Mar. 1	40 56		21	9	56 00	167 50	23
2			21	10	55 10	167 35	16
3	42 14		24	13	55 50	167 47	7
4			21	14	55 50	168 35	44
5	42 18	126 50	7	15	55 56	168 24	98
7	43 10	125 30	4	18	55 52	168 00	64
8	42 58		23	19	55 52	167 30	22
12	44 29	125 48	12	21	55 30	168 00	22
13	44 48	126 12	3	24	55 09	166 49	43
14	44 50	125 39	23	25	54 30	168 00	4
15	44 22	125 31	16	26	54 40	168 50	43
16	45 54	124 50	19	27	55 00	168 30	4
17	46 38	126 00	8	31	54 20	170 15	25
19, 26, 27			21	Aug. 1	54 30	168 00	15
28	47 37	126 06	12	2	54 41	170 28	6
29	47 39	125 58	4	3	54 47	168 30	63
30	47 43	126 00	23	4	54 15	169 00	8
31	47 10	125 00	14	6	55 18	168 19	10
Apr. 4	47 42	126 03	21	7	55 25	169 09	131
5	47 31	126 44	20	8	55 18	169 39	21
6	47 24	126 19	12	9	55 10	169 30	140
7	47 43	127 43	18	10	55 13	169 39	67
8	47 56	127 07	2	11	55 08	170 00	63
10	47 33	125 44	48	12	55 10	169 05	14
11, 12, 14			11	16	55 00	169 00	28
16	47 53	125 47	13	17	54 35	168 40	41
18	48 04	126 13	11	18	54 43	166 20	26
19	47 57	127 10	32	19	54 25	167 20	10
20	48 05		13	20	54 53	165 15	50
24	50 12	128 30	14	21	54 50	165 20	53
25	49 55	128 50	2	22	54 50	165 40	66
26	49 54	128 34	13	23			2
May 11	48 33	126 30	15				
12	48 26	127 30	12	Total			1,954
13	48 35	128 15	5				

The *Mary Ellen* continued sealing in the same waters for several years afterwards. Her catch for 1885 was 2,304; for 1886, 4,295, and for 1887, 2,474 seals.

There are many indications that the pelagic catch of seals during the eighties was much greater than is generally supposed. For instance, in the British commissioner's report, Bering Sea Arbitration, pages 207 et seq., the *Mary Ellen* is credited with seal skins landed at Victoria as follows: 1884, 1,500 (estimated); 1885, 1,989; 1886, 3,553; 1887, 1,460. The logs of this vessel for the same years (see Townsend, Senate Doc. 137, 54th Cong., Pt. II, pp. 50–53) give the catches as follows: 1884, 1,953; 1885, 2,304; 1886, 4,295; 1887, 2,474. This being an American vessel, portions of the catch may have been taken to San Francisco. The writer obtained these logs from Captain McLean, master of the vessel.

Another instance is that of the British schooner *San Jose*, credited with 107 seals for the Northwest coast in 1888. Original records appended to this report state the catch at 355 seals.

On page 211 of the British commissioner's report referred to above the catch of the British Columbia sealing fleet in 1889 is given as 27,868 seals for 22 vessels.

In certain original records loaned me by Capt. N. Hodgson, of San Francisco, I find the catch of Canadian vessels for 1889 stated by vessel and corresponding very closely with the figures given on page 211. Three additional vessels are named, however—the *Triumph*, with a catch of 72 seals on the Northwest coast; the *Venture*, with a catch of 317 seals for the same region, and the *Mollie Adams*, with 1,553 seals from Bering Sea.

On page 209 of the British commissioner's report the Northwest coast catch of the schooner *Favorite* is given as 1,726 seals. This vessel was reported by the revenue cutter *Corwin* as sealing in Alaskan waters in 1885, with 2,065 seals. (See Cruise of the *Corwin*, 1885, House Doc. 153, 49th Cong., p. 18.) The catch of this vessel, with other vessels reported by the *Corwin*, in Alaskan waters during the same season is as follows:

Catch of certain vessels sealing in Alaskan Waters in 1885.

Vessel.	Seals.	Vessel.	Seals.
Lookout	1,100	Sierra	1,312
Mary Ellen	2,309	Vanderbilt	1,000
Favorite (British)	2,065	Henrietta	1,200
San Diego	1,725	Alexander	660

In the Cruise of the *Corwin* in 1884 (House Doc. 153, 49th Cong., pp. 8 and 16) the schooners *Favorite* and *Alexander* are both referred to as sealing in Alaskan waters.

No complete official records having been kept for the American sealing fleet, the statements of catches up to 1890 are only approximate. There are many reasons for believing that the accepted figures are below the number actually taken.

On the Japan coast seals have long been taken by the boats of Japanese fishermen, but the first vessel to engage in pelagic sealing in Japanese waters was the *C. G. White*, which in 1890 secured 680 seals in Japanese and Russian waters. In the following season this vessel again visited the Japanese sealing grounds and the catch of the preceding season was nearly trebled. By 1892 there were on the Japanese sealing grounds 9 vessels, which made a catch of over 14,000 seals. In 1893 the number of vessels in Japanese waters had reached 53 and the catch of seals amounted to 53,526. In 1894, owing largely to restrictions in the award area, sealing in these waters reached its greatest height, a fleet of 70 vessels taking over 71,667 seals. Less than half that number were taken in 1895 and less than one-third in 1896, while in 1897 the Japanese catch was only 13,843 seals for a fleet of 27 vessels. In Japanese waters the average of over 1,000 seals per vessel for 1893 and 1894 decreased to 512 in 1897. Vessels under the Japanese flag are now supplanting those sealing under other flags.

Pelagic sealing in the waters adjacent to the Commander Islands was of no special importance until about 1892, when, by reason of the modus vivendi, the operations of the sealing fleet were transferred from American waters.

Prior to that time the desultory sealing carried on about the Commander Islands virtually amounted to sealing on the rookeries, the seals having been taken in foggy weather close to the shores, or, when opportunity afforded, on unguarded rookeries.

In 1893 a 30-mile protected zone was established for the purpose of preventing raids on the islands. During that season about 12,000 seals were taken just outside this limit. Since then the catch of seals about the Commander Islands has decreased, the catch for 1897 being only 1,382.

The annual average per vessel for the Canadian, Japanese, and United States sealing fleets in all waters during recent years has been as follows: [1]

Year.	Vessels.	Seals.	Average per vessel.
1895	102	92,437	906
1896	94	69,536	739
1897	71	39,511	556

VESSELS, BOATS, AND METHODS OF HUNTING.

The vessels employed for pelagic sealing are schooners ranging in size from less than 20 tons to 150 tons, the average size being 60 or 70 tons. The vessels of less than 20 tons are usually not employed elsewhere than on the sealing grounds off Washington and British Columbia, and are frequently owned and manned by Indians.

The greater part of the sealing fleet sails from Victoria, British Columbia, and the crews are made up chiefly of British Columbia Indians, who hunt in canoes. The largest vessels carry as many as 18 canoes, the number carried being dependent on the size of the vessels. The smaller vessels carry about 8. Where white crews and hunters are employed there are from 6 to 10 boats carried, the larger vessels carrying 12 boats.

Boats are usually manned by three men and canoes by two. The total number of boats carried by the British Columbia fleet in 1897 was 149 and of canoes 288. The total number of boats carried by the American sealing fleet in 1897 was 62 and of canoes 67. The total tonnage of the British Columbia sealing fleet in 1897 was 2,708, the number of vessels employed being 41. During the same season there were 17 vessels in the American sealing fleet, with a total tonnage of 898. The total number of whites carried by the British Columbia fleet in 1897 was 495 and of Indians 587, the American fleet carrying 235 whites and 182 Indians.

In 1885 the American vessels engaged in sealing numbered 36, with a total tonnage of 2,263. The total value of the vessels was $125,050, the value of the hunting boats, outfit, and provisions amounting to $74,779 more. The value of the catch for this year was $209,232.

[1] These figures do not include the catch made by Japanese and Indian canoes hunting from coast villages.

Statement showing the American vessels engaged in pelagic fur sealing, the capital invested, and the record of their catch in 1895.

Home port of vessels.	Names of vessels.	Net tonnage.	Value of vessels.	No. of crew.	Boats.		Guns.			Spears.		Salt.		Provisions.	Advances to crew.	Number of seals taken.					
					No.	Value.	No.	Value.	Value of ammunition.	No.	Value.	Tons.	Value.			From Russian coast.	From Northwest coast.	From Bering Sea.	From Japan coast.	Total. No.	Total. Value.
San Francisco	Bonanza	152.40	$6,000	23	8	$800	15	$600	$500	20	$30	10	$70	$1,340	$860	....	....	289	927	1,216	$10,944
	M. T. Dyer	103.48	6,000	23	6	450	14	560	450	....	....	12	84	1,500	900	149	....	....	651	800	7,200
	Jane Gray	107.07	2,000	27	6	240	13	520	350	24	36	10	70	1,200	1,000	185	....	....	1,112	1,297	11,673
	Emma and Louisa	84.70	3,000	26	7	700	16	640	500	24	36	12	84	1,500	1,000	....	....	507	350	857	7,713
	Alton	84.39	4,000	21	6	500	15	600	400	20	30	10	70	1,400	1,000	....	....	143	315	458	4,122
	E. E. Webster	93.86	5,000	24	8	800	18	720	500	20	30	10	70	1,300	1,000	....	....	271	766	1,037	9,333
	Herman	100.48	9,000	24	8	800	18	720	500	20	30	12	84	1,586	1,200	....	....	430	637	1,067	9,603
	J. Eppinger	107.18	2,500	25	8	480	16	640	600	36	54	12	84	1,240	1,000	....	....	340	1,362	1,702	15,318
	Kate and Anna	23.42	1,000	10	4	300	12	480	350	....	....	6	42	800	400	....	391	....	....	391	3,519
	Rattler	93.34	8,000	23	7	595	14	868	550	24	36	12	84	900	900	....	....	492	576	1,068	9,933
	Therese	70.76	3,500	24	6	450	14	420	280	24	36	12	84	1,281	600	....	....	462	408	870	7,014
	Bowhead	103.45	6,000	23	6	660	20	857	500	....	....	12	84	1,500	1,000	....	....	....	684	684	6,156
	Winchester	112.57	9,500	27	7	770	23	981	600	....	....	12	84	1,600	1,100	102	232	....	589	923	8,307
Los Angeles	Penelope	40.91	8,000	16	4	400	8	320	400	....	....	8	56	1,000	500	....	....	....	595	595	5,950
Port Townsend	Elsie	56.88	3,500	20	10	230	10	400	300	10	60	6	54	500	600	....	209	....	....	209	1,567
	Geo. W. Prescott	39.02	2,250	19	8	160	....	....	....	15	90	5	45	600	600	....	....	329	....	329	3,454
	Idler	10.39	1,000	8	4	300	6	200	100	....	....	2	18	600	500	....	41	....	....	41	307
Neah Bay	Columbia	41.17	3,300	22	11	250	5	150	100	15	90	6	54	800	700	....	369	544	....	913	8,387
	James G. Swan	44.70	1,200	23	10	200	5	150	100	15	90	7	63	800	600	....	224	1,084	....	1,308	13,277
	Deeahks	42.85	2,000	23	10	200	4	120	80	17	102	6	54	800	600	....	82	592	....	674	6,810
	C. C. Perkins	25.38	400	13	6	120	....	....	....	6	36	1	9	100	100	....	34	....	....	34	247
	Matilda	25.21	1,000	13	6	120	2	60	40	8	48	2	18	100	100	....	35	....	....	35	254
	Puritan	14.18	900	9	4	80	....	....	....	6	36	1	9	20	....	....	10	....	....	10	73
	Emmet Felitz	30.93	1,500	13	6	120	3	100	50	6	36	2	18	100	200	....	49	....	....	49	355
	August	10.10	500	9	4	80	....	....	....	4	24	1	9	50	....	....	6	....	....	6	43
Port Angeles	Jessie	36.34	* 2,000	17	8	190	2	60	40	7	42	2	18	250	....	....	24	....	....	24	180
	R. Ecrett	30.51	1,800	16	8	160	4	120	80	10	60	2	18	250	....	....	99	....	....	99	742
Seattle	Teaser	33.27	1,200	19	8	160	6	200	100	8	48	3	27	250	200	....	87	....	....	87	652
	Willard Ainsworth.	42.40	4,000	17	5	250	10	400	300	....	....	10	90	1,700	800	61	....	440	1,180	1,681	12,607
	M. M. Morrill	43.19	3,500	14	4	200	8	320	200	....	....	10	90	1,400	700	....	....	393	591	984	7,382
	Allie J. Alger	75.45	6,000	24	6	300	12	500	300	....	....	20	180	2,100	1,200	....	....	193	1,003	1,196	8,970
	Stella Erland	46.91	2,500	24	12	350	....	....	....	12	72	10	90	900	600	....	165	676	....	841	6,307
	Bering Sea	46.18	3,000	24	12	350	....	....	....	12	72	10	90	600	500	....	180	663	....	843	6,322
	Ida Etta	69.23	5,000	23	6	300	12	350	250	....	....	20	180	1,800	800	....	....	....	564	564	4,230
Portland	Sophia Sutherland.	148.97	3,000	27	8	600	18	720	600	24	144	12	84	1,000	850	....	14	....	295	309	2,781
Astoria	Louis Olsen	72.10	2,000	24	7	1,000	17	720	500	30	105	10	90	1,300	1,000	....	....	340	660	1,000	7,500
	Total	2,263.37	125,050	717	254	13.665	340	13,496	9,620	417	1,473	298	2,358	34,167	23,110	497	2,251	8,188	13,265	24,201	209,232

* From U. S. Fish Com. Rept., 1896.

The boats employed for sealing are sharp at both ends and 18 to 20 feet long, with about $4\frac{1}{2}$ to 5 feet beam. They are fitted with single masts and sails, and when out for hunting carry a gaff for seizing seals, club for killing the wounded animals, compass, food, and water.

The canoes used by the Indian sealers are the cedar dugout canoes employed by the Indian tribes of the Northwest coast. They are light and graceful craft of the high bow and stern pattern, common from Washington to Yakutat, Alaska. The outfit of the canoe is similar to that of the sealing boat.

The guns in use are generally shotguns of 10 bore, shooting 21 pellets of No. 2 buckshot. Repeating rifles are also carried, but not to the same extent as in former years. The number of guns carried is, of course, not less than the number of boats and canoes in use. Guns are used almost entirely in the waters of the North Pacific Ocean; but since 1894 spears have been employed in all seal hunting in the eastern part of Bering Sea, in accordance with the provisions of the Paris award. Each vessel is provided with a fog horn, and a small signal gun or yacht cannon for disclosing the position of the vessel in foggy weather.

A sealing vessel's outfit of provisions is sufficient for the entire cruise, which may last eight to ten months if several sealing grounds are visited.

The spear used in Bering Sea since 1893, in conformity with the regulations of the Paris award, is similar to that which has long been employed by the Indians of the Northwest coast in hunting seals from shore. The pole is 12 to 14 feet long, pronged with two detachable barbed iron spear points secured by a 30-yard line, the end of which is tied to the boat. When a seal is struck the barbed points slip off the pole, the latter being recovered after the seal has been pulled alongside the boat and clubbed. Seals fight savagely at such times and require to be brought alongside carefully, while large animals are very dangerous.

In hunting, the boats leave the vessel at daylight and, when the weather is good, remain out all day. They work to windward, sailing, if possible, and take positions a mile or more apart, all hunting on the same tack. The vessel follows slowly in the course taken by the boats, keeping a position that will enable the boats to sail down to her in case of unfavorable weather. When there is no wind, the boats not infrequently pass out of sight of the vessel altogether, keeping their own bearings on her position to find their way back. When many seals are taken, it is necessary to skin them in the boats to prevent overloading, but a light catch is usually brought back to the vessel and the seals skinned on deck. The method of hunting practiced by Indians is somewhat less regular, but the canoes also carry small sails. As a rule the catch is made from seals found sleeping, those traveling or fishing being usually difficult to secure. The sleeping seals must be approached from the leeward, and the shooting is usually done at distances of 30 to 40 feet. When the animals are awake, they have to be shot at much longer range and are much more difficult to get. As a rule, seals that have been killed must be recovered quickly in order to secure them before they sink, although if killed instantly by shooting in the head many will float for a long time.

In calm weather the hunting boats pull away from the vessel in all directions the vessel maintaining her position until the hunters return. The favorite position of the sleeping seal is on its back, with its nose protruding above the water, the hind flippers turned forward and the fore flippers stretched along the breast. The sleeping seal makes many uneasy movements, frequently allowing its head to sink below the surface, rolling from side to side, scratching, or raising its flippers in the air. Swimming seals go along sometimes swimming by continuous easy dives, appearing at the surface to breathe, or go slowly with little more than the back exposed. This is usually the way with single animals. Where there are several seals traveling together, they will frequently rise clear of the water with dolphin-like leaps. The greatest care is necessary in approaching a sleeping seal, as the slightest noise will awaken it. The hunter stands in the bow ready to fire at the first favorable opportunity, letting the boat approach very close if the animal shows no signs of awaking.

In taking seals with the spear still more care is necessary, as the range of the weapon is less and it is necessary to approach somewhat closer.

The best catches are made when the sea is smooth, as seals have little chance to sleep when the sea is rough.

An important number of seals is wasted in pelagic sealing, as some of them sink before they can be recovered, while others are wounded and dash away apparently uninjured, only to succumb to their wounds later. The indications of these are traces of blood left upon the water and the considerable number of male seals killed on the fur-seal islands that retain buckshot in their skins. A few seals die on the rookeries, from gunshot wounds.

Many seals that are considered by the hunters as missed are undoubtedly seriously wounded. There is no means of knowing what proportion the injured seals arriving at the islands bear to the number that have died of their injuries before reaching the islands.

Seals killed instantly when their heads are above the water sink quickly; the rest of the body being submerged, the pressure of the water forces the air from it and it goes down at once. Sleeping seals killed when the head is low in the water float for a time, as the head settling into the water first retains the air in the lungs, causing the body to float.

Pelagic sealing is very effective as a means of destroying seals. Each vessel carries many boats, and these boats, hunting in all directions, frequently miles away from the vessels to which they belong, are able to explore a great extent of ocean. When many vessels are hunting on the more contracted sealing grounds, they are frequently so close together that the hunting areas of the different schooners overlap.

Sealing vessels starting out for the full season's work engage for a short time in sealing in the winter on the northwest coast sealing grounds; then proceeding across the Pacific Ocean, begin operations off the Japan coast in the spring. By the end of June the seals have left this region on the northward migration, and are followed by the sealing fleet to the sealing grounds in Bering Sea. As the sealing there is not concluded until late in September, the vessels return to British Columbia frequently after a cruise of eight or ten months. This is a long and more or less rough voyage for schooners of rather small size, and it is perhaps surprising that the loss of vessels has not been greater.

VESSELS LOST.

Pelagic sealing, like other industries carried on on the high seas, is subject to many dangers. The more northerly sealing grounds are in stormy and foggy latitudes, and vessels have frequently been lost during gales, while others have been wrecked on imperfectly surveyed coasts, or have been carried in the fog into dangerous places by unknown currents. The spring sealing off the coast of southeast Alaska has been attended with frequent loss of vessels, and many vessels have been lost on the coast of Japan and in the Kuril Islands. Quite a number of vessels have been capsized and lost with all hands during gales. Sealing in Bering Sea has not been accompanied with disasters to the same extent as in the North Pacific Ocean. This is probably due to the fact that sealing in these waters has been carried on during the summer and restricted to a shorter season. The following list of vessels lost during the past nine years is incomplete, but probably includes nearly all the losses that occurred during that period:

Year.	Vessel.	Remarks.
1889	Annie	Lost with all hands.
1892	Lottie	Wrecked on the northwest coast.
1892	Laura	Wrecked.
1892	Maggie Mac	Lost with all hands.
1892	Bessie Rutter	Do.
1893	Matthew Turner	Capsized and lost off Japan coast.
1893	Mary Parker	
1893	Henry Dennis	Wrecked Japan coast. Eventually repaired as Japanese schooner, Kaio Maru.
1893	Narwhal	Wrecked.
1894	George R. White	Lost with all hands, Bering Sea.
1894	Mascot	Capsized and lost off Japan coast.
1894	Fortuna	Lost with all hands.
1894	San Diego	Lost. (Built New York, 1850.)
1894	Unga	Lost.
1894	Mary H. Thomas	Do.
1895	Walter A. Earle	Capsized, all hands lost. (Originally the Sylvia Handy, built 1886.)
1895	Brenda	Vessel wrecked on Kuril Islands.
1895	Mattie T. Dyer	
1895	Dart	Vessel lost.
1895	George Peabody	Lost with all hands.
1895	Rosie Olsen	Vessel wrecked on Japan coast.
1895	C. G. White	Wrecked on Kadiak Island, Alaska. Most of crew lost.
1896	May Belle	Lost with all hands.
1896	Wanderer	Vessel lost.
1896	San Jose	Wrecked on Aleutian Islands, Alaska.
1896	Rose Sparks	Lost with all hands.
1896	Katherine	Foundered at sea.
1897	Agnes McDonald	Wrecked on Japan coast.
1897	Maud S.	Wrecked on Queen Charlotte Islands, British Columbia.
1897	Sapphire	Burned at sea off northwest coast.
1897	Pointer	Lost, Skotan Island, Japan.
1898	Golden Fleece	Lost off Japan coast.
1898	Pioneer	Lost with all hands. Bering Sea.

In addition to the loss of vessels, there are few vessels in the sealing fleets that have not lost boats and hunters. This is a constant danger connected with pelagic sealing. On the Japan coast, where there are many strong currents setting in different directions, the hunting boats are frequently carried long distances from the vessels, and, being sometimes unable to regain the vessels, are lost if not picked up by other vessels of the fleet. Fortunately, on the principal sealing grounds the sealing fleet is of considerable size and the chances for boats being picked up by other vessels are good. On the Japan grounds killer whales are abundant and a number of the losses of boats and men have been attributed to this cause, as in several cases killers have been seen to attack and overturn hunting boats. On the northwest coast sealing grounds boats are frequently lost from their vessels, but they have in most cases managed to reach some part of the mainland. This is also true of the Bering Sea sealing grounds. The lost hunters have at times remained for days in their boats and subsisted on the flesh of seals that they picked up, while heavy gales have been ridden out by keeping the boat lying to a drag made from the carcasses or skins of seals. Indian hunters have, on a few occasions, been lost in their canoes from vessels in Bering Sea, and finally reached some of the Aleutian Islands greatly exhausted.

HUNTING GROUNDS OF THE SEALING FLEET.

The pelagic sealing fleet frequents four hunting grounds during the year, two in Bering Sea, adjacent to the Pribilof and Commander islands, and two in the Pacific Ocean, off the American and Asiatic coasts.

The Pribilof (or "Bering Sea") sealing ground lies to the westward and southward of the Pribilof Islands, outside of the 60-mile protected zone. Its northwestern portion is in general about 75 miles wide, its width increasing toward the southeastward, where it reaches the Aleutian Islands.

The Commander (or so-called "Copper Island") sealing ground extends almost around the Commander Islands, its most important part lying to the southward and southeastward, and extending for about 60 miles beyond the 30-mile protected zone. The sealing area to the northward and westward is of less importance. Its northern limit is reached in Ukinsk Bay, at a distance of 200 miles from Bering Island.

The Japan sealing ground, which during the last four or five years has been the most important of the Pacific sealing grounds, has its southern limit in about latitude 36°, a little to the northward of Yokohama, the northern limit reaching nearly to latitude 46°, opposite Iterup Island. Its southern and central portions are nearly 400 miles wide, the northern being quite narrow. Throughout the north and south extent of this area sealing is carried on close to the coast and well into its indentations

The American (or "Northwest coast") sealing ground extends from the Santa Barbara Islands, California, northward along the coast to Bering Sea, a distance of nearly 3,000 miles. It is divided into three favorite sealing areas. The first extends from about latitude 36° northward to Cape Mendocino; the second and most important, from Yaquina Bay, Oregon, to the northern end of Vancouver Island; and the third from Sitka to Middleton Island. They are frequently referred to as the "Farallon," "Vancouver," and "Fairweather" grounds. Sealing is carried on throughout the entire Northwest coast region, from the Santa Barbara Islands northward, but the most important part of any catch is derived from one or more of the three favorite sealing grounds, on each of which the seals appear to linger for a time during their general movement northward. Since the Paris regulations went into force in 1894 there has been no sealing along the southern coast of the Alaska Peninsula.

Sealing commences off the coast of California about the middle of December, but during this month is limited to three or four San Francisco and San Pedro vessels. The earliest date noted is December 10. In 1894 the Canadian schooner *Umbrina* took seals during the last week in December 800 miles off the coast of Oregon, and early in January 1,000 miles off northern California.

It does not appear that seals are taken in December along the coast north of the Farallon ground, and the catch for that month is usually less than 100 skins per vessel. January sealing on the Farallone ground is regularly engaged in by San Francisco vessels, some of these bound for the Japan coast, stopping for a short time off the California coast before taking their final departure. The most southerly catches noted for the American coast were made south of Point Conception in 1896 and 1897. In the latter year 764 seals were taken south of the award area, 717 being females.

Sealing on the Farallon ground continues through February and March. Seals are scarce on the Vancouver ground in January, their hunting seldom being attempted before February, while March and April seem to be the best months for this ground.

On the Fairweather ground sealing is carried on from March until June.

Sealing on the Japan coast does not regularly commence before the middle of March, and the sealing fleet is not on the ground in full force before April 1. For January and February there appears to be but the record of a single vessel, at the southern border of this sealing ground.

March sealing is practically limited to the southern quarter of this ground. Sealing in April is extended north to about the latitude of Hakodate, and operations in May extend but little north of it. June sealing begins a little south of Hakodate and extends to the north end of Iterup Island, when the seal herd begins to move rapidly, there being no July sealing of any importance south of the summer habitat in Bering sea. The height of the sealing on both sides of the Pacific is in March, April, and May, but the difference in the latitude of the hunting grounds is very great, 90 per cent of the northwest coast catch being made from 500 to 1,000 miles farther north than that of the Japan coast.

The coastwise hunting range on the Japan coast for any month averages little more than 400 miles, while the range for the same month on the northwest coast is from two to five times as great. Thus, for February there is a range of 1,000; for March, 2,000; for April, 1,500; for May, 1,000, and for June, 1,000 miles.

For both of the Bering Sea sealing grounds sealing is practically limited to July, August, and September, and is conducted within a radius of 500 miles. There is no sealing anywhere in October and November.

Vessels sealing on the Japan coast in 1896 cleared from Canadian and American ports between December 20 and January 20, reaching the sealing ground, or some of the Japanese ports, early in March, a few calling at Honolulu on the way. Vessels going to Bering Sea leave the Japan sealing ground in June, those clearing from Puget Sound or Victoria sailing usually after the middle of the same month.

Vessels refitting at Japanese ports call at Yokohama only at the commencement of the season, Hakodate being the most convenient port later in the season.

In June, 1895, 15 seals were taken in the northern part of the Sea of Japan and in La Perouse Straits, by the American schooner *Penelope*. Seals occurring in these waters are probably referable to the Robben Island herd.

Although sealing vessels have for the past eighteen years taken more than 60,000 seals from islands in the Okhotsk Sea, there are no data at hand to show that any important number was procured in the water. In 1895 the American schooner *Anaconda* took 170 seals in the Okhotsk Sea, in the vicinity of St. Iona Island.

Late in June, 1895, the American schooner *M. M. Morrill* took 80 seals in the Kuril passes south of Paramusir Island, many of which were females in milk, indicating their connection with the now nearly obliterated rookeries in the Middle Kuril Islands. A slightly earlier breeding season is also indicated for seals belonging to the Kuril rookeries.

Pelagic sealing off the Japan coast was not engaged in to any important extent until the restrictions of the modus vivendi in 1892 excluded the sealing fleet from the American side of Bering Sea. Since then the Japan ground has been regularly visited by a large portion of the fleet.

Prior to 1892 the seals taken in May and June off the southern coast of the Alaska Peninsula constituted an important part of the pelagic catch. Since the Paris regulations came into force in the award area there has been no May, June, or July sealing in this section of the Northwest sealing belt, the season closing April 30, before sealing operations have extended to the westward of the Fairweather ground.

While the restrictions placed on pelagic sealing at various times during the last half dozen years have scattered the fleet over all parts of the Pacific Ocean north of latitude 35°, it does not appear from the abundant sealing records at hand that seals occur in important numbers anywhere outside of the coastwise hunting grounds already outlined.

In June and July sealers passing from the Japan coast to Bering Sea or to North American ports pick up stragglers, consisting chiefly of young seals, at many points in mid-ocean, but the entire number of seals taken in this way would probably not exceed a thousand.

COMPARISON OF MIGRATION ROUTES.

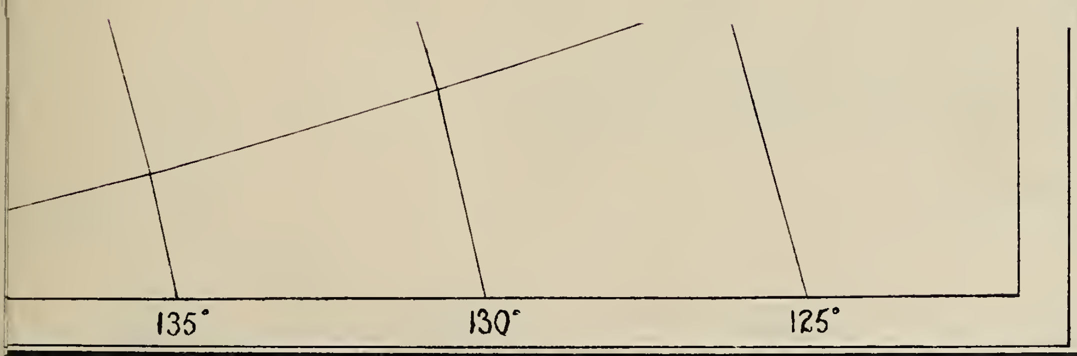
Although the American and Asiatic seal herds migrate between the same degrees of latitude—34° and 60° north—the length of the route followed by the former is nearly twice that of the latter. It extends not merely through 26 degrees of latitude, but through 56 degrees of longitude, or from longitude 119° to 175° west, while the Asiatic herd has but 30 degrees to traverse, or from longitude 141° to 171° east. The extreme range of the American herd is but little short of 3,500 miles. Both herds arrive at and depart from the summer habitat in Bering Sea simultaneously, but there the resemblance in their respective migratory movements begins to diminish. What the ocean temperatures, currents, and prevailing winds they encounter along their respective migration routes may have to do with their progress we do not know, but it appears that the American herd, traversing a vastly longer route, reaches the common southern limit of 34° first. Its movement for the next six months is slowly and steadily northward toward the summer habitat, which is reached by the adult portion of the herd but little earlier than the actual commencement of the breeding season. The younger classes of seals arrive somewhat later.

The Asiatic herd, on the contrary, lingers in the winter habitat until the breeding season is near, when its northward movement is sudden and rapid. The two herds thus differ much in the course and extent of their migration routes and the progress they make in following them.

SEALING GROUNDS IN RELATION TO FISHING BANKS.

It does not appear that the various tracts of ocean frequented by the seals during their seasonal movements have any very direct relation to the coast fishing banks, as the greater part of any sealing ground is off soundings. On the Japan sealing ground the hundred-fathom line is reached at a distance averaging less than 10 miles from the shore, while a few miles beyond it exist some of the most profound depths that have yet been sounded. Even in the great gulf opposite the Straits of Tsugar, where an important part of the Japan seal catch is made, the hundred-fathom curve follows the shores, an arm of the deep sea penetrating far in between the islands. The same is true of the Commander sealing ground, the hundred fathom line being everywhere close along shore, while at the southern border of this sealing ground there exists a depth of 2 miles.

Fully three-fourths of the Pribilof sealing ground lies off the western border of the great plateau from which the Pribilof Islands rise. Perhaps the seals would not be found on soundings there were it not that their breeding grounds are located far back on the plateau.



Scale: 1 inch 200 miles (Statute)


KEY TO COLORS
January
February
March
April
May
June
July
August
September
December
(Sealing not carried on in October and November.)
Each colored platting indicates the latitude and longitude of a vessel for one days sealing.
Each months sealing is colored distinctively - See key to colors.
Sealing positions in full represent an aggregate catch of 304,713 seals.
Sealing position for month of May at Guadalupe Id., Mex., relates to the Guadalupe Fur Seal
Positions of sealing vessels from logbooks collected by C.H. Townsend, A.B. Alexander, and Dr. L. Stejneger; with additions from records filed in the Treasury Department and comprising all available data.
Names of islands on which fur seals breed in important numbers are underlined in red.
Names of islands on which the fur seal is practically exterminated are underlined in blue.
No May June or July sealing in award area since 1893.
June and July positions in mid-ocean said to represent young seals.
Latest data omitted for want of space (Location indicated thus ⟶)
EASTERN SIBERIA
ALASKA
ARCTIC OCEAN
SEA OF OKHOTSK
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
JAPAN SEA
JAPAN ISLANDS
KURILE ISLANDS
ALEUTIAN ISLANDS
COMMANDER IS.
PRIBILOF IDS.
SAGHALIN I.
YEZO I.
NIPON
YOKOHAMA
Vladivostok
Petropavlowsk
St. Paul
St. George
Unalaska
Shumagin Is.
Kodiak
SAN FRANCISCO
SAN DIEGO
PARIS AWARD AREA
JAPAN COAST SEALING GROUND
COMMANDER SEALING GROUND
PRIBILOF SEALING GROUND
NORTHWEST COAST SEALING GROUNDS
Midway I.
BONIN IS.
MAP
OF
BERING SEA AND THE NORTH PACIFIC OCEAN
SHOWING THE
DISTRIBUTION AND MIGRATIONS
OF THE
AMERICAN AND ASIATIC FUR SEAL HERDS
BASED ON THE LOG RECORDS OF 123 VESSELS ENGAGED IN PELAGIC SEALING
AT VARIOUS TIMES FROM 1883 TO 1897, WITH AN AGGREGATE CATCH OF 304,713 SEALS.
Prepared by C. H. TOWNSEND
U. S. FISH COMMISSION

Throughout the extensive Northwest sealing belt the seal herd, while following the coast very closely, keeps as a rule off the plateau included within the hundred-fathom curve. The Fairweather ground is altogether off soundings except in the case of a few stragglers.

The Vancouver and Farallon grounds lie mostly off soundings, their inshore margins overlapping on the plateau. Elsewhere along the coast seals are found almost entirely off soundings, the submerged plateau being very narrow.

In the case of the Farallon and Vancouver grounds, where seals are taken very close to the coast, there are great salmon runs toward the Sacramento and Columbia rivers and the Straits of Fuca, which may have some influence on the seal herd. We know very little about the food of the seal herd during its migration up the coast.

INSPECTION OF SEAL SKINS—EXCESS OF FEMALES IN THE PELAGIC CATCH.

In order to give effect to the award rendered by the Tribunal of Arbitration at Paris, relative to the fur-seal fishery, masters of sealing vessels were required to file with collectors of customs full information respecting the sex of all seals taken.

It soon became evident that the proportion of sexes was not being reported in accordance with the facts, and inspectors of seal skins were appointed to examine all skins entered at United States ports. Practical furriers were selected for this purpose, and as a guide to such persons examining skins an explanatory circular was furnished.[1]

The inspections showed in most cases, a much greater proportion of females than was reported by the masters of vessels. Many of the latter discredited the inspections, contending that the sex of skins could not be determined with accuracy. Experience has, however, proved that the sex of salted skins can be determined, except in the case of yearlings.

Mr. L. J. Hansen, a furrier of thirteen years' experience, who has inspected all catches of seal skins entered at San Francisco since 1894, affirms that the determination of the sex of skins is practicable, except in yearlings, and offers no difficulty with proper care and attention. Mr. Hansen relies mainly on the evidence furnished by the presence or absence of teats and the size and shape of the pelt. He finds the pelt of the female broader in the region of the teats and narrower at the tail end than that of the male of the same size.

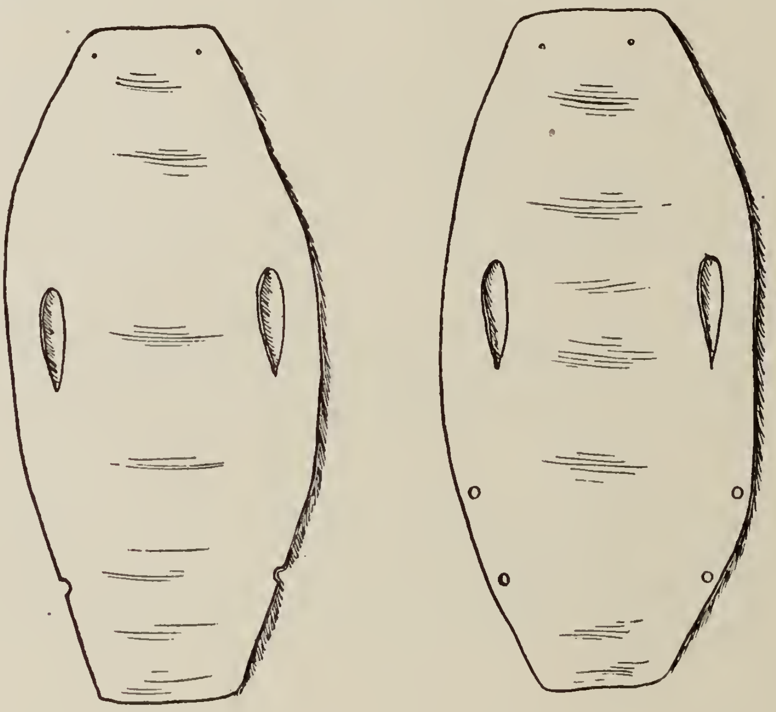
In the circular referred to the directions for the determination of sex furnished by the writer, are as follows:

As a guide to inspectors in examining skins, appended hereto will be found outline sketches of male and female fur seals, seen from under side after removal of skins, showing the lines along which the cuts are made in skinning (figs. 1 and 2); skins of male and female seals, seen from the raw side, showing the positions of the indentations on the margins of the male skin (caused by cutting through the genital opening), and of the teats in the female skin by which the sexes may be determined (figs. 3 and 4). The presence or absence of teats furnishes the best evidence as to sex represented by the skins of adult seals, the differences presented by the skins of the two sexes being shown in the figures which accompany this circular. The teats, four in number, are situated near the margins of the skin, about midway between the flipper holes and the tail end. They are not readily discernible, but their positions will be disclosed by feeling with the fingers over the raw side of the skin, and when found, they can easily be pushed through the fur. In the males, the teats exist only in an undeveloped condition, and the genital opening, cut through by the operation of skinning, forms a slight indentation on each margin of the skin, a short distance in advance of the rear end; these indentations, however,

[1] Treas. Dep., Div. Special Agts., Circular No. 75, 1895.

being often disfigured in the cutting. The skins of male seals over 3 years old may be recognized by their large size. The sex of young seals is more difficult to determine, the teats being undeveloped, but traces of the genital openings of the young males may be looked for on the margins of the skins, as above described.

In the light of experience it seems desirable to make some additions to these directions: The pelts of females are broader across the belly and narrower at the tail end than in males of the same size. The difference in the tail end of the pelts may be observed more readily by bringing the edges of the skin together. In adult females an additional clue to the sex and age exists in bluish spots on the raw side of the skin opposite the teats, which may be seen by turning back the blubber, which generally conceals them.



a. b.

Diragram showing differences between commercial skins of male, *a*, and female, *b*, fur seal.

No official inspection of seal skins as to sex has been undertaken by Canadian customs authorities, and the proportion of female seals reported by masters of sealing vessels has averaged much larger than at United States ports where inspections have been made.

When seals are skinned in the boats and canoes, in order to lighten them, the tally of the sexes is troublesome as the daily catch is brought on board ship, and the proportion of sexes represented is seldom determined faithfully. There is an enormous excess of breeding females in the pelagic catch, in Bering Sea especially, which is not so reported, as sealers fear further restrictions on their wasteful methods of sealing. This subject has been discussed at some length by the writer in reports on pelagic sealing in 1894–95.[1] For the year 1896 the number of females

[1] Senate Doc. 137, Part II, Fifty-fourth Congress, first session, Cond. Seal Life, etc.

reported by American vessels from all hunting grounds is three times that of the males, while Canadian vessels report the two sexes in nearly equal numbers, the females being slightly in excess.

Comparison of Canadian and American figures on proportion of sexes represented in pelagic catch for 1896.

	Japan coast.		Russian coast.		Total.		Northwest coast.		Bering Sea.		Total.		Grand total.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
Canadian	8,470	9,498	479	829	8,949	10,327	5,015	3,335	10,185	15,515	15,200	18,850	24,149	29,177
American	1,820	2,788	19	253	1,839	3,041	232	3,229	959	2,831	1,191	5,050	3,030	9,101

Similar comparisons for 1897 show that Canadian vessels reported the two sexes in more nearly equal numbers, while American vessels reported the number of females as more than five times that of the males:

	Japan coast.		Russian coast.		Total.		Northwest coast.		Bering Sea.		Total.		Grand total.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
Canadian	3,677	3,644	454	928	4,131	4,572	2,263	2,819	6,720	8,887	8,983	11,706	13,114	16,278
American	222	1,053	....	....	222	1,053	193	1,565	229	628	422	2,193	644	3,243

The effect of these inspections on the returns made by masters of American vessels has been wholesome, and the difference in the figures for each sex, as reported by the two fleets may be seen in the above tables.

In the Northwest coast catch of 1896, made by the American schooner *J. Eppinger*, we have 1,340 females against 17 males. It is unnecessary to cite further differences in this respect. The facts are against the possibility of a preponderance of males being taken on any sealing ground.

Following the pelagic sealing season in Bering Sea a loss of young seals takes place on the islands that is proof of the great numbers of adult females destroyed, while the killing of most of the nonbreeding males on the islands, and the fact that the breeding males remain on land during the best of the pelagic season, precludes the possibility of any such proportion of males being found in the Canadian pelagic catch as has been reported. In addition to this, advices under date of January 8, 1897, from London establishments, where the pelagic catch is prepared for market, show at least 85 per cent of it to consist of the skins of females. This is also true of preceding seasons.

The log-book records of the two fleets during recent years being at hand, interesting comparisons have been made.

Canadian vessels reporting a preponderance of male seals having been sealing side by side with American vessels proved to have taken a majority of female seals, it is evident that the returns of the Canadian fleet in this respect are unreliable. The records show also that a few Canadian vessels reported a large majority of females.

WEATHER CONDITIONS ON THE PELAGIC SEALING GROUNDS.

The following tables have been prepared from the log records of the Canadian and American vessels engaged in pelagic sealing in Bering Sea from 1894 to 1897. They are interesting chiefly as showing the large number of days during the season when the weather conditions were such as to permit of seals being taken. Sealing begins in Bering Sea on August 1 and is continued actively until some time after the middle of September, when the vessels leave for home. The records do not show any very great differences in the weather conditions from year to year. In August seals are taken nearly every day, there having been but three August days from 1894 to 1897 when seals were not taken. In September during the same years sealing has been nearly continuous until after the middle of the month, when the rapid withdrawal of vessels begins on account of heavy weather. Very few vessels remain after the 20th, and they are usually all out of Bering Sea before the end of the month. There are days on some parts of the sealing grounds when vessels do not lower their boats while vessels elsewhere make fair catches. A careful examination of the records shows that summer storms in Bering Sea are local and do not necessarily interrupt hunting over the entire sealing area.

Table showing number of days during months of August and September, 1894, when pelagic sealing was carried on in Bering Sea, as indicated by log entries of a majority of the vessels of the sealing fleet.[1]

1894.	Vessels.
Aug. 1	Mascot, Borealis, Earle, Favorite, Rich, Minnie, Etta, and Beatrice.
2	Mascot, Therese, Etta, Triumph, Sapphire, Moore, and Katherine.
3	Mascot, San Jose, Borealis, Earle, Favorite, Rich, Therese, Minnie, Etta, Columbia, Beatrice, and Fawn.
4	Jose, Borealis, Earle, Favorite, Rich, Therese, Minnie, Etta, Columbia, Beatrice, Fawn, and L. Olsen.
5	Jose, Borealis, Favorite, Rich, Erland, Minnie, Etta, Columbia, Beatrice, and Fawn.
6	Jose, Ellen, Earle, Rich, Kilmeny, Therese, Deeahks, Erland, Minnie, Etta, Columbia, Fawn, and L. Olsen.
7	Ellen, Borealis, Earle, Favorite, Therese, Deeahks, Minnie, Etta, Columbia, Beatrice, Fawn, and L. Olsen.
8	Jose, Borealis, Ellen, Favorite, Kilmeny, Therese, Deeahks, Erland, Minnie, Columbia, and Beatrice.
9	Mascot, Borealis, Kilmeny, Deeahks, Columbia, Beatrice, Fawn, and Johnson.
10	Jose, Borealis, Ellen, Earle, Mascot, Favorite, Rich, Kilmeny, Deeahks, Minnie, Columbia, Beatrice, Fawn, Johnson, and L. Olsen.
11	Jose, Borealis, Ellen, Favorite, Kilmeny, Therese, Deeahks, Minnie, Etta, Sparks, Beatrice, Fawn, Johnson, and L. Olsen.
12	Jose, Borealis, Rich, Kilmeny, Erland, Minnie, Beatrice, and Johnson.
13	Rosie Olsen, Jane Grey, Arietis, Vera, Sapphire, and Aurora.
14	Borealis and Deeahks.
15	Borealis, Favorite, Grey, Rich. Deeahks, Minnie, Beatrice, Algar, Johnson, and Sparks.
16	R. Olsen, Rich, Deeahks, Erland, Minnie, and Fawn.
17	R. Olsen, Grey, Kilmeny, Minnie. Columbia, and Beatrice.
18	Borealis, R. Olsen, Earle, Favorite, Grey, Rich, Kilmeny, Deeahks, Erland, Minnie, Etta, Beatrice, Henrietta, Algar, Fawn, Johnson, and Sparks.
19	Favorite, Rich, Kilmeny, Deeahks, Minnie, Etta, Columbia, Henrietta, Beatrice, Algar, Johnson, and Sparks.
20	Kilmeny.
22	Ellen, R. Olsen, Earle, Favorite, Grey, Kilmeny, Deeahks, Erland, Minnie, Etta, Algar, and Fawn.
23	Favorite, Rich, Kilmeny, Therese, Deeahks, Minnie, Etta, Columbia, Beatrice, Algar, Fawn, Johnson, and Sparks.
24	Favorite, Rich, Kilmeny, Therese, Deeahks, Minnie, Etta, Columbia, Henrietta, Algar, Johnson, and Sparks.
25	Rich, Kilmeny. Erland, Minnie, Beatrice, and Sparks.
26	Grey, Rich, Kilmeny, Deeahks, Minnie, and Etta.
27	Grey, Rich, Kilmeny, Therese, Deeahks, Erland, Minnie, Etta, Beatrice, Algar, Fawn, and Johnson.
28	Grey, Rich, Kilmeny, Therese, Deeahks, Erland, Minnie, Etta, Columbia, Henrietta, Beatrice, Algar, Fawn, Johnson, and Sparks.
29	Grey, Rich, Kilmeny, Therese. Deeahks, Erland, Minnie, Etta, Columbia, Henrietta, Beatrice, Algar, Fawn, Johnson, and Sparks.
30	Grey, Rich, Kilmeny, Therese, Deeahks, Erland, Minnie, Etta, Henrietta, Beatrice, Algar, Fawn, Johnson, and Sparks.
31	Grey, Rich, Kilmeny, Deeahks, Erland, Minnie, Etta, Columbia, Beatrice, Henrietta, Algar, Fawn, Johnson, and Sparks.
Sept. 1	Grey, Rich, Kilmeny, Therese, Deeahks, Erland, Minnie, Columbia, Etta, Beatrice, Henrietta, Algar, Fawn, Johnson, and Sparks
2	Grey, Rich, Kilmeny, Therese, Deeahks, Erland, Minnie, Etta, Columbia, Beatrice, Henrietta, Algar, Fawn, Johnson and Sparks.
3	Therese, Columbia, and Katherine.
4	Triumph, Sapphire, Borealis, Ainoko, and Kate.
5	Rich, Columbia, Beatrice, Henrietta, Algar, Fawn, Johnson, and Sparks.
6	Beatrice, Henrietta, Fawn, and Sparks.
7	Erland, Henrietta, Algar, Fawn, Etta, Deeahks, and Johnson.
8	Beatrice, Erland, Etta, Deeahks, Johnson, and Therese.
9	Columbia, Beatrice, Fawn, Etta, Deeahks, Johnson, and Therese.
10	Columbia, Beatrice. Erland, Fawn, Deeahks, and Therese.
11	Sapphire and San Jose.
12	Erland, Fawn, Deeahks, and Mascot.
13	Columbia, Beatrice, Fawn, Deeahks, and Johnson.
14	Beatrice, Erland, Fawn. and Deeahks.
15	Beatrice, Erland, Fawn, Deeahks, and Johnson.
16	Beatrice, Etta, Kate, Saucy Lass, and Beatrice.
17	Beatrice, Etta, Shelby, Ainoko, and Beatrice.
18	Beatrice, Etta, Venture, Saucy Lass, and Beatrice.
19	Etta, Shelby, Beatrice, Sapphire, and Rosie Olsen.
20	Etta, Shelby, and Rosie Olsen.
21	Etta.

[1] Senate Doc. 157, Part II, Fifty-fourth Congress, first session, pp. 48-50.

Table showing number of days during months of August and September, 1895, when pelagic sealing was carried on in Bering Sea, as indicated by log entries of a majority of the vessels of the sealing fleet.[1]

1895.	Vessels.
Aug. 1	Rattler, Maud S., M. M. Morrill, Enterprise, Vera, Victoria, Triumph, G. W. Prescott, Columbia, Deeahks, J. G. Swan, Bering Sea, Stella Erland, J. Eppinger, Herman, and Dora Siewerd.
2	Rattler, Maud S., Enterprise, Vera, Victoria, Triumph, G. W. Prescott, Columbia, Deeahks, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, J. Eppinger, Herman, and Dora Siewerd.
3	Maud S., Enterprise, Vera, Victoria, Triumph, Columbia, J. G. Swan, Bering Sea, Stella Erland, Alton, and Dora Siewerd.
4	Rattler, Maud S., M. M. Morrill, Enterprise, Vera, Victoria, Triumph, Columbia, Deeahks, Allie Algar, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, J. Eppinger, and Dora Siewerd.
5	Borealis, M. M. Morrill, Victoria, Triumph, Columbia, Deeahks, Allie Algar, and Stella Erland.
6	Bering Sea.
7	Maud S., Borealis, Vera, and Deeahks.
8	Maud S., Victoria, Columbia, Deeahks, J. G. Swan, Bering Sea, Stella Erland, Louisa, and Rattler.
9	Maud S., Borealis, M. M. Morrill, Enterprise, Vera, Victoria, Triumph, Deeahks, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, E. E. Webster, Bonanza, J. Eppinger, Rattler, and Dora Siewerd.
10	Maud S., M. M. Morrill, Enterprise, Vera, Victoria, Triumph, G. W. Prescott, Columbia, Deeahks, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, and Therese.
11	Maud S., Enterprise, Vera, Victoria, Triumph, G. W, Prescott, Columbia, Deeahks, Allie Algar, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa, E. E. Webster, Alton, J. Eppinger, and Therese.
12	Maud S., Vera, Victoria, Triumph, G. W. Prescott, Columbia, Deeahks, Allie Algar, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, and Therese.
13	Triumph.
14	Victoria, Triumph, Deeahks, M. M. Morrill, Willard Ainsworth, J. G. Swan, Louisa, Alton, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
15	Victoria, Triumph, G. W. Prescott, Columbia, Deeahks, Allie Algar, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, Therese, Rattler, and Herman.
16	Louisa, J. Eppinger, and Dora Siewerd.
17	Victoria, Triumph, G. W. Prescott, Columbia, Deeahks, Allie Alger, M. M. Morrill, Willard Ainsworth, J. G. Swan, Stella Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, Therese, Rattler, and Herman.
18	Triumph, G. W. Prescott, Deeahks, Louisa, E. E. Webster, Alton, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
19	Victoria, Triumph, G. W. Prescott, Columbia, Willard Ainsworth, J. G. Swan, Stella Erland, Louisa, J. Eppinger, Therese, Herman, and Dora Siewerd.
20	Victoria, Triumph, G. W. Prescott, Columbia, Deeahks, Allie Alger, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, Therese, Rattler, and Herman.
21	Columbia, Deeahks, G. W. Prescott, Allie Alger, M. M. Morrill, Williard Ainsworth, J. G. Swan, Bering Sea, Stella, Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Seiwerd.
22	G. W. Prescott, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
23	Bering Sea, Stella Erland, Louisa, Therese, and Herman.
24	Columbia, G. W. Prescott, Allie Algar, M. M. Morrill, Willard Ainsworth, Stella Erland, E. E. Webster, Alton, J. Eppinger, Rattler, and Dora Siewerd.
25	Allie Algar, Louisa, J. Eppinger, Therese. Rattler, and Herman.
26	Allie Algar, Columbia, M. M. Morrill, J. G. Swan, Bering Sea, Louisa, E. E. Webster, Alton, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
27	Deeahks, G. W. Prescott, Allie Algar, Columbia, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa. E. E. Webster, Alton. Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
28	Deeahks, G. W. Prescott, Allie Algar, Columbia, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Stella Erland, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
29	Bonanza.
30	Deeahks and G. W. Prescott.
31	Deeahks, G. W. Prescott, Columbia, J. G. Swan. Bering Sea, Alton, Bonanza, Herman, and Dora Siewerd.
Sept. 1	Deeahks, G. W. Prescott, Columbia, M. M. Morrill, Willard Ainsworth, J. G. Swan, Bering Sea, Louisa, E. E. Webster, Alton, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
2	Deeahks, G. W. Prescott. Columbia, M. M. Morrill, J. G. Swan, Bering Sea, Stella Erland, Louisa, Alton, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
3	G. W. Prescott, Allie Algar, Columbia, Bering Sea, and Louisa.
4	J. G. Swan and Bering Sea.
5	
6	Therese and Rattler.
7	Deeahks, Columbia, M. M. Morrill, Bering Sea, Stella Erland, Bonanza, and Dora Siewerd.
8	Deeahks, G. W. Prescott, Columbia, M. M. Morrill, Willard Ainsworth, Bering Sea, Louisa, E. E. Webster, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
9	Deeahks, G. W. Prescott, Columbia, M. M. Morrill, Willard Ainsworth, Bering Sea, Stella Erland, Louisa, Bonanza, J. Eppinger, Therese, Rattler, Herman, and Dora Siewerd.
10	Deeahks, G. W. Prescott, Columbia, M. M. Morrill, J. G. Swan, Bering Sea, Stella Erland, Louisa, Bonanza, Rattler, and Dora Siewerd.
11	Deeahks, Columbia, and Bonanza.
12	G. W. Prescott.
13	Bering Sea, Louisa, and Herman.
14	
15	Deeahks, Bering Sea, Stella Erland, J. Eppinger, Rattler and Dora Siewerd.
16	Columbia, Bering Sea, and Stella Erland,
17	
18	Columbia, Louisa, and Rattler.
20	Stella Erland, Rattler, and Dora Siewerd.
21	Bering Sea.

[1] Senate Doc. 157, Part II, Fifty-fourth Congress, first session, pp. 48-50.

Table showing number of days during season of 1896 when pelagic sealing was carried on in Bering Sea.

[× = seals taken.]

1896.	Canadian vessels—51.																													
	Ada.	Agnes McDonald.	Ainoko.	Allie Algar.	Annie Moore.	Annie Paint.	Arietis.	Aurora.	Beatrice (Vancouver).	Beatrice (Shanghai).	Borealis.	Carlotta Cox.	Carrie C. W.	C. D. Rand.	City of San Diego.	Dolphin.	Dora Siewerd.	Doris.	E. B. Marvin.	Favorite.	Fawn.	Florence Smith.	Ida Etta.	Libbie.	Mary Ellen.	Mary Taylor.	Mascot.	Maud S.	Mermaid.	Minnie.	Ocean Belle.
Aug. 1	....	....	×	....	....	×	×	×	×	×	×	×	....	×	×	×	....	....	....	....	....	....	....	....	×	....	....	×	....	×	×
2	×	×	×	×	×	×	×	×	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	....	×	×	×	×	×
3	....	....	....	....	....	....	....	....	×	×	....	....	....	....	....	....	....	....	×	....	....	....	×	....	....	....	....	....	....	....	....
4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
5	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	....	×	×	×	×
6	×	×	....	×	×	....	....	....	....	×	×	....	×	×	....	×	×	....	×	....	×	....	×	....	×	....	....	×	×	×	....
7	....	....	....	×	....	....	....	×	....	....	....	....	....	×	×	....	....	....	×	×	×	....	....	×	×	....	....	....	....	×	....
8	×	....	....	×	×	....	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	....	×	....	×	....	....	×	....
9	×	×	....	×	×	×	×	×	....	....	×	×	....	....	....	....	....	×	....	×	....	×	×	....	....	....	....	×	×	×	×
10	×	×	....	×	×	×	×	×	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	....	×	....	×	×	×
11	×	×	....	×	×	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
12	×	×	....	×	×	×	....	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
13	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
14	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....	....	×	....	....	....	....	....	....	....	×
15	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	×	....
16	×	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×
17	....	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
18	....	....	....	×	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	×	×	×	....	×	×	....	....	....	....	×	×
19	×	....	....	....	....	....	....	....	....	×	....	....	×	×	....	×	....	....	....	....	....	....	....	×	....	....	×	....	....	....	×
20	×	....	....	×	×	×	×	....	....	×	....	×	×	×	....	×	×	....	×	×	×	×	×	×	×	×	×	×	×	×	×
21	×	×	....	×	×	×	×	....	....	×	....	×	×	×	×	×	×	×	×	×	×	×	×	....	×	....	×	×	×	×	×
22	×	×	....	×	×	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
23	....	×	....	×	....	×	×	....	....	....	....	×	×	....	×	....	×	×	....	....	....	....	×	×	×	....	....	....	....	×	×
24	×	×	....	×	×	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
25	×	....	....	×	×	×	×	....	....	×	×	×	×	×	×	×	....	×	×	×	×	×	....	....	×	×	×	×	....	×	×
26	×	×	....	×	....	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	....	×	×	×	×	....
27	×	×	....	×	×	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
28	×	....	....	....	....	....	....	....	....	×	....	....	....	×	....	×	....	....	×	×	....	....	×	....	×	×	×	×	....	×	×
29	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
30	×	....	....	....	....	....	....	....	....	×	×	....	×	....	....	×	....	....	×	....	....	×	×	....	×	×	×	....	....	....	....
31	×	....	....	×	×	×	×	....	....	×	×	×	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Sept. 1	×	×	....	×	×	×	×	....	....	×	....	×	×	×	×	....	×	×	×	×	×	×	×	×	×	....	×	×	×	....	....
2	....	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	×	....	....	....
3	×	×	....	×	×	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
5	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....	×	×	....	....	×	....	×	....	....	....	....	×
6	×	×	....	×	....	×	....	....	....	×	×	....	....	×	×	....	....	....	×	....	....	×	×	×	....	×	×	×	....	....	....
7	×	×	....	×	×	×	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
8	×	×	....	×	....	×	....	....	....	×	×	×	×	×	×	×	×	×	×	....	×	×	×	×	×	....	×	×	....	×	....
9	×	×	....	×	×	....	×	....	....	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	×	....	....	....	....	....	×	....	....	....
12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....
13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
14	....	×	....	×	....	....	....	....	....	×	....	....	....	×	....	....	....	....	×	....	×	×	×	....	....	....	....	....	....	....	....
15	....	×	....	×	....	×	×	....	....	×	×	×	×	×	×	×	×	....	×	×	×	×	×	×	×	....	×	×	×	×	×
16	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
17	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....	×	....	....	....	....
18	....	×	....	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	×	....	....	×	....	....	×
19	×	....	....	....	....	×	....	....	....	....	....	....	×	....	×	....	×	×	....	....	×	....	×	....	×	×	....	×	....	×	....
20	....	....	....	....	....	....	....	....	....	....	×	....	....	×	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	....
21	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....	×	....	....	....	×	....	....	×	....
22	....	....	....	....	....	×	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	×	....	....	....	....
23	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
24	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
25	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....
26	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
27	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....
28	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....
29	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
30	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	×	....	....	....	....

Table showing number of days during season of 1896 when pelagic sealing was carried on in Bering Sea—Continued.

1896.	Canadian vessels—51.																				American vessels—11.										
	Ocean Rover.	Oscar and Hattie.	Osprey.	Otto.	Penelope.	Pioneer.	Sadie Turpel.	San Jose.	Sapphire.	Saucy Lass.	Selma.	South Bend.	Teresa.	Triumph.	Umbrina.	Venture.	Vera.	Victoria.	Walter Rich.	Zillah May.	Louisa D.	Rattler.	Alton.	Falcon.	Columbia.	Deeahks.	Jas. G. Swan.	Bering Sea.	M. M. Morrill.	W. Ainsworth.	St. Lawrence.
Aug. 1	×	...	...	×	...	×	...	...	×	...	×	×	×	...	×	...	×	×	×	...	...	×	...	...	...	...	...	×	...	×	...
2	×	×	×	×	×	...	×	×	×	×	×	×	...	×	...	×	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...	...	...
4	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5	×	×	×	×	×	...	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×
6	×	...	×	...	×	...	×	×	...	×	×	×	...	×	...	...	...	×	...	×	×	...	...	...	×	×	...	×	×	...	×
7	×	×	...	...	×	×	×	×	...	...	...	×	...	×	...	...	×	...	...	...	...	×	...	...	...	×	...	...	×	...	...
8	×	×	×	×	×	...	...	×	×	×	×	×	...	×	×	×	×	...	...	×	×	×	×	...	×	×	...	×	×	×	×
9	×	×	...	×	...	...	...	×	×	...	...	...	×	...	×	×	...	×	×	...	×	×	...	...	×	×	...	...	...	×	...
10	×	×	×	×	×	×	...	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×
11	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×
12	×	...	×	...	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×	×	×	...	×	×	×	×
13	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...
14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	×	...
15	...	×	...	×	...	...	...	×	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	...
16	×	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×	...
17	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	×	...	...	...	...	...	...
18	×	×	...	...	...	×	×	×	...	...	...	...	...	...	...	×	...	...	×	...	...	×	...	...	...	...	...	...	...	×	...
19	...	×	×	...	×	...	...	...	×	...	...	×	×	×	...	...	×	...	...	...	...	×	...	...	...	×	...	...	...	×	×
20	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×	...	×	×	...	...	×	×	×
21	×	...	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	...	×	×	...	×	×	×	×
22	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	...	×	×	×	×
23	×	×	...	...	×	×	×	×	...	×	...	...	...	×	...	...	...	×	×	...	×	...	...	×	...	...	...	...	...	×	...
24	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	...	×	×	×	...	...	...	×	×	×
25	×	×	×	×	×	×	...	×	×	×	×	...	×	×	×	×	×	...	×	...	...	...	...	×	×	...	...	...	×	×	×
26	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	...	...	×	×	×
27	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	...	×	×	×
28	...	...	...	×	×	...	...	...	×	...	×	×	×	×	...	×	×	...	...	...	...	...	...	...	×	×	...	×	×	×	×
29	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
30	×	...	...	...	×	×	...	×	×	×	×	×	×	...	×	...	×	...	...	...	...	...	...	...	×	×	...	×	...	×	×
31	×	×	...	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	...	×	×	×	×	×	...	×	×	×	×
Sept. 1	...	×	×	×	...	...	×	...	×	×	...	...	×	×	...	×	...	×	×	...	...	×	×	×	...	...	...	×	...	...	...
2	×	...	...	...	×	×	...	×	...	...	×	×	×	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×	...	×	×
3	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×
4	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5	...	×	...	×	...	...	×	...	×	×	...	...	...	×	×	...	...	...	...	...	×	...	×	...	...	...	...	×	...	...	...
6	×	...	...	...	...	×	...	...	...	...	×	...	×	...	...	×	×	...	...	...	...	×	×	×	...	×	...	×	...	...	...
7	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	×	...	×	...	×	×
8	×	×	×	×	×	×	×	×	×	...	×	×	×	...	...	...	×	×	...	×	×	×	...	...	...	×	...	×	...	×	×
9	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×	×	×	...	×	×	...	×	...	×	...	×	×
10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11	×	...	...	...	×	×	×	×	×	...	...	×	...	...	...	...	×	...	...	...	...	...	...	...	×	×	...	...	...	×	...
12	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13	...	...	...	...	...	...	...	...	×	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14	×	...	×	×	×	×	×	×	...	...	×	...	×	...	...	...	×	...	×	×	...	...	×	×	×	×	...	...	...	...	×
15	×	...	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	...	...	×	...	...	×
16	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...
18	×	...	...	...	...	×	...	×	×	×	×	...	...	...	...	...	...	...	...	×	...	...	...	...	×	...	...	...	...	...	...
19	×	×	...	...	...	×	×	×	×	...	×	...	×	...	...	...	...	...	×	×	...	...	...	...	×	...	...	×	...	...	...
20	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×	...	×	...	×	...	...	...	...	...	...	...	...	...	...	...
22	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table showing number of days during season of 1897 when pelagic sealing was carried on in Bering Sea.

[× = seals taken.]

1897.	Canadian vessels—25.																								American vessels—3.		
	Ainoko.	A. E. Paint.	Arietis.	Beatrice.	Borealis.	City of San Diego.	Dora Siewerd.	E. B. Marvin.	Enterprise.	Favourite.	Fawn.	Geneva.	Mary Taylor.	Minnie.	Ocean Belle.	Otto.	Penelope.	Pioneer.	Sadie Turpel.	Teresa.	Triumph.	Umbrina.	Vera.	Victoria.	Zillah May.	Elsie.	J. Eppinger.	St. Lawrence.
Aug. 1	×	×	...	...	×	×	×	×	×	×	...	...	×	×	×	×	...	...	...	×	×	×	×	×	×	×	...	...
2	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	...	×	×	×	×	×	×	×	×	×
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...
5	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	...	×	×	×	×	×	×	×	×	...
6	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	...	×	×	×	×	×	×	×	×	×
7	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	...	×	×	...	×	×	×	×	×	×
8	×	×	...	×	...	...	×	×	×	...	×	...	×	...	×	...	×	...	...	...	...	...	...	...	...	...	...	×
9	×	...	...	×	...	×	×	×	×	...	×	...	...	×	×	...	...	...	...	...	×	...	×	×	...	...	...	...
10	×	...	×	...	...	×	×	...	×	...	×	...	×	×	×	×	×	...	...	×	×	...	...	×	×	...	×	×
11	×	×	×	...	×	×	×	×	×	×	...	...	×	×	×	×	...	...	...	×	×	...	×	×	×	×	×	×
12	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	...	×	×	×	×	...	×	×	×	×
13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14	...	...	...	...	...	...	...	...	...	...	×	...	×	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...
15	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	×	×	×	×	×	...	×	...	×	×
16	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	...	...	×	×	×	...	×	×	×	×	×	×
17	×	×	×	×	×	×	×	×	×	×	×	...	×	...	×	×	×	...	...	×	...	×	...	×	×	×	×	...
18	×	×	×	×	×	×	×	×	×	...	×	...	...	...	×	...	×	...	...	×	×	×	×	...	...	...	×	×
19	...	×	×	×	×	...	×	×	...	×	...	...	×	×	×	×	×	...	×	×	×	...	×	×	×	×	×	...
20	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	×	×	×	...	×	×	×	×	×	...
21	×	...	...	×	...	×	×	...	×	...	×	...	...	×	×	...	...	...	...	×	×	×	...	×	...	...	×	×
22	...	×	×	...	×	...	×	×	...	×	...	...	×	...	...	×	×	...	×	...	...	...	×	×	×	×	...	...
23	×	×	×	...	×	...	...	...	...	×	...	...	×	×	×	...	...	...	×	×	×	...	×	×	...	×	×	×
24	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	×	×	×	×	×	...	×	×	×	×
25	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	...	...	×	×	×	×	×	×	×	×	×	...
26	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	×	×	×	×	×	×	...	×	×	×
27	×	×	×	×	...	×	×	×	×	...	×	...	...	×	×	...	×	...	...	×	×	×	×	...	×	...	×	×
28	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
29	×	...	×	×	...	×	×	×	×	...	×	...	×	×	×	...	×	...	...	×	×	×	×	×	...	×	×	×
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	×	...	...	×	...	×	×	...	×	×	×	...	...	×	×	...	...	...	...	×	×	×	×	×	...	...	×	×
Sept. 1	×	×	×	×	...	×	×	×	...	×	...	...	...	×	×	×	×	...	×	×	×	...	×	×	×	×	×	×
2	×	×	×	×	...	×	×	×	...	×	×	...	×	×	×	×	×	...	...	×	×	...	×	×	...	×	×	×
3	×	×	×	×	×	×	×	×	×	×	×	...	×	×	×	×	×	...	×	×	×	×	×	×	×	×	×	×
4	×	...	×	×	...	×	×	×	×	×	×	...	...	×	×	...	×	...	...	×	×	×	×	×	...	...	...	×
5	...	...	...	...	...	...	...	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6	×	×	×	×	...	×	×	×	×	...	×	...	×	×	...	×	...	...	...	×	×	...	×	...	×	×	×	×
7	×	...	×	×	...	×	×	×	×	×	×	...	...	×	×	...	...	...	...	×	×	×	×	...	...	×	×	...
8	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...
10	×	×	×	×	...	×	×	...	...	...	×	...	×	×	...	...	...	...	×	×	×	...	...	...	×	...	...	...
11	×	×	×	×	×	×	×	...	×	×	×	...	×	...	×	×	×	...	×	×	×	×	×	×	×	...	...	×
12	...	×	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×	×	...	...	...	...
13	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	×	...	...	...	×	...	...	...	...	...	...	...
14	×	×	×	×	×	×	...	...	...	...	×	...	...	×	...	×	...	...	×	×	...	×	...	...	×	...	...	...
15	×	×	...	×	×	×	...	...	...	...	×	...	...	×	...	×	...	...	...	×	...	...	×	...	...	...	...	...
16	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17	...	×	×	×	...	...	×	...	×	...	...	...	×	×	...	×	×	...	...	×	...	...	...	...	×	...	...	...
18	...	...	×	...	×	...	...	...	...	...	...	...	...	...	...	×	×	...	...	×	...	...	...	...	...	...	...	...
19	...	×	×	...	×	...	...	...	×	...	...	...	...	...	...	×	×	...	...	×	...	...	...	×	...	...	...	...
20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	×	...
22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
26	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...
27	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

NOTE.—One seal taken October 4, Bering Sea schooner Geneva; only October date recorded.

On the Northwest coast sealing grounds sealing begins late in December and ends the last of April. Very few vessels are actively engaged until February. As soon as the vessels are on the ground, sealing goes on more or less regularly until the close of the season. The great extent of this hunting ground permits of seals being taken along some portions of their migrating route when the weather does not permit of their being taken on others. The following tables show the days when seals were taken along the Northwest coast during the seasons of 1895, 1896, and 1897. The earliest sealing is off the coast of California, where it is commenced by two or three American and Canadian vessels late in December, some of these vessels proceeding to the Japan coast in January. During January and February other vessels clear for the sealing grounds, but the fleet, as a whole, is not actively engaged until March and April, when the bulk of the catch is taken. In 1896 most of the Canadian fleet cleared from Victoria late in January, eight vessels not clearing until late in February. No seals were taken by Canadian vessels until February 24 of that year. Vessels clearing from ports in Puget Sound in January, 1896, did not commence sealing until after the middle of February, and three of the Puget Sound vessels did not clear until some time in March.

From an examination of the table for 1896 showing the number of days from January 10 to April 30 when pelagic sealing was carried on by the Canadian and American vessels off the Northwest coast, it appears that seals were taken every day during the month of April, and every day but four during the month of March. From January 10 to February 28 there were 17 days when seals were not taken, but many vessels had not yet cleared, while those already cleared were making up their crews at Indian villages along the coast.

The vessel making the longest cruise on the Northwest sealing ground was the *J. Eppinger*, which began sealing off the coast of California on December 17 (1895), took the last seals for the season off the coast of Washington on April 21. During this time seals were taken on 69 days or a little over half of the whole number of days for the cruise. A similar table for the season of 1895 shows that there were 3 days in April and 1 in March when seals were not taken.

In 1897 about a third of the fleet was engaged in January; by the end of February more than half the Canadian and American vessels were sealing, the entire fleet not being at work as a whole until March and April. Late in December (1896) 110 seals were taken by 4 Canadian and 2 American vessels off the coast of California. In 1897 seals were taken by many vessels with more or less regularity throughout the season.

Table showing number of days in months of February, March, and April, 1895, when pelagic sealing was carried on off the Northwest coast.

[× — seals taken.]

1895.	Canadian vessels—29.																													American vessels—14.													
	Saucy Lass.	C. D. Rand.	Dora Siewerd.	Beatrice (sh.).	Maud S.	Katherine.	Oscar and Hattie.	Triumph.	Sapphire.	A. C. Moore.	Libbie.	Otto.	May Belle.	Ainoko.	Fisher Maid.	Amateur.	San Jose.	Fawn.	Victoria.	W. L. Rich.	Kate.	Aurora.	Teresa.	Favorite.	Mountain Chief.	Kilmeny.	Enterprise.	Shelby.	F. M. Smith.	Columbia.	Jas. G. Swan.	Stella Erland.	Teaser.	Matilda.	Elsie.	Bering Sea.	Deeahks.	Emmett F.	Idler.	Jessie.	R. Ecrett.	Kate and Anna.	J. Eppinger.
Feb. 1																																										×	
2																															×												
3																															×											×	
4																																										×	
5																																										×	
6																																							×				
7					×																									×	×	×											
8																														×	×	×			×				×				
9					×																									×		×		×	×				×				
10																																							×				
11																																											
12																																											
13					×																														×								
14																																										×	
15															×																											×	
16			×												×																											×	
17																																											
18																																											
19																																										×	
20			×																																							×	
21				×		×																																				×	
22			×			×		×																											×								
23			×			×		×	×																										×							×	
24			×	×		×		×																		×									×								
25																																											
26																																											
27																																										×	
28			×	×		×																						×															
Mar. 1			×	×	×	×		×	×										×		×							×														×	
2																																										×	
3			×		×			×	×						×	×			×		×		×		×										×							×	
4	×				×	×					×		×		×				×						×	×				×		×			×	×	×	×				×	
5	×			×	×	×		×	×		×			×	×	×			×		×		×		×	×				×	×	×	×	×	×	×	×	×	×		×	×	
6	×		×	×		×					×	×	×	×	×	×	×		×		×		×					×	×	×	×	×	×		×	×	×	×			×	×	
7	×		×	×	×						×	×	×	×	×	×	×		×		×	×	×		×		×	×		×	×	×	×			×	×	×			×	×	
8	×		×	×	×						×	×	×	×	×	×	×		×		×	×	×		×		×	×	×	×	×	×	×	×			×	×			×		
9			×		×						×	×	×	×		×	×	×			×	×		×	×		×		×			×	×	×	×	×					×		
10			×																				×												×	×					×		
11																																											
12			×																		×																						
13	×	×	×	×			×			×							×			×	×	×		×				×															
14	×		×				×											×						×																			
15																								×																		×	
16	×	×						×	×		×	×	×	×			×	×	×			×		×		×			×														
17																										×																	
18																																											
19												×																														×	
20	×								×	×	×	×						×				×			×																	×	
21						×						×		×															×	×		×											
22	×	×						×	×		×	×		×				×				×		×			×															×	
23																									×					×												×	
24								×	×													×							×	×		×										×	
25	×						×	×	×		×	×	×	×			×	×		×		×		×						×		×										×	
26			×																		×			×						×		×											
27	×						×	×	×		×							×				×							×	×		×											
28	×	×		×			×	×	×	×	×	×	×	×				×		×		×		×			×	×	×	×													
29																														×		×											
30							×				×																															×	
31	×	×					×		×		×	×	×					×											×														
Apr. 1			×		×									×						×							×																
2		×					×				×	×	×																×														
3	×	×	×	×	×		×	×	×	×	×	×	×	×			×	×			×	×		×				×	×														
4	×	×			×		×	×	×		×	×	×								×	×						×	×						×								
5																																											
6																													×													×	
7																																										×	
8	×						×						×				×				×			×				×					×		×								
9	×	×	×	×	×	×	×	×		×	×	×	×	×			×		×	×	×	×	×	×				×											×				
10	×	×	×	×	×		×	×	×	×	×	×	×	×				×	×	×		×		×			×	×	×											×			
11	×						×		×		×		×					×			×	×		×				×	×														

Table showing number of days in months of February, March, and April, 1895, when pelagic sealing was carried on off the Northwest coast—Continued.

1895.	Canadian vessels—29.																													American vessels—14.													
	Saucy Lass.	C. D. Rand.	Dora Sieward.	Beatrice (sh.).	Maud S.	Katherine.	Oscar and Hattie.	Triumph.	Sapphire.	A. C. Moore.	Libbie.	Otto.	May Belle.	Ainoko.	Fisher Maid.	Amateur.	San Jose.	Fawn.	Victoria.	W. L. Rich.	Kate.	Aurora.	Teresa.	Favorite.	Mountain Chief.	Kilmeny.	Enterprise.	Shelby.	F. M. Smith.	Columbia.	Jas. G. Swan.	Stella Erland.	Teaser.	Matilda.	Elsie.	Bering Sea.	Deeahks.	Emmett F.	Idler.	Jessie.	R. Ecrett.	Kate and Anna.	J. Eppinger.
Apr. 12	×	×	×	×	×	×	×	×	×	×	×	×	×	×					×			×		×			×	×															
13																																											
14																																									×		
15																																											
16	×					×		×	×				×						×																								
17	×		×			×	×		×		×		×					×	×		×	×					×	×	×														
18	×	×	×	×	×				×		×	×		×			×	×						×																		×	
19	×	×	×	×	×	×	×	×	×	×	×	×	×					×	×	×	×			×					×							×						×	
20															×	×						×	×												×	×					×	×	
21															×	×							×								×		×	×	×	×	×	×	×		×	×	
22																×							×								×		×	×	×	×							
23	×	×	×	×	×		×	×	×	×	×		×	×	×		×	×	×	×	×			×			×	×	×								×		×		×		
24	×	×	×	×			×		×			×	×		×		×	×	×		×			×			×	×			×			×	×						×		
25	×		×	×	×	×	×							×				×	×		×	×		×			×	×			×											×	
26	×											×		×		×	×	×	×		×										×		×	×	×				×			×	
27	×				×		×					×			×	×	×	×	×		×	×						×			×		×	×	×	×			×		×	×	
28	×	×	×	×	×	×	×	×			×	×	×	×	×	×	×	×	×	×	×	×					×	×	×							×					×	×	
29						×									×						×										×				×	×			×		×	×	
30	×			×								×	×					×	×		×	×					×	×															

Table showing number of days during January, February, March, and April, 1896, when pelagic sealing was carried on off the Northwest coast.

[×= Dates when seals were taken. O= Dates of clearance.]

1896.	Canadian vessels—23.																							American vessels—11.										
	Minnie.	Fawn.	W. L. Rich.	Victoria.	Dora Sieward.	Ainoko.	Venture.	San Jose.	Sapphire.	Kate.	Labrador.	Carrie C. W.	A. C. Moore.	City San Diego.	Saucy Lass.	Libbie.	Oscar and Hattie.	Beatrice (Shanghai).	Dolphin.	Penelope.	Beatrice (Vancouver).	Favorite.	South Bend.	Eppinger.	Penelope.	Jessie.	Perkins.	Kate and Anna.	Puritan.	Columbia.	Deeahks.	Jas. G. Swan.	Bering Sea.	Teaser.
Jan. 10																								×				×						
11										O														×				×						
12																								×										
13	O																							×										
14																														O	O			
15														O											O									
16																																		
17																								×										
18							O								O																			
19																																		
20																																		
21																		O		O														
22																								×										
23		O															O																	
24																									×							O		
25																																		
26																																		
27									O			O									O													
28					O																				×	O								
29																																	O	
30																								×				×						
31				O																				×				×						
Feb. 1																								×				×						
2																																		
3																																		
4																								×										
5																						O		×										
6																																		
7						O																		×				×						
8													O			O								×	×			×						
9																								×	×			×						
10																								×	×									
11																																		
12																								×										

Table showing number of days during January, February, March, and April, 1896, when pelagic sealing was carried on off the Northwest coast—Continued.

1896.	Canadian vessels—23.																							American vessels—11.										
	Minnie.	Fawn.	W. L. Rich.	Victoria.	Dora Siewerd.	Ainoko.	Venture.	San Jose.	Sapphire.	Kate.	Labrador.	Carrie C. W.	A. C. Moore.	City San Diego.	Saucy Lass.	Libbie.	Oscar and Hattie.	Beatrice (Shanghai).	Dolphin.	Penelope.	Beatrice (Vancouver).	Favorite.	South Bend.	Eppinger.	Penelope.	Jessie.	Perkins.	Kate and Anna.	Puritan.	Columbia.	Deeahks.	Jas. G. Swan.	Bering Sea.	Teaser.
Feb. 13																								×	×			×						
14																								×	×									
15																								×	×			×						
16																								×	×									
17																								×	×			×			×		×	
18																								×	×	×		×		×	×	×	×	
19			O					O																×	×			×		×	×			
20																			O					×	×			×						
21																									×									
22																												×						
23																								×				×						
24	×				×																			×	×			×						
25																								×	×			×						
26	×											×												×	×			×						
27																												×						
28																																		
Mar. 1																																		
2																							O	×										
3							×									×													O					
4	×				×		×			×		×				×	×	×		×	×	×		×				×						
5	×	×			×							×					×			×	×			×				×						
6							×			×	×	×			×			×		×		×		×										
7																								×				×						O
8	×																											×						
9	×	×	×	×	×		×		×	×		×			×	×	×	×				×												
10	×	×	×	×	×		×		×	×		×	×		×	×	×	×				×						×						
11	×	×	×		×				×	×		×	×	×	×	×	×	×				×		×				×						
12		×					×		×								×							×						×				
13									×						×	×	×	×		×	×	×								×				
14	×	×					×	×	×	×	×		×	×	×	×	×	×	×	×	×	×		×		×		×	×		×		×	×
15	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×		×		×		×	×	×	×	×
16		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×	×	×	×		×		×		×	×	×	×	×	×	×
17		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×		×	×	×	×	×	×	×
18		×	×	×	×	×	×		×	×		×	×	×		×	×		×	×		×		×		×		×	×	×	×	×	×	×
19																												×						
20							×									×								×				×						
21			×			×	×					×	×	×	×	×	×		×	×		×		×			O							
22							×	×						×	×	×		×	×	×		×												
23																								×										
24																								×										
25			×			×	×	×					×	×			×											×						
26	×	×				×	×	×	×					×									×											
27																																		
28																																		
29																																		
30			×																			×												
31						×	×		×				×											×				×						
Apr. 1		×		×	×	×			×												×			×							×			
2	×	×		×		×	×		×			×	×											×							×		×	
3		×			×			×	×		×													×		×				×	×	×	×	×
4						×	×		×	×												×				×	×		×	×			×	
5																		×				×												
6						×	×		×			×	×		×	×			×	×	×													
7	×	×		×		×		×	×		×		×	×	×	×	×	×	×	×	×	×												
8		×					×	×	×			×		×			×				×												×	
9	×	×	×		×				×			×	×	×	×	×		×	×		×	×												
10	×	×		×		×		×		×			×	×	×	×	×	×	×			×	×							×	×			
11	×														×	×		×	×	×	×			×									×	
12	×	×	×			×		×	×	×		×	×	×	×	×	×	×	×	×	×	×												
13	×										×				×	×		×	×											×				
14	×					×							×	×	×	×		×	×	×	×	×								×				
15	×	×	×		×	×	×		×	×		×	×	×	×	×	×	×	×	×	×	×		×		×		×		×				
16		×	×	×	×	×	×	×	×	×	×			×			×						×	×		×	×	×	×	×	×	×	×	×
17		×		×	×	×	×	×	×	×	×						×						×	×		×	×	×		×	×	×	×	×
18						×									×				×															
19	×	×			×	×		×	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×		×		×		×	×		×	×
20		×			×	×	×	×									×						×	×		×		×		×	×	×	×	×
21		×			×	×	×	×		×	×		×				×						×	×		×	×	×		×		×	×	×
22	×	×		×		×		×	×	×				×			×						×							×		×		×
23	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×			×		×		×		×		
24	×	×		×		×	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×	×			×	×		×	×		×	×	×
25		×	×		×	×		×	×	×							×									×	×	×	×	×		×	×	

Table showing number of days during January, February, March, and April, 1896, when pelagic sealing was carried on off the Northwest coast—Continued.

1896.	Canadian vessels—23.																							American vessels—11.										
	Minnie.	Fawn.	W. L. Rich.	Victoria.	Dora Siewerd.	Ainoko.	Venture.	San Jose.	Sapphire.	Kate.	Labrador.	Carrie C. W.	A. C. Moore.	City San Diego.	Saucy Lass.	Libbie.	Oscar and Hattie.	Beatrice (Shanghai).	Dolphin.	Penelope.	Beatrice (Vancouver).	Favorite.	South Bend.	Eppinger.	Penelope.	Jessie.	Perkins.	Kate and Anna.	Puritan.	Columbia.	Deeahks.	Jas. G. Swan.	Bering Sea.	Teaser.
Apr. 26	...	×	×	×	×	×	×	×	×	×	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	×	×	×	...	×	×	×	×	×
27	...	×	...	...	×	×	×	×	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
28	×	...	...	...	...	...	...	...	...	...	...	×	×	×	×	×	...	×	×	×	×	×	...	...	...	...	...	...	...	...	×	...	...	...
29	...	...	...	×	×	×	...	×	×	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	×	...	...	...	...	...	...	...	...	...	...	...	×	...	×	×	...	×	×	×	×	×	...	...	...	...	...	...	...	...	...	...	...	...

Three Canadian and one American vessel omitted—no logs.

Table showing number of days when pelagic sealing was conducted off the Northwest coast in 1897.

[× = seals taken.]

1897.	Canadian vessels—29.																													American vessels—11.										
	Ainoko.	Allie L. Algar.	Annie E. Paint.	Amateur.	Arietis.	Beatrice.	C. D. Rand.	C. G. Cox.	City of San Diego.	Director.	Dora Siewerd.	E. B. Marvin.	Enterprise.	Fawn.	Fisher Maid.	Labrador.	Mary Taylor.	Mary Ellen.	Minnie.	Mermaid.	Ocean Belle.	Otto.	Pachwellis.	Penelope.	Pioneer.	South Bend.	Teresa.	Zillah May.	Triumph.	Bering Sea.	Columbia.	Deeahks.	Fischer Bros.	Jas. G. Swan.	J. Eppinger.	Kate and Anne.	Louisa D.	Rattler.	Teaser.	W. Ainsworth.
Jan. 1	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2	...	...	...	...	...	...	×	×	...	...	...	...	...	...	...	...	×	×	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	...	×
3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	...	...
5	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	...	...
6	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×	...	...	...
7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	...	...
8	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...
9	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	×	...	...	...
10	...	×	...	...	...	...	×	×	...	×	...	...	...	...	...	...	×	×	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	×	...	...	×
11	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	×
12	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...
13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
14	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	×
15	...	×	×	...	...	...	...	×	...	...	...	...	...	...	...	...	×	...	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	...	...	×
16	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×
17	...	×	...	...	...	...	×	×	...	...	...	...	...	...	...	...	...	×	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	×
18	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	×	...	...	×
19	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	×	...	...	×
20	...	×	...	...	...	...	×	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	×
21	...	×	...	...	...	...	×	×	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	×	...	×
22	...	×	...	...	...	...	×	×	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	×	×	...	×
23	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	×	...	...
24	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	...	×	...	×
25	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
26	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	×	...	×
27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×	...	...
28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	...	...	...
31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	×
Feb. 1	...	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	×	...	×
2	...	×	×	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	×	...	×
3	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...
4	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	×	...	×
5	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	×	...	...	...
6	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	...	...	...	×
7	...	...	×	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×
8	...	×	×	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×
9	...	×	×	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	×	×	×	...	×
10	...	...	×	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	×	×	...	×
11	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	×	...	×
12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...
13	×	×	...	...	...	...	×	...	...	...	...	×	...	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
14	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	×	...	...
15	...	×	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	×	...	...	...	...	...	×	×	×	...	...	×
16	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	×	...	...

Table showing number of days when pelagic sealing was conducted off the Northwest coast in 1897—Cont'd.

1897.	Canadian vessels—29.																													American vessels—11.										
	Ainoko.	Allie L. Algar.	Annie E. Paint.	Amateur.	Arietis.	Beatrice.	C. D. Rand.	C. G. Cox.	City of San Diego.	Director.	Dora Siewerd.	E. B. Marvin.	Enterprise.	Fawn.	Fisher Maid.	Labrador.	Mary Taylor.	Mary Ellen.	Minnie.	Mermaid.	Ocean Belle.	Otto.	Pachwellis.	Penelope.	Pioneer.	South Bend.	Teresa.	Zillah May.	Triumph.	Bering Sea.	Columbia.	Deeahks.	Fischer Bros.	Jas. G. Swan.	J. Eppinger.	Kate and Anne.	Louisa D.	Rattler.	Teaser.	W. Ainsworth.
Feb. 17	×	×										×						×							×											×		×		×
18							×																						×											
19												×																												
20							×					×																	×											×
21		×					×					×						×											×											×
22	×	×					×					×			×		×	×							×				×				×			×	×	×		×
23	×																	×							×										×	×	×	×		×
24	×											×			×										×				×		×			×	×	×	×	×		
25	×	×		×			×					×			×			×					×		×					×	×	×			×	×	×	×		×
26	×											×					×						×		×				×	×	×	×			×	×	×	×		×
27																	×																	×	×		×			
28	×	×																×							×					×	×		×		×		×			
Mar. 1															×		×								×									×						
2	×	×		×													×	×														×								
3	×	×				×											×	×					×	×	×					×	×	×			×	×		×		
4	×																×								×									×	×			×		
5	×																	×							×										×	×	×			
6						×											×					×		×														×		×
7	×	×				×	×					×							×			×		×	×				×					×	×					
8	×																								×									×	×					
9	×																								×												×			
10																																					×			
11																																								
12						×					×								×										×									×		
13							×										×												×					×	×	×				
14												×							×		×	×							×				×			×		×		×
15	×										×	×									×														×	×	×	×		
16	×											×																		×						×		×		
17																	×																	×						
18	×											×					×																			×				
19	×																				×														×					
20							×					×									×								×											
21																													×								×	×		
22	×																×																		×	×	×			
23																									×										×	×				
24	×																								×										×	×				
25	×	×										×									×														×					
26																																								
27																																			×					×
28																																								
29		×					×				×										×	×		×					×								×			
30	×																																				×			
31		×																																		×				
Apr. 1	×	×															×				×																			
2	×	×				×	×					×					×				×	×	×		×				×								×			
3	×	×			×	×	×		×			×			×						×	×						×	×											
4	×				×						×						×												×	×	×	×		×						×
5	×	×																																			×			
6	×				×	×	×		×			×	×					×	×		×	×		×					×											
7	×				×													×			×																×			
8	×					×	×		×		×	×						×			×	×		×				×	×								×			×
9		×			×	×	×					×		×			×	×	×		×	×		×	×			×	×	×	×	×		×						×
10		×			×	×	×		×			×					×		×		×	×		×				×	×											×
11	×												×												×						×									
12				×	×				×		×	×		×			×				×						×			×	×			×						×
13		×		×	×	×	×		×		×		×	×	×		×	×	×		×	×		×			×	×	×		×									×
14				×										×	×	×									×		×				×	×							×	
15	×	×		×	×									×	×		×				×				×		×			×	×	×		×			×		×	×
16	×				×		×		×								×				×		×	×		×											×			×
17		×										×	×	×			×										×	×	×	×	×									×
18	×	×			×	×	×		×			×					×	×	×		×	×		×				×	×								×			×
19	×	×			×				×		×		×	×					×		×	×		×					×	×	×									×
20					×								×																											
21		×							×						×				×										×											×
22														×			×														×					×				
23					×	×	×					×							×								×			×	×					×	×			
24	×												×	×													×			×	×					×	×		×	
25	×	×		×		×	×		×		×	×	×	×		×	×	×	×		×	×		×			×	×	×	×	×			×		×			×	×
26																																								
27		×				×	×		×			×	×			×		×	×		×	×		×				×												×
28																×																								
29									×							×																								
30						×							×					×			×	×		×				×												×

NOTE.—110 seals taken off California and Oregon late in December, 1896, by 4 Canadian and 2 American vessels.

An examination of the records of ten vessels sealing off the Japan coast in 1896 shows that there were but six days between March 14 and June 30 when seals were not taken, less than half the records being at hand.

Table showing number of days during the months of March, April, May, and June, 1896, when pelagic sealing was carried on off the coast of Japan.

[× = seals taken.]

1896.	American.									Canadian.
	Elsie.	Jane Gray.	Ainsworth.	Morrill.	Ratler.	Alton.	Golden Fleece.	Louisa D.	St. Lawrence.	Allie Algar.
Mar. 1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14							×			
15							×			
16		×					×			
17		×			×					
18	×	×	×	×	×		×			
19	×	×		×	×					
20			×							
21		×	×		×					
22		×	×	×						
23	×	×	×	×	×		×			
24	×	×	×	×	×		×			
25	×	×	×	×	×					
26	×		×	×	×		×			
27	×	×			×					
28										
29										
30	×	×	×	×		×	×			
31	×	×	×							
Apr. 1	×	×	×	×	×	×		×		×
2	×		×	×	×	×				×
3	×	×	×		×	×		×		×
4	×	×	×	×	×	×	×	×	×	×
5		×	×		×	×	×	×	×	
6	×	×	×	×		×	×	×	×	×
7	×	×			×		×	×	×	
8						×	×			
9	×	×	×	×	×	×	×		×	×
10	×	×	×		×		×	×	×	
11					×				×	
12	×			×	×	×		×		
13	×	×	×	×	×	×	×	×	×	×
14										
15	×			×	×					×
16		×	×	×				×		×
17							×		×	×
18				×	×			×		
19	×		×	×			×		×	×
20	×			×					×	
21					×				×	×
22	×	×	×	×	×	×	×	×		×
23			×	×	×	×		×	×	×
24					×		×			×
25										
26		×		×		×	×	×	×	
27	×	×				×			×	
28	×	×		×	×	×		×		×
29	×	×		×			×	×		×
30			×	×			×	×		

1896.	American									Canadian.
	Elsie.	Jane Gray.	Ainsworth.	Morrill.	Ratler.	Alton.	Golden Fleece.	Louisa D	St. Lawrence.	Allie Algar.
May 1			×	×	×	×	×			
2	×	×		×		×	×	×		×
3	×	×	×	×	×		×	×		×
4				×						
5	×									
6				×						
7	×	×	×	×	×		×	×		×
8	×	×	×	×	×	×	×	×	×	×
9	×	×	×	×		×	×	×	×	×
10			×							×
11	×	×	×		×	×	×		×	×
12			×			×	×			
13	×	×			×	×	×	×	×	×
14	×	×	×		×	×	×	×	×	×
15	×	×	×	×	×	×	×	×	×	×
16	×	×	×		×	×	×	×	×	×
17	×		×		×	×	×	×	×	×
18	×		×		×	×	×	×	×	×
19	×	×	×		×	×	×	×	×	×
20							×			
21	×	×	×	×		×	×	×	×	
22		×		×		×		×	×	×
23							×			
24			×			×	×	×		×
25			×			×	×		×	×
26								×	×	
27			×	×				×		
28			×	×			×		×	×
29	×		×	×		×	×			×
30				×		×				
31			×	×			×			×
June 1				×		×				
2	×		×			×	×			
3	×		×			×	×			
4	×	×	×	×		×				
5	×	×	×	×		×	×			
6			×	×		×	×			
7	×	×	×			×	×			
8			×	×						
9					×		×		×	
10			×		×		×		×	
11		×	×	×		×	×		×	
12		×	×	×		×			×	
13			×	×			×		×	
14		×				×			×	
15		×	×	×	×		×			
16		×		×			×			
17			×	×			×			
18		×	×	×						
19		×	×						×	
20		×								
21										
22									×	
23									×	
24		×						×		
25					×					
26					×					
27					×					
28	×		×							
29					×					
30										

The only log-book records at hand relating to the sealing grounds adjacent to the Commander Islands show that eight Canadian vessels and one American vessel, sealing in August, 1892, found the weather conditions similar to those of recent seasons, there being but one day in that month of 1892 when seals were not taken.

Table showing number of days during the months of August and September, 1892, when sealing was carried on about the Commander Islands.

[× = seals taken.]

1892.	Vessels.								
	Umbrina.	W. P. Hall.	Maud S.	McDonald.	Arietis.	Beatrice.	A. E. Paint.	Vanc. Belle.	Henry Dennis.
August 1	×	....	....	×	×	×	....	×	×
2	×	×	×	×	×	×	....	×	....
3	×	×	×	×	×	×	×	×	×
4	×	×	×	×	×	×	×	×	×
5	×	×	×	×	×	×	×	×	×
6	×	×	×	×	....	×	×	×	×
7	×	....	×	×	×	×	....	×	×
8	....	×	×	....	×	....	×	×	....
9	....	×	....	×	×	×	....	....	×
10	×	×	×	×	×	×	....	×	×
11	×	×	×	×	....	×	....	×	×
12	×	....	....	....	....	....	×	....	×
13	....	....	×	....	....	....	....	....	....
14	....	....	×	....	....	....	....	....	×
15	....	....	....	....	....	....	....	....	....
16	×	....	....	....	....	×	....	....	....
17	×	....	×	×	....	×	×	....	....
18	×	....	×	×	×	×	....	....	×
19	×	....	×	....	....	....	×	....	×
20	....	....	....	×	....	....	....	....	....
21	×	×	×	×	....	×	×	....	....
22	×	×	×	×	×	×	×	....	×
23	×	....	×	....	....	×	×	....	×
24	×	....	....	....	×	×	....	....	....
25	×	....	×	×	....	×	....	....	....
26	×	....	×	....	....	....	....	....	×
August 27	....	×	×	....	....	....	×	....	×
28	....	....	....	....	....	....	....	....	×
29	....	....	....	....	×	....	....	....	....
30	×	....	....	....	....	....	....	....	....
31	×	....	×	....	....	....	×	....	....
September 1	....	....	....	....	....	....	....	....	....
2	....	....	....	....	....	....	....	....	....
3	....	....	....	....	....	....	....	....	....
4	....	....	×	....	....	....	....	....	....
5	....	....	×	....	....	....	×	....	....
6	....	....	×	....	....	....	....	....	....
7	....	....	×	....	....	....	....	....	....
8	....	....	×	....	....	....	....	....	....
9	....	....	....	....	....	....	....	....	....
10	....	....	....	....	....	....	....	....	....
11	....	....	....	....	....	....	....	....	....
12	....	....	....	....	....	....	×	....	....
13	....	....	....	....	....	....	×	....	....
14	....	....	....	....	....	....	....	....	....
15	....	....	....	....	....	....	....	....	....
16	....	....	....	....	....	....	....	....	....
17	....	....	....	....	....	....	....	....	....
18	....	....	....	....	....	....	....	....	....
19	....	....	....	....	....	....	....	....	....
20	....	....	....	....	....	....	×	....	....
21	....	....	....	....	....	....	....	....	....

On the whole, it does not appear that the average weather conditions from season to season are worth considering in their effect upon the catch of seals.

WASTEFULNESS OF INDISCRIMINATE SEALING.

Pelagic sealing is not regularly practiced elsewhere than in Bering Sea and the North Pacific Ocean. During the voyage of the Canadian schooner *Director* from the Atlantic to the Pacific in 1895, 620 seals were obtained by pelagic sealing off the Falkland Islands, and in 1897 a catch of 224 seals was made adjacent to the seal rookeries of the Galapagos Islands. During the progress and decline of this industry in the North Pacific Ocean and Bering Sea those engaged in pelagic sealing have stoutly maintained that the industry was not especially disastrous to the race of seals, alleging that there was no excessive number of female seals destroyed; that the decline in the catch during recent years has been due more to stormy weather than to scarcity of seals, and that the various international restrictions of the past seven or eight years have also greatly restricted the catch. It is a matter of fact, however, that the pelagic catch is made up largely of female seals; that the weather conditions have not materially affected the annual catch, and that sealing, while restricted in some localities, has remained unrestricted in others, thus leaving the fleet always at liberty to operate somewhere. The industry is undoubtedly responsible for the great reduction that has taken place in the American and Asiatic seal herds, and is rapidly declining. The history of all seal fisheries, except where the seals breed in well-protected localities and are killed under government supervision, has been a history of wasted resources. Unrestricted fur sealing in other parts of the world has, during the past century, resulted in the ruin of all the great seal rookeries of the Antarctic.

About the close of the last century a traffic sprang up in the skins of fur seals, and as a result of the many voyages made to the Antarctic regions enormous numbers of fur seals were taken. These were not, however, procured at sea by the ordinary methods of pelagic sealing, but were taken from the rookeries on which they bred. By 1830 the supply of fur seals in the southern seas was nearly exhausted. No discrimination was made in the character of the seals taken, whether males or females. The markets were frequently glutted and much of the catch wasted. In many parts of the Antarctic remnants of these seal herds still linger about their ancient breeding places, and new rookeries could doubtless be established by their protection against indiscriminate sealing.

In pelagic sealing no selections can be made; males and females must be taken indiscriminately. So long as indiscriminate sealing continues the restoration of the seal fisheries to their former importance will be impossible. American citizens are no longer permitted to engage in it, and no portion of the pelagic catch can be imported in any form into the United States. The American and Russian seal islands have already been rendered nearly valueless by reason of pelagic sealing, and the industry itself is greatly diminished in consequence of the scarcity of seals. It is almost as suicidal as the indiscriminate raiding of seal rookeries.

The value of the seal skin procured in pelagic sealing does not average more than one-third that of the skin taken on land. The land catch, made under the supervision of the American and Russian Governments, consists of the skins of 3-year-old males taken when they are in best condition, and constitutes a single grade of the best quality. The pelagic catch is obtained in season and out of season. It consists of young and old, male and female, with all skins more or less damaged by shooting or spearing. It must, therefore, be divided into several grades, most of them of poor quality.

Pelagic sealing is not only responsible for the destruction of large numbers ot adult female seals, but equal numbers of young seals have died of starvation on the seal islands in consequence of the loss of their mothers.

THE LOG-BOOK RECORDS OF THE SEALING FLEET.

Many of the difficulties in the way of solving problems connected with the life history of the fur seal have been due to the fact that the animal is absent from its island home in Bering Sea for about half the year, migrating thousands of miles into the Pacific Ocean. Investigations of seal life at sea, especially in the vicinity of the Pribilof Islands, have been undertaken several times by means of Government vessels, and the work accomplished has not been without important results, but information regarding the seal's migration has been derived chiefly from the log-book records of the sealing fleet.[a] The gradual extension of pelagic sealing by vessels from Bering Sea, where it originated in 1880, over all parts of the Pacific Ocean frequented by fur seals, made such records important, and a large number of them have recently been gathered together.

These records, based on actual captures of hundreds of thousands of seals at all seasons of the year throughout the fur-seals range, include at the present time the log books of 123 different vessels sealing at various times during a period extending over fourteen years.

It appears from a study of the records of the sealing fleet that the American herd, as a body, follows the continental outlines in its lingering northward migration. As the seals do not leave the summer habitat until November, and make their first coastwise appearance far to the southward in December and January, there is good reason for supposing that the southward movement is well offshore and very rapid.

From the limited references in the log-book records to the different classes of seals taken on each of the American hunting grounds, the indications are that the adult females migrate farthest—to the Santa Barbara Islands—the younger classes reaching the coast a little farther to the northward—on the Vancouver ground—while the adult males are seldom taken south of the Fairweather ground. The schooner *Penelope*, in a catch of 215 seals taken south of San Francisco in 1896, reported only 8 males. A catch of 1,266 seals made in 1897 south of San Francisco by the schooners *Eppinger* and *Louisa D.* contained only 72 males. Young seals 6 or 7 months old appear in large numbers along the coasts of Oregon and Washington. Yearlings of both sexes are reported to linger in small bands far offshore in June and July, but sealers do not spend much time in hunting them, as their market value is small.

On the Japan coast there appears to be a larger proportion of medium-sized males among the adult females than on any other Pacific hunting ground.

In Bering Sea, as is well known, the adult females taken by the sealing fleet outnumber all other classes of seals combined.

The latitude and longitude of the daily sealing operations of all these vessels have been platted on the accompanying map, and, each month's sealing being indicated distinctively, the map may be considered as representing our present knowledge of the seasonal movement of the American and Asiatic seal herds, as well as outlining the hunting grounds of the pelagic sealing fleet.

List of the log-book records used in the preparation of the map showing the migration and distribution of the fur seal.

	Seals.
All United States official data (Asiatic and American coasts), 1894 to 1897, statistical tables, fur-seal catch, Treasury Department	85,985
Canadian official data (award area only), 1894 to 1897, department of marine and fisheries, Ottawa	142,009
Canadian official data (Asiatic, in part), 1893, department of marine and fisheries, Ottawa	21,055
Miscellaneous Canadian and United States data (Senate Doc. 157, Part II, pp. 50-55), 1883 to 1893	21,877
Miscellaneous Canadian data (Fur-Seal Arbitration, vol. 8, pp. 816-843), 1892	15,875
Miscellaneous Canadian and United States data (unpublished; collected by C. H. Townsend), 1886 to 1896	14,828
Miscellaneous Japanese data (unpublished; collected by L. Stejneger), 1894 to 1897	3,084
Total	304,713

List of hitherto unpublished pelagic-sealing records collected by C. H. Townsend.

Year.	Schooner.	Range.
1886	Vanderbilt	Northwest coast and Bering Sea.
1887	Alexander	Do.
1888	San Jose	Northwest coast.
1891	Alton	Northwest coast and Commander Islands.
1892	Sophia Sutherland	Northwest coast and Bering Sea.
1892	Bowhead	Japan coast.
1893	do	Do.
1893	Alton	Do.
1893	Therese	Northwest coast and Commander Islands.
1894	Bowhead	Japan coast.
1894	Therese	Do.
1894	Anna Matilda	Do.
1894	Alexander	Japan coast and Kuril Islands.
1894	Jane Gray	Japan coast.
1895	M. M. Morrill	Do.
1895	Brenda	Japan coast and Kuril Islands.
1895	Mascot	Japan coast.
1896	Golden Fleece	Do.
1896	Allie I. Algar	Do.

Miscellaneous log-book records of sealing vessels collected by C. H. Townsend.

SCHOONER VANDERBILT.

Northwest coast and Bering Sea. From private log of John T. Ford.

1886.	Lat. N.	Long. W.	Seals.	1886.	Lat. N.	Long. W.	Seals.	1886.	Lat. N.	Long. W.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
May 17	38 29	125 40	20	July 11	58 05	173 42	4	Aug. 5	54 43	167 20	13
23	38 40	126 42	2	12	56 40	171 10	30	7	54 56	167 33	3
24	40	128 20	3	13	56 10	170 25	36	8	55 03	167 44	6
26	40 10	128 54	21	14	56	171 05	9	9	55 47	167 23	46
June 10	55 10	169 41	1	16	56 10	170 57	14	10	55 10	168 34	38
11	55 30	170	1	17	56 14	171 03	64	11	55 30	168 40	3
20	55 40	170 25	16	18	55 57	170 45	2	13	55	168 09	1
21	54 56	169 57	21	20	55 43	172 20	3	15	54 33	168 25	13
23	54 58	169 43	32	21	55 37	172 43	38	16	54 43	168 24	9
25	54 37	168 37	3	22	55 43	171 57	73	19	55 03	168 53	125
26	50 16	169 42	4	24	55 23	171 05	31	21	54 57	168 24	48
27	55 47	170 10	2	25	54 58	170 54	20	23	54 44	167 54	56
28	55 57	171 20	48	28	54 57	170 43	90	24	54 40	167 33	14
30	55 48	171 48	4	29	54 27	169 23	57	26	55 27	166 47	1
July 1	56 20	172 05	68	30	54 15	168 37	10	29	55 37	166 37	92
2	56 33	173 20	22	31	54 37	164 56	4				
3	56 45	172 54	4	Aug. 1	54 39	167 60	53		Total.	....	1,425
7	57 05	173 08	34	2	54 53	166 57	71				
10	57 32	173 25	1	3	54 37	166 43	41				

Miscellaneous notes from this log are follows:

Schooner Vanderbilt, 1886 (sealing), Captain Mayer.

Left San Francisco March 26. One hundred and twenty seals taken by April 21; 90 of these taken on banks off Point Arenas; remaining 20 taken near Cape Perpetua.

April 23.—One seal.

April 26.—Salmon jumping and seals seen off Tillamook.

May 1.—Two seals; saw a sea lion eating a rock cod. Off Point Grenville.

May 2.—Twenty-four seals off Point Grenville 35 miles.

May 3.—One seal; females here large, and most of them have large pups in them.

May 4.—Four seals. Almost impossible to find "sleepers." In sight of 4 schooner, which have 15 to 20 canoes and boats; sails could be seen in any direction. Schooner *Granger* reported 300 seals in three days. The Siwash uses both gun and spear, and can get closer than we can. He furnishes his own canoe, assistant, and grub, sells his catch to the vessel at a discount, and pays one-third for use of the schooner.

May 9.—At Victoria. Schooner *Sierra*, 202 seals; *Mary Ellen*, 460 seals.
June 5.—Anchored in the Pass near Ugamok Island. Passed schooner *Therese*.
June 6.—First day in Bering Sea.
June 11.—In sight of St. George Island.
June 27.—Boarded by *Corwin* and notified not to hunt in Bering Sea, but captain produced papers which were considered sufficient as permit. Guns and ammunition of schooner *Sierra*, Captain Lee, seized by *Corwin*.
July 10.—Saw schooner *Black Diamond*, with Siwash crew.
August 3.—Spoke *Mary Ellen*, with 2,850 seals on board—full catch from San Francisco 3,550 seals.
August 11.—Spoke *Therese*, with 1,200 seals.
August 15.—Fifty miles north of Unalaska Island. Longitude, 167° 25′ north; 54° 33′ latitude.
August 30.—Starting home. About 54° 36′ latitude; 171° 50′ longitude. Catch for the season: Ufron, 528; Ball, 244; Cooper, 366; Bremond, 421; Ford, 258; Captain Meyer, 101. Catch for Bering Sea: Ufron, 323; Ball, 257; Cooper, 240; Bremond, 303; Ford, 241; Captain Meyer, 81. Rifles used during cruise.
September 23.—Victoria.
September 24.—Sold skins at $6.25 each.
October 12.—San Francisco.

SCHOONER ALEXANDER.

[Northwest coast and Bering Sea.]

1887.		Lat. N. ° ′	Long. W. ° ′	Seals.	1887.		Lat. N. ° ′	Long. W. ° ′	Seals.	1887.		Lat. N. ° ′	Long. W. ° ′	Seals.
Feb.	8	37 10	123 30	1	Apr.	18	41 35	125 00	9	June	13	53 45	162 49	4
	10	37 15	123 45	2		20	43 35	124 57	12		18	54 00	162 38	6
	16	37 27	124 10	5		21	44 50	124 54	16		19	53 43	163 07	7
	17	37 50	123 45	6		22	44 45	124 57	29		20	53 27	163 20	10
	26	37 45	123 50	2		23	45 48	124 50	62		22	53 37	163 10	11
	28	37 45	123 43	3		28	47 58	124 30	2		24	53 40	162 57	12
Mar.	1	38 00	124 00	3	May	12	48 10	125 20	36		26	53 45	162 40	14
	15	38 30	123 57	4		13	48 30	126 20	42		27	53 47	163 35	18
	18	38 35	123 47	2		14	48 45	126 40	47		28	53 59	162 57	18
	23	39 10	124 40	9		15	48 30	127 10	58		29	53 37	163 10	5
	28	39 00	124 45	1		22	51 10	138 20	63	July	12	53 46	163 25	65
	30	39 15	124 47	2		23	52 40	148 30	65	Aug.	18	54 00	162 25	86
Apr.	3	40 00	124 40	7	June	7	53 30	163 05	1					
	14	40 15	124 50	12		9	53 40	162 57	2			Total.	....	800
	15	41 25	124 55	38		10	53 50	162 47	3					

Extracts from a private log kept on board the Canadian schooner San José during a sealing cruise along the coasts of California, Oregon, and Washington in February, March, and April, 1888.

1888.		Position.	Seals.	1888.		Position.	Seals.
Feb.	—	Westport, 35 miles NE	7	Mar.	26	Lookout, 15 miles NE	21
	6	Capo Gorda, 35 miles NE	2		27	.....do	15
	8	Cape Mendocino, 25 miles E	5	Apr.	2	Haystack Rock, 15 miles ENE	14
	9	Klamath River, 20 miles NE	6		3	Haystack Rock, 20 miles ENE	5
	17	Off Albion	1		4	Haystack Rock, 25 miles ENE	4
	25	Fort Ross, 30 miles NE	4		5	Haystack Rock, 15 miles ENE	3
Mar.	5	Farallones, 10 miles ENE	6		5	Tillamook Head, 30 miles N	10
	6	Point Reyes, 35 miles ESE	2		9	Tillamook Head, 18 miles NE	11
	7	Point Arena, 25 miles NE	1		10	Columbia River, 30 miles NE	8
	9	Cape Mendocino, 60 miles N	4		11	Columbia River, 35 miles ENE	22
	10	Cape Mendocino, 40 miles N	3		12	Columbia River, 40 miles ENE	18
	14	Umpqua Shoal, 20 miles E	17		13	Columbia Rivor, 45 miles ENE	2
	15	Cape Perpetua, 60 miles E. by N	7		16	Tillamook Head, 30 miles E. by N	29
	16	Cape Perpetua, 40 miles NE	15		17	Tillamook Head, 40 miles E. by N	13
	17	.....do	5		18	Columbia River, 35 miles NE. by N	7
	19	Cape Perpetua, NE	2		21	Destruction Island, 30 miles NE	29
	20	Capo Lookout, 25 miles NNE	7		22	Dead seal gaffed from schooner	1
	21	Capo Lookout, 30 miles NE	6		23	Cape Flattery, 40 miles NNW	8
	23	Cape Lookout (from deck), NNE	1				
	24	Haystack Rock, 6 miles (Davis 2) ENE	34			Total	355

Miscellaneous log-book records of sealing vessels collected by C. H. Townsend—Continued.

SCHOONER ALTON—GEORGE WESTER, MASTER.

[Northwest coast and Commander Islands.]

1891.	Where obtained.	Seals.	1891.	Where obtained.		Seals.
				Lat. N.	Long. W.	
				° ′	° ′	
Mar. 1	Off Tillamook, Oregon	2				
2	......do	2				
3	Cape Disappointment	7	June 1	57 12	140 57	20
4	Shoalwater Bay, Washington	5	4	58 22	141 36	20
5	Cape Flattery, Washington	9	6	58 22	141 36	4
6	Cape Beale, British Columbia	2	8	58 30	145 30	2
23	Cape Flattery	16	9	58 15	146 45	7
27	Shoalwater Bay	4	10	58 15	146 45	10
28	Cape Disappointment	21	11	Portlock Bk. (center)		5
29	......do	7	13	......do		2
31	Grays Harbor	21	14–19	Near Kadiak (6 pos.)		28
Apr. 18	Cape Disappointment	4				
24	Mount Edgcombe, Alaska	6				506
27	Mount Fairweather	6		Off Commander Islands:		
28	......do	16	July 15	Copper Island, SE., near shore		200
29	......do	4	17–23	......do		288
30	......do	17	24	SW. of Bering Island, near shore		11
May 1-10	Mount Fairweather (5 pos.)	69	28–29	SE. of Copper Island, near shore		84
12-15	Pamplona Rocks (2 pos.)	35	Aug. 4–9	Lat. N. 54° 42′, long. E. 169° 12′ (3 days)		28
17-25	Cape St. Elias (5 pos.)	76	10–11	SE. of Copper Island, near shore		45
27-31	Mount Fairweather (4 pos.)	79		Total		1,162

SCHOONER SOPHIA SUTHERLAND.

[Northwest coast and Bering Sea.]

1892.	Lat. N.	Long. W.	Seals.	1892.	Lat. N.	Long. W.	Seals.	1892.	Lat. N.	Long. W.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Mar. 7	37 35	123 44	1	May 12	51 30	132 57	4	June 7	59 20	143 05	10
8	38 42	124 00	14	15	53 45	133 43	1	9	59 35	143 10	6
9	38 23	124 15	3	16	54 57	134 57	2	10	58 40	143 20	8
10	38 32	124 30	4	18	55 40	134 43	3	12	58 34	142 57	25
11	38 57	124 40	9	20	56 47	136 42	19	14	59 47	142 50	10
14	38 43	124 56	3	22	58 00	139 40	40	17	58 30	143 00	14
16	39 33	124 40	5	24	58 00	140 40	40	21	57 50	148 43	6
18	40 20	124 56	1	25	58 30	140 34	5	22	57 45	150 00	1
31	43 47	124 57	2	26	57 43	141 35	4	July 4	56 30	164 45	2
Apr. 13	47 48	125 57	9	27	57 57	142 10	10	18	56 03	167 23	9
18	47 57	125 56	1	28	58 03	142 03	1	21	55 40	169 34	2
May 1	49 30	128 05	4	30	58 49	142 17	9	a 22	55 35	170 34	2
2	49 33	128 07	1	31	58 47	142 43	40				
9	49 43	128 34	19	June 4	58 57	142 33	20		Total		392
11	50 07	131 43	20	5	59 21	143 30	3				

a Ordered out of Bering Sea.

SCHOONER BOWHEAD.

[Japan coast.]

1892.	Lat. N.	Long. E.	Seals.	1892.	Lat. N.	Long. E.	Seals.	1892.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Apr. 14	38 17	144 25	37	May 20	41 04	144 28	185	June 14	41 40	142 10	1
16	38 38	144 06	16	21	41 15	143 56	26	15	41 47	142 09	1
17	40 25	143 02	1	22	41 27	144 20	22	16	40 45	142 20	66
18	40 35	144 57	21	23	41 15	144 14	23	17	41 40	142 10	5
20	41 20	145 00	41	24	41 24	144 45	2	18	41 40	142 30	26
21	40 45	144 40	2	31	41 21	144 18	29	19	41 25	142 25	1
22	40 30	145 08	31	June 1	41 30	144 08	70	20	41 30	142 40	19
23	39 47	145 56	13	2	41 30	144 18	2	21	41 45	143 23	1
26	39 27	142 48	1	3	41 38	143 55	23	23	43 12	146 47	2
27	40 41	142 25	36	4	41 00	142 57	12	25	44 30	148 08	29
May 6	40 34	142 09	29	5	40 55	143 02	25	28	45 06	150 40	3
7	40 40	142 35	38	6	41 04	142 49	19	July 6	53 20	167 24	5
8	40 37	143 05	18	7	41 15	142 57	41	11	54 05	169 12	2
10	39 45	142 56	37	8	41 00	142 03	102	12	54 27	169 27	1
13	40 27	143 00	3	9	41 11	142 18	69	14	54 11	168 39	6
15	40 20	142 30	20	10	41 15	141 54	12	15	54 23	169 00	12
16	40 55	144 11	5	11	41 20	141 30	73	17	54 30	168 48	1
17	41 05	144 15	36	12	41 16	141 35	6				
18	40 56	144 17	92	13	41 45	141 45	108		Total		1,712
19	41 04	144 29	205								

Miscellaneous log-book records of sealing vessels collected by C. H. Townsend—Continued.

SCHOONER BOWHEAD—Continued.

[California coast—Japan coast.]

1893.	Lat. N.	Long. W.	Seals.	1893.	Lat. N.	Long. E.	Seals.	1893.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Jan. 23	38 24	123 20	8	Apr. 23	39 33	143 56	8	June 4	41 37	142 56	41
24	38 00	123 40	2	24	39 40	143 55	27	5	41 48	142 50	3
25	37 40	123 50	3	27	40 14	144 34	3	6	41 26	143 00	5
				28	39 44	144 06	53	7	41 40	143 50	7
	Lat. N.	Long. E.		29	40 03	144 04	23	8	41 51	145 44	18
Apr. 1	38 22	146 30	2	May 1	39 41	144 10	3	9	41 40	143 40	11
2	38 46	146 44	30	7	39 59	145 49	2	15	43 10	145 50	17
4	37 38	145 32	1	10	39 45	142 20	9	16	43 04	145 54	10
5	38 03	145 35	2	11	39 37	142 55	30	19	43 20	146 16	8
6	38 45	145 40	15	13	39 48	142 30	42	22	43 12	146 30	5
9	36 56	145 21	49	14	39 45	142 30	37	29	43 15	146 45	2
10	37 50	145 30	5	16	39 39	142 40	22	July 15	45 18	151 25	5
12	38 13	145 18	2	17	39 54	142 36	74	16	45 41	152 25	8
13	37 36	144 53	2	18	39 52	142 42	47	23	53 46	169 00	3
14	39 05	144 52	5	19	39 58	142 56	11	Aug. 1	53 17	167 43	9
15	39 41	145 00	21	20	39 50	142 32	47	2	53 22	168 18	2
16	40 00	145 10	53	21	39 53	142 47	8	3	53 37	168 10	1
17	40 17	144 40	2	23	39 58	144 41	10	4	53 38	168 08	3
18	40 05	144 50	19	24	39 51	144 28	40	10	53 57	167 00	2
19	39 32	145 03	3	25	40 18	144 30	25	12	53 53	167 20	16
20	39 46	145 06	16	26	41 15	144 00	8				
21	39 57	143 51	34	29	40 15	143 10	1		Total.	....	987
22	39 41	143 49	2	June 2	41 30	141 55	5				

SCHOONER ALTON.

[Japan coast.]

1893.	Lat. N.	Long. E.	Seals.	1893.	Lat. N.	Long. E.	Seals.	1893.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Apr. 15	37 42	142 40	7	May 18	41	143 20	41	June 18	41 30	142 10	35
16	38 10	143 15	6	19	40 40	143 30	23	19	41 37	142 15	16
18	38	143 10	30	20	40 30	143 05	25	20	41 18	142 20	12
19	38 40	142 40	34	24	42 20	144 40	33	24	41 20	142 30	33
20	38 20	143 10	50	25	42 35	145 01	24	25	41 40	142 29	24
22	37 48	143 09	16	29	43	146 30	5	29	41 44	142 35	5
24	38 24	144	8	30	43 10	146 40	16	Aug.(?)5	53 30	167	5
30	37 24	143 56	10	June 2	43 15	146 57	8	10	53 40	167 40	1
May 6	39 42	144 37	11	3	43 57	147 25	6	12	53 17	167 58	5
7	40 27	145 15	9	6	43 48	147 30	6	14	53 35	166 58	1
8	41 30	143 45	4	7	43 38	147 42	41	17	54 30	166 40	10
9	41 20	142 57	5	9	43 40	147 30	22	19	54 20	165 37	3
11	41 05	144 20	7	11	43 10	147 20	3	20	53 57	166 27	4
13	41 23	143 10	4	12	43	146 25	1	21	53 37	168 42	9
14	42	144	13	14	42 40	146 45	20				
15	41 57	143 20	3	15	41 50	146 30	1		Total.	....	795
16	40 20	142 40	22	16	41 30	144	53				
17	40 50	143	30	17	41 37	142 30	35				

Miscellaneous log-book records of sealing vessels collected by C. H. Townsend—Continued.

SCHOONER THERESE—SCHMALING, MASTER.

[Northwest coast and Copper Island.]

1893.	Lat. N.	Long. W.	Seals.	1893.	Lat. N.	Long. W.	Seals.	1893.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Mar. 12	38	123 34	2	May 15	57 10	136 01	4	July 15	53 55	168 29	13
13	38 05	123 42	1	17	57 38	136 32	13	16	54 03	168 12	14
18	49	125 08	9	18	57 41	136 47	15	17	53 48	168 09	71
22	42 16	124 51	6	19	57 51	137 07	16	18	54	167 35	10
24	44 05	124 34	7	20	58 11	137 12	1	24	53 49	167 54	20
28	44 30	124 25	2	22	58 25	141 13	3	26	53 59	167 24	49
29	44 49	124 56	2	24	59 06	146 13	2	27	53 11	167 20	9
30	44 26	124 50	3	25	59 06	146 18	13	28	59 10	167 07	12
Apr. 5	46 55	124 43	8	27	58 40	147 25	2	29	54 07	168	4
7	46 30	124 32	5	30	58 30	148 51	4	Aug. 1	54 43	168 02	29
8	46 25	124 25	6	June 5	58 14	152 03	2	5	53 45	167 55	13
9	46 54	124 46	15	13	55 20	155 59	18	8	53 14	168 21	29
10	47 25	124 53	4	26	51 59	162 51	2	10	53 25	168 11	43
15	47	125	12	July 4	49 52	178 22	4	12	53 34	167 44	85
17	45 54	124 59	5		Lat. N.[1]	Long. E.		14	53 10	167 20	21
18	46 56	124 56	14	July 12	53 45	146 04	8	17	53	167 59	49
25	57 20	131 10	1	13	53 37	165 39	9				
May 12	56 06	136 25	4	14	54	168 35	47		Total.	....	750
14	56 58	136 20	10								

[1] Off Copper Island.

SCHOONER BOWHEAD.

[Japan coast.]

Date.	Lat. N.	Long. W.	Seals.	Date.	Lat. N.	Long. E.	Seals.	Date.	Lat. N.	Long. E.	Seals.
1893.	° ′	° ′		1894.	° ′	° ′		1894.	° ′	° ′	
Dec. 18	35 34	126 46	2	May 7	37 41	145 41	19	June 9	42 20	145 40	21
				8	37 27	146 22	50	12	42 40	144 50	12
1894.		Long. E.		9	37 33	146 15	13	13	42 50	145 35	5
Apr. 1	38 06	145	1	11	37 40	146 45	45	15	42 40	145 35	1
3	39 01	146 07	25	12	37 53	146 04	18	17	43 36	146 40	3
5	38 48	145 57	15	15	38 10	146 50	80	18	43 34	146 40	21
7	38 38	146 25	78	18	38 12	147 50	69	19	42 50	147 10	17
10	38 51	146 40	13	22	37 48	148 09	32	21	44 45	148 57	2
11	39 02	146 30	53	26	39 41	144 45	3	22	44 40	149	23
12	39 12	146 40	84	28	41 48	144 12	1	24	44 15	149 20	3
13	39 20	146 40	75	29	41 58	143 50	5	25	44 26	149 25	16
18	39 05	146 32	6	31	42 50	145 25	40	26	44 36	148 56	33
19	38 54	147 09	42	June 1	42 48	145 40	32	27	44 40	149 02	14
25	39 16	144 30	4	2	42 40	145 25	6	28	44 45	149 08	4
26	39 30	145	8	3	42 30	145 28	13	29	44 36	148 50	3
27	38 28	145 13	20	4	42 51	145 35	10	July 16	43 30	143 30	6
29	38 28	145 30	14	5	42 37	143 32	19				
30	38 35	145 35	48	6	42 20	143 28	4		Total.	....	1,375
May 3	36 28	145 10	79	7	42 30	143 20	40				
6	37 23	146 38	92	8	42 10	145 20	33				

SCHOONER THERESE.

[Japan coast.]

1894.	Lat. N.	Long. E.	Seals.	1894.	Lat. N.	Long. E.	Seals.	1894.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Apr. 1	37 25	146 10	29	May 5	41 04	143 07	1	June 1	42 57	144 20	16
2	37 45	145 56	53	6	41 35	142 57	34	2	43	145 30	22
3	37 50	146	53	7	41 40	142 35	3	3	43 59	145 45	9
4	38	145 54	38	8	41 37	142 40	4	4	43 09	145 57	3
5	38 10	145 41	8	11	41 29	142 30	23	5	43 07	146	6
6	38 20	144 45	1	15	41 30	142 30	4	6	43 10	146 15	8
7	38 30	144 15	3	17	41 37	142 35	27	7	43 25	146 57	8
8	38 35	145 57	7	21	41 40	142 23	8	8	43 20	146 54	6
12	39 03	143 47	1	22	42 02	142	1	9	43 30	147 10	18
18	39 07	144	40	23	41 57	142 36	10	12	43 40	147 54	1
26	39 38	144 20	10	24	41 54	142 50	18	16	43 45	148	1
27	40	146	1	26	41 50	142 38	15	19	43 57	148 38	9
28	39 56	142 57	11	27	41 57	142 48	1	July 12	50 34	162	1
30	40 07	142 50	19	28	42 07	143 35	13	24	53 50	165 40	12
May 1	40 35	143 02	7	29	42 15	143 40	6	25	53 45	166 57	3
3	40 39	142 44	46	30	42 20	143 45	35				
4	41 03	142 37	1	31	42 18	144 57	26		Total.	....	680

Miscellaneous log-book records of sealing vessels collected by C. H. Townsend—Continued.

SCHOONER ANNA MATILDA.

[California coast—Japan coast.]

Date.	Lat. N.	Long. W.	Seals.	Date.	Lat. N.	Long E.	Seals.	Date.	Lat. N.	Long. E.	Seals.
1893.	° ′	° ′		1894.	° ′	° ′		1894.	° ′	° ′	
Dec. 16	38 13	123 57	2	Apr. 21	44	142 40	1	May 27	41 54	142 10	2
17	38 06	123 55	5	23	41 14	141 34	5	28	41 58	142 06	3
18	37 47	123 43	11	26	42 12	141 43	23	29	41 50	142 30	9
19	37 49	124 08	10	28	42 25	142 50	8	30	41 46	140 46	23
21	38 13	121 03	1	May 4	41 50	141 10	6	June 1	41 44	144 25	16
28	38 24	124 12	2	5	41 40	141	6	2	42 18	144 12	12
30	38 02	123 40	2	6	41 30	141 50	3	3	42	144	7
31	37 42	124 04	1	7	49 40	142 24	17	4	42 40	144 10	1
				13	40 30	142	9	5	42 40	144 30	10
1894.		Long. E.		14	40 30	142	23	6	42 34	144 20	16
Apr. 2	39 25	144 09	12	16	40 30	140 30	22	7	42 46	145 08	11
3	39 14	144 20	24	17	40 55	142	14	8	42 58	145 10	8
4	39 49	145 03	14	19	41 17	141	8	12	43	145 50	6
5	39 48	144 34	14	20	41 20	141 50	9	17	44 20	147 35	6
7	39 07	145 30	5	21	41 29	142 03	3	18	43 52	147 16	6
11	39 37	143 03	1	24	41 36	143 20	3	19	43 58	147	4
13	39 34	144 36	11	25	41 30	143 3	3				
18	39 49	145 03	10	26	41 32	142 25	8		Total.	....	436

SCHOONER ALEXANDER—C. LORENSEN, MASTER.

[Japan, Kurile Islands.]

1894.	Lat. N.	Long. E.	Seals.	1894.	Lat. N.	Long. E.	Seals.	1894.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Mar. 5	38 34	143 03	2	May 7	41 11	142 02	19	June 5	42 40	144 57	8
6	38 01	144 58	1	10	41 25	141 50	1	6	42 43	145	6
15	38 19	176 26	52	11	41 30	142 05	3	7	42 38	145 20	12
19	38 37	147 17	6	12	41 15	142 02	24	8	42 29	144 50	15
21	38 21	146 40	4	13	41 32	141 55	16	9	42 09	143 53	24
23	37 39	146 22	10	14	41 35	142 20	23	13	41 56	142 11	3
24	37 30	145 32	5	16	41 25	141 40	3	14	41 52	142	4
25	38	145 58	27	17	41 15	141 57	16	15	41 45	142 16	1
26	38 02	146	10	18	41 20	142	4	July 21	2 p. m., 1 mile off Broughton Island, Kuriles, sent one boat ashore to look for seals; boat with 7 seals—all they could find. Squared away for Rashua Island (returned).		
Apr. 1	38 18	146 48	39	19	41 25	142 30	20				
2	38 30	146 24	12	20	41 30	142 25	7				
4	38 58	146 41	12	25	41 45	141 30	14				
5	39 14	146 33	22	26	41 30	141 35	3				
7	39 12	146	5	27	41 55	142 03	4				
12	40 22	142 35	1	28	41 30	141 55	14				
20	41 17	142 30	13	29	41 40	142 03	11				
23	40 53	142 55	13	30	41 43	141 57	12				
24	40 24	142 19	3	31	42 10	143 40	1				
25	40 16	142 18	19	June 1	42 35	145	15	25	Rashua Island, one sea otter.		
26	40 11	142 09	4	2	42 37	145 10	1				
May 2	39 25	142	5	3	42 39	145 20	4				
3	40 25	142 25	1	4	42 30	145 09	7		Total	....	561

SCHOONER JANE GRAY—E. W. FUNCKE, MASTER.

[Japan coast.]

1894.	Lat. N.	Long. E.	Seals.	1894.	Lat. N.	Long. E.	Seals.	1894.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
Mar. 4	37 42	142 50	1	May 5	40 29	142 29	5	June 1	42 05	142 30	23
6	37 38	142 32	34	6	40 10	142 22	8	2	42 20	143 44	6
Apr. 1	36 38	141 47	2	8	40 42	143 06	12	3	42 34	144 24	8
7	40 08	144 24	78	11	41 29	142 03	25	4	42 35	144 35	8
8	39 21	143 32	2	12	41 30	141 41	50	5	42 44	142 24	17
12	39 49	143 37	2	14	41 28	141 39	20	8	43 32	143 30	22
13	39 54	142 45	1	15	41 32	142 34	2	12	43 02	144 26	8
20	Yamada Head, N. by W. 10 miles.		17	16	41 15	142 42	16	13	42 31	144 33	3
				17	40 52	142 53	20	17	43 20	147 22	1
22	39 23	142 41	15	18	40 39	142 13	9	18	43 20	146 58	8
23	39 47	142 30	58	19	40 47	141 43	29	19	43 18	146 12	38
25	39 51	142 12	19	20	41 19	142	24	21	43 25	146 13	7
26	Yamada Head, SW. 15 miles.		17	21	41 39	142 18	67	23	42 45	146 50	2
				24	41 29	142 26	53	26	Arrive at Akisha Bay.		
27	39 32	142 40	16	27	41 32	142 10	4				
28	39 30	143	1	28	41 46	142 15	34				
30	40 26	143 21	12	29	41 39	142 30	12		Total	....	879
May 1	40 23	142 43	2	30	41 38	142 26	61				

Miscellaneous log-book records of sealing vessels collected by C. H. Townsend—Continued.

SCHOONER M. M. MORRILL—E. CANTILLION, MASTER.

[Japan coast.]

1895.	Lat. N.	Long. E.	Seals.	1895.	Lat. N.	Long. E.	Seals.	1895.	Lat. N.	Long. E.	Seals.
Mar. 27	Off Kinkasan.	Long. 25 miles.	24				72	June 13	8 miles southeast of Yeterop Island.		16
29	....do	S.E. 18 miles.	10	May 4	40 17	142 30	6	14	15 miles east of Yeterop Island.		17
30	....do	50 miles	1	5	40 37	142 40	13	15	20 miles southeast of Yeterop Island.		17
Apr. 3	37 46	140 48	5	7	40 30	142 10	7				11
5	38 40	142 15	4	8	41 30	143	22	17	44 20	147 18	5
6	39 45	142 42	1	9	41 26	143	13	18	44 20	15 miles offshore.	26
10	41 37	143 21	2	10	30 miles south of Cape Yerimo.		4	25	Amphitrite Strait..		16
11	40 48	142 53	9	12	41 56	15 miles offshore.	6	26	.....do		27
12	40 42	142 35	12	24	41 41	144 20	4	29	Amphitrite Strait, anchored, Paramusir Island.		10
15	39 37	145	1	25	40 42	144 49	37	30	Amphitrite Strait, Paramusir Island.		1
16	38 27	147 30	1	June 2	Off Christmas Harbor, Shikotan Island, 15 miles.		16	July 2	Amphitrite Strait..		1
18	40 15	143 50	14	6	44 20	147 12	16	3	10 miles east of Paramusir Island.		1
19	40 23	143 43	20	7	20 miles southeast of Yeterop Island.		13	6	53 09	163	
21	40 16	144 01	32	8	12 miles off Yeterop Island.		14		Total	....	581
23	40 35	144 05	8	10	15 miles south of Yeterop Island.		5				
27	40	143 51	13	11	20 miles south of Yeterop Island.						
28	40 15	144 05	11								
May 1	39 54	15 miles offshore.	1								
2	40 50	143 05	1								
3	40 11	142 47	15								

SCHOONER BRENDA—C. LOCKE, MASTER.

[Japan coast.]

1895.	Lat. N.	Long. E.	Seals.	1895.	Lat. N.	Long. E.	Seals.	1895.	Lat. N.	Long. E.	Seals.
Apr. 2	38 07	143 15	20	May 3	39 56	142 45	1	May 30	42 52	146 16	2
3	38 35	144 12	6	4	39 56	142 27	104	June 7	43 32	146 40	8
5	39 56	143 17	18	5	40 34	142 28	4	8	43 26	146 22	9
6	39 23	142 25	2	6	40 24	142 15	8	9	43 10	146 53	1
7	39 50	142 44	1	7	40 54	142 31	24	13	44 28	147 28	5
11	38 39	142 01	30	8	40 55	142 17	7	14	44 20	147 32	27
12	38 42	142 01	58	9	40 53	141 56	27	15	44 38	148 02	12
16	39 28	142 58	11	10	41 07	142 52	29	17	44 35	148 01	42
18	39 48	143 18	55	12	41 09	142 03	3	18	45 14	150	6
19	39 43	142 39	49	14	41 45	142 55	41	19	45 31	150 53	3
20	39 41	142 42	17	15	41 51	143 35	17	29	50 08	Bird Isl'd, Kurile Strait.	7
22	39 43	141 13	38	20	41 23	142 58	36	July 1	Vessel lost.		
23	30 34	143 09	15	21	41	142 53	7		Total	....	843
26	38 55	146 12	2	23	41 44	143 17	54				
27	39 20	146 33	10	24	42 15	144 20	11				
28	38 25	145 33	2	25	42 47	144 44	14				

SCHOONER MASCOT—E. LORENZ, MASTER.

[Japan coast.]

1895.	Lat. N.	Long. E.	Temperature.	Seals.	1895.	Lat. N.	Long. E.	Temperature.	Seals.
Apr. 5	35 50	144 54	54	34	May 6	40 47	145 48	42	37
7	36 13	147	58	22	7	40 46	145 46	42	57
12	36 57	145 29	55	5	8	40 35	145 40	42	49
13	36 39	146 25	54	28	10	40 42	147 59	46	18
15	37 13	145 20	55	15	12	40 51	145 37	44	55
17	38 42	145 45	55	8	13	41 09	145 25	44	23
18	39	146 27	62	5	15	43	145 30	44	6
19	39 34	146 18	51	55	24	41 05	145 50	54	20
22	39 43	147 25	54	10	25	40 56	145	54	15
23	39 54	147 25	58	5	27	41 05	145 30	56	26
May 3	40 21	146 18	42	32	31	40 46	146 20	53	17
4	40 42	145 54	44	46					
5	40 41	145 53	42	209	Total	....	....	....	797

Miscellaneous log-book records of sealing vessels collected by C. H. Townsend—Continued.

SCHOONER GOLDEN FLEECE, SAN FRANCISCO—E. W. FUNCKE, MASTER.

[Japan coast.]

1896.	Lat. N.	Long. E.	Males.	Females.	Total.	Shot at.	1896.	Lat. N.	Long. E.	Males.	Females.	Total.	Shot at.
	° ′	° ′						° ′	° ′				
Mar. 14	37 07	141 40	1	9	10	16	May 31	42	142 41	7	3	10	11
15	37 23	141 50	4	12	16	23	June 2	41 42	141 50	2	1	3	4
16	37 38	141 40	....	1	1	2	3	42 12	141 45	29	8	37	45
18	38 02	142 12	5	11	16	21	5	42 13	141 44	39	16	55	65
23	39 11	142 16	2	3	5	6	6	42 12	141 40	27	5	32	40
24	39 10	142 23	....	3	3	4	7	42 12	141 40	12	8	20	27
26	38 18	142 20	1	2	3	4	9	42 15	141 40	4	1	5	7
30	38 06	141 58	2	6	8	12	10	42 12	141 35	7	5	12	15
Apr. 4	38 16	142 12	1	2	3	5	11	42 09	141 39	2	2	4	......
5	39 13	....	5	8	13	16	13	41 44	143 12	....	1	1	2
6	39 03	142 51	7	5	12	......	15	42 37	144 32	11	3	14	16
7	39 06	142 40	....	1	1	......	16	42 34	144 41	....	1	1	......
8	39 08	142 25	1	1	2	......	17	42 40	144 57	3	1	4	......
9	39 11	142 40	8	19	27	40	July 5	41 30	143 17	2	....	2	3
10	38 36	142 26	6	9	15	17	6	41 38	144 50	1	....	1	2
13	39 03	142 57	....	2	2	4	7	42 09	146 07	8	1	9	10
17	39 18	142 27	1	3	4	5	11	44 23	148 12	2	....	2	......
19	40 10	143 50	1	1	2	3	12	45 02	149 30	1	1	2	......
22	40 14	142 23	....	1	1	2	20	50 48	159 30	1	....	1	......
24	38 47	142 16	3	7	10	15	25	57 30	166 04	....	1	1	2
26	38 11	143 07	3	8	11	20	26	57	166 03	1	2	3	4
29	37 38	142 56	1	8	9	12	27	57 04	166 09	2	12	14	17
30	37 40	142 38	....	1	1	......	29	56 39	165 58	....	1	1	......
May 1	38 36	141 56	1	....	1	......	30	56 54	166 10	3	42	45	60
2	38 32	142 23	1	10	11	13	31	57 09	166 10	2	7	9	12
3	38 33	142 29	....	5	5	6	Aug. 1	57 12	166 09	4	37	41	55
7	40 37	145 20	3	1	4	......	5	57 04	165 12	1	....	1	2
8	40 29	145 32	3	12	15	18	9	57 22	163 58	3	17	20	25
9	41 12	145 18	....	1	1	......	10	57 25	164 10	2	10	12	14
11	42 04	142 30	19	3	22	28	11	57 06	164 10	6	33	39	45
12	41 53	142 36	2	1	3	......	12	57 01	164 32	1	2	3	4
13	39 55	141 42	....	2	2	16	15	56 45	164 37	1	7	8	9
14	41 53	142 45	6	7	13	......	16	56 58	163 50	....	1	1	......
15	41 57	142 40	56	7	63	70	18	56 54	164 12	....	2	2	......
16	41 49	142 42	14	11	25	35	22	56 23	164 11	3	8	11	14
17	41 54	142 40	1	....	1	......	23	56 18	163 58	13	34	47	60
18	41 54	142 43	54	21	75	90	24	56 14	164 04	5	16	21	25
19	41 56	142 40	41	11	52	65	25	56 04	164 30	2	4	6	......
20	41 55	142 43	5	1	6	8	27	55 30	163	2	....	2	......
21	42 07	142 28	19	4	23	30	30	54	166	3	7	10	12
23	42	142 50	1	....	1	......	Sept. 6	46 33	153 51	1	....	1	......
24	42 07	142	23	4	27	40	17	Yokohama.					
25	42 03	141 55	11	2	13	16							
28	41 57	142 38	4	2	6	......		Total............		550	535	1,085	1,299
29	41 55	142 39	21	7	28	30							

NOTE.—Schooner, 121 tons; crew, 19; hunters (white), 5; boats, 8.

SCHOONER ALLIE I. ALGAR—C. LOCKE, MASTER.

[Japan coast.]

1896.	Lat. N.	Long. E.	Seals.	1896.	Lat. N.	Long. E.	Seals.	1896.	Lat. N.	Long. E.	Seals.
	° ′	° ′			° ′	° ′			° ′	° ′	
April 1	37 52	143 06	4	Apr. 29	38 51	145 16	17	May 24	39 06	145 53	8
2	37 50	142 20	6	May 2	38 47	145 51	27	25	39 12	146 06	18
3	38 28	142 02	7	3	38 58	145 02	61	28	41 52	142 57	10
4	38 22	142 50	2	7	39 00	144 16	5	29	41 50	142 57	12
6	39 39	145 08	13	8	38 56	144 45	125	31	41 42	142 39	6
9	40 07	145 30	17	9	38 59	144 55	5	June 6	41 30	142 00	1
13	40 11	142 47	4	10	39 24	145 31	3	10	42 50	148 00	2
15	40 00	144 04	1	11	39 24	145 07	7	11	43 23	147 51	14
16	40 00	144 30	1	13	40 36	144 12	6	12	43 24	147 16	9
17	39 20	145 00	5	14	40 16	145 20	1	15	44 18	148 04	22
19	39 55	142 19	2	15	40 05	145 30	4	16	44 03	148 06	4
21	38 51	144 56	7	16	39 26	145 27	4	18	44 50	148 40	5
22	38 53	144 51	55	17	38 51	145 56	13				
23	38 48	144 56	11	18	39 12	145 50	30		Total.	....	653
24	39 08	145 30	40	19	39 02	145 52	28				
28	38 47	145 12	19	22	39 17	145 54	12				

MISCELLANEOUS NOTES.

FUR-SEAL CATCH OF BRITISH COLUMBIA VESSELS IN 1898.

The pelagic catch made by British Columbia vessels from the American fur-seal herd in 1898 was 28,142 skins; 10,746 were taken off the Northwest coast and 17,396 in Bering Sea.

Vessels.	Tons.	Crews.		Boats.		Catch.				Total.
						Northwest Coast.		Bering Sea.		
		Whites.	Indians.	Boats.	Canoes.	Male.	Female.	Male.	Female.	
Abbie M. Deering	96	22	...	6	...	...	...	59	319	378
Ada	97	9	20	2	10	54	131	...	...	185
Ainoko	75	6	18	2	9	80	343	274	420	1,117
Allie I. Algar	75	23	...	7	...	402	304	...	...	706
Arietis	86	8	30	2	15	70	159	203	211	643
Beatrice	66	5	16	1	8	167	163	126	125	581
Carrie C. W	92	6	26	2	13	105	83	302	167	657
C. D. Rand	51	8	22	2	11	151	91	...	...	242
City of San Diego	49	6	20	1	10	97	240	186	438	961
Diana	50	...	...	...	...	...	...	126	201	327
Director	87	23	...	6	...	16	14	...	...	30
Dora Siewerd	93	10	34	2	17	89	220	444	361	1,114
Doris	60	6	20	2	10	84	257	...	...	341
Enterprise	69	6	28	2	13	89	220	275	317	901
Favourite	80	6	31	2	15	179	152	250	188	769
Geneva	93	24	...	8	...	390	502	...	...	892
Hatzic	72	7	24	2	12	179	85	338	422	1,024
Ida Etta	69	6	25	2	12	117	90	236	198	641
Libbie	93	{ 8 / 29	14 / ...	2 / 7	7 / ... }	204	57	116	114	491
Mary Ellen	63	8	22	2	11	129	147	...	...	276
Mary Taylor	43	6	16	2	8	200	338	251	468	1,257
Mermaid	76	10	22	3	11	52	165	396	860	1,473
Minnie	46	6	19	2	10	123	148	233	160	664
Ocean Belle	83	7	22	2	11	66	61	304	271	702
Ocean Rover	55	6	16	2	8	79	69	193	144	485
Otto	86	8	28	2	14	217	242	376	414	1,249
Penelope	70	6	24	2	12	102	430	210	295	1,037
Pioneer	73	6	20	2	10	...	...	...	...	453
Saucy Lass	38	6	14	2	7	85	77	109	145	416
Teresa	63	8	23	1	13	42	256	155	173	626
Umbrina	99	8	30	2	15	117	169	654	1,028	1,968
Victoria	63	7	20	2	10	169	168	1,004	764	2,105
Viva	92	7	21	2	10	...	...	191	459	650
Walter L. Rich	84	6	26	2	13	144	86	143	263	636
Zillah May	66	7	22	2	11	95	86	441	423	1,045
Catch by Indians in canoes	...	...	...	...	...	...	...	...	...	1,100
Total	2,553	330	673	92	336	4,093	5,553	7,595	9,348	28,142

NOTE.—To the above should be added the catch made by the American schooner *Kate and Anna* off Point Conception, California. This vessel took 336 seals south of the award area—1 male and 335 females.

The schooner *Director* took 360 seals off the Japan coast (201 males, 159 females) and 50 in vicinity of Commander Islands (20 males, 30 females).

The following table[1] showing the pelagic seal catches made from the American and Asiatic seal herds from 1868 to 1897 is inserted for general reference. It is imperfect in many respects, the earlier records being incomplete, and the catches of Japanese vessels during recent years not fully stated.

[1] Treasury Document 2009, Division of Special Agents, pp. 25 et seq.

Pelagic seal catches, made from the Alaskan and Asiatic seal herds from 1868 to 1897, being a tabulation from the most trustworthy sources obtainable.

Year.	Northwest coast.					Bering Sea.					Award area. *a*	Japan coast.				Russian coast.				Asiatic, total catch.	Undetermined, American or Asiatic.	Total, American, Asiatic, and undetermined.	Year.
	Nationality.	Vessels.	Total catch.	Average per vessel.	Per cent of females.	Nationality.	Vessels.	Total catch.	Average per vessel.	Per cent of females.	Total.	Nationality.	Vessels.	Total catch.	Average per vessel.	Nationality.	Vessels.	Total catch.	Average per vessel.				
1868			[2]4,367								4,367											4,367	1868
1869			[2]4,430								4,430											4,430	1869
1870			[2]8,686								8,686											8,686	1870
1871			[2]16,911								16,911											16,911	1871
1872			[2]5,336								5,336											5,336	1872
1873			[2]5,229								5,229											5,229	1873
1874			[2]5,873								5,873											5,873	1874
1875		[1]1	[2]5,033								5,033											5,033	1875
1876		[1]1	[2]5,515								5,515											5,515	1876
1877			[2]5,210								5,210											5,210	1877
1878		[1]1	[2]5,544								5,544											5,544	1878
1879		[1]2	[3]8,557								8,557										[4]310	8,867	1879
1880		[1]16	[3]8,718	544							8,418										[4]1,192	8,910	1880
1881		[1]12	[3]10,382	865							10,382											10,382	1881
1882		[1]15	[3]15,551	1,036							15,551											15,551	1882
1883		[1]13	[3]14,057	1,080				[5]2,500			16,557										[4]28	16,585	1883
1884		[1]11	[3]16,971	1,542							16,971										[4]212	17,183	1884
1885		[1]15	[6]21,840	1,456				[6]1,200			23,040										[4]1,920	24,960	1885
1886		[1]34	[7]13,899	408				[8]14,595			28,494										[9]11,000	39,494	1886
1887		[1]47	[10]9,324	198				[11]21,304			30,628										[9]16,000	46,628	1887
1888		[1]39	[12]8,714	223				[13]17,475			26,189										[4]726	26,915	1888
1889		[1]68	[12]14,361	211				[13]15,497			29,858										[9]13,300	43,158	1889
1890		[1]61	[14]21,838	358				[13]18,976			40,814										[9]11,000	51,814	1890
1891		[1]115	[17]32,118	279				[16]27,450			59,568									[16]8,432		[15]68,000	1891
1892		[1]122	[18]46,642	382				Mod. viv.			46,642									[18]26,752		73,394	1892
	Am.	[21]29	[20]2,199	76				Mod. viv.			[20]2,199	Am.	[19]31	[21]24,320	784	Am.	(*b*)	[21]604					
1893	Can.	[22]35	[22]28,613	817				Mod. viv.			[22]28,613	Can.	22	[22]29,206	1,327	Can.	35	[22]12,013	[22]343				1893
	Total	64	30,812	481							30,812	Total	53	53,526	1,009	Total	(*b*)	12,617		66,143		[23]96,955	
	Am.	22	[21]12,398	563	[31]88	Am.	10	[21]5,160	516	[31]69	[25]23,710	Am.	35	[26]22,184	633	Am.		[24]201					
1894	Can.	[27]22	[27]11,703	532		Can.	27	[27]26,425	978	[32]55	[27]38,128	Can.	35	[27]49,483	1,413	Can.	24	[27]7,437	309				1894
	Total	44	24,101	547		Total	37	31,585	853		61,838	Total	70	71,667	1,023	Total		7,638		79,305		[30]141,143	
	Am.	[28]19	[28]2,269	119	[31]74	Am.	18	[28]8,251	458	[31]73	[28]10,520	Am.	14	[28]11,301	635	Am.	6	[28]766	127				
1895	Can.	[28]33	[29]9,853	298		Can.	41	[29]35,918	876	[32]55	[29]45,771	Can.	22	[29]18,687	849	Can.	20	[29]6,281	314				1895
	Total	52	12,122	233		Total	59	44,169	748		56,291	Total	36	29,988	833	Total	26	7,047	271	37,935		[30,34]93,326	
	Am.	13	3,714	[35]268	[38]92	Am.	13	3,800	317	[38]74	7,514	Am.	8	4,645	581	Am.	1	272	272	4,917		[36]12,431	
1896	Can.	27	10,703	[35]309	[38]40	Can.	54	25,700	476	[39]60	36,403	Can.	28	17,968	642	Can.	11	1,306	119	19,274		55,677	1896
	Total	40	14,417	296	45	Total	67	29,500	440	62	43,917	Total	36	22,613	628	Total	12	1,578	131	24,191	[36]4,889	[40]72,997	
	Am.	14	1,758	[41]126	[46]89	Am.	3	857	286	[45]73	2,615	Am.	2	1,275	638	Am.				1,275		[44]4,872	
1897	Can.	32	6,100	[41]159	[45]55	Can.	25	15,607	624	[45]57	21,707	Can.	11	7,321	666	Can.	8	1,382	173	8,703		30,410	1897
	Total	46	7,858	149	64	Total	28	16,464	588	58	24,322	Total	13	8,596	661	Total	8	1,382	173	9,978	[42]6,838	[43]42,120	

NOTE.—1898 catch: 10 746 Northwest coast, 17,396 Bering Sea.

a The sum of the totals of Northwest coast and Bering Sea.

b Unknown.

AUTHORITIES FOR FIGURES USED IN FOREGOING TABLE.

[In quoting from Fur-Seal Arbitration Papers, the first edition is always referred to.]

[1] Fur-seal Arbitration. App. to U. S. Case, vol. 1, p. 591.

[2] Catches for years 1868 to 1879, inclusive, are made up of northwest coast catches (Fur-Seal Arbitration; British Commissioners' Report, p. 207 et seq.); Indian canoe catches (British Commissioners' Report, pp. 207, 208), and skins obtained through the Hudson Bay Company's trading stations (British Commissioners' Report, p. 213.

[3] Catches of pelagic sealers and Indian canoes (British Commissioners' Report, pp. 207, 208), and returns from Hudson Bay Company's posts (British Commissioners' Report, p. 213).

[4] San Francisco custom-house records; Deputy Collector Jerome's letters of February 26 et seq., 1892, on file in Treasury Department.

[5] Catch of schooner *City of San Diego* (British Commissioners' Report, p. 208).

[6] Catches of pelagic sealers in North Pacific and Bering Sea (British Commissioners' Report, p. 209), and returns from Hudson Bay Company's posts (British Commissioners' Report, p. 213).

[7] Catches in North Pacific from all sources (British Commissioners' Report, pp. 210, 213).

[8] Marketed catches from Bering Sea (British Commissioners' Report, p. 210) plus 2,000 skins seized on schooners *Onward*, *Thornton*, *Carolena*, and *San Diego* (H. H. McIntyre's manuscript report to Alaska Commercial Company, a copy of which is in possession of Department.

[9] British commissioners' estimated catch of American vessels in all localities (British Commissioners' Report, p. 212).

[10] North Pacific catches (British Commissioners' Report, pp. 210, 213).

[11] Marketed catches from Bering Sea (British Commissioners' Report, p. 210) plus 8,910 skins seized in Bering Sea and unaccounted for by British commissioners; 11,901 skins were seized that year (United States Counter Case, p. 337), and the British commissioners, on page 210 of their report, account for 2,991 of them.

[12] North Pacific catches (British Commissioners' Report, pp. 211, 213).

[13] Bering Sea catches (British Commissioners' Report, pp. 211, 212).

[14] North Pacific catches (British Commissioners' Report, pp. 211, 213).

[15] This figure, 27,450, is the sum of the figures 22,530 and 4,920, the origin of which will be found under note 16. The British commissioners, on page 18 of their report, give the approximate total catch as 68,000.

[16] In a letter from the British foreign office to the Secretary of State, dated May 17, 1895, the Bering Sea catch of British vessels for 1891 is quoted at 29,146. It has been found by this Department that these figures represent the total catch in Bering Sea—that is, including seals killed off the western side, in Russian waters, as well as off the eastern side, which afterwards became the award area. This is borne out by the fact that it appears by the British case before the tribunal at Paris that 41 vessels were warned out of the American side of Bering Sea between June 29 and August 15, 1891, under the modus vivendi of June 15 of that year. It is certain that many of these vessels crossed over to the Russian side of Bering Sea and continued sealing until the close of the season.

Statistics made by Mr. Alfred Fraser, now in possession of the Treasury Department, show that 8,432 skins were thus taken on the western side of Bering Sea in Russian waters. Of these, 6,616 were taken by British vessels and 1,816 by American vessels. We should, therefore, deduct from the British figures (29,146) the sum of 6,616, leaving 22,530 as the British catch in the award area—that is, the eastern side of Bering Sea—for the year 1891.

It further appears from Mr. Fraser's figures that the American catch in Bering Sea in 1891 was 6,736, of which 1,816 were taken in Russian waters and 4,920 in the award area. Adding to the corrected British catch, 22,530, the catch of the American vessels, 4,920, we have 27,450 as the total catch of British and American vessels in that part of Bering Sea known as the award area for the year 1891.

In the report of the Committee on Ways and Means to accompany H. R. 8909, Fifty-third Congress, third session, Report No. 1849, the catch in Bering Sea for the year 1891 was given as 23,041 on the authority of the Treasury Department. These figures included only the returns of British vessels, as no reliable returns as to American vessels were then in possession of the Department. The result was reached by deducting from the estimate given by Consul Meyers in his report (United States counter case), 28,605, a number of skins estimated to have been taken off the Russian coast. This estimate was reached by a careful examination of all catches referred to in the affidavits and other papers in the case and counter case of the United States and Great Britain, excluding those which were claimed to have been taken off the Russian coast.

That the British returns (above cited), 29,146, include seals taken on the western side of Bering Sea, from the Russian herd, will appear, as above stated, from the fact of the warning of said vessels, under the modus vivendi, and their subsequent crossing to the Russian coast.

The report of the minister of marine and fisheries of Canada for 1891 credits none of the catch to Russian waters. In 1892, however, said report credits 14,805 skins out of a total of 53,912 from said Asiatic shores. The fact that this large catch was made in 1892 points strongly to similar catches in the year 1891, which are confirmed by the above-mentioned evidence.

[17] Obtained by subtracting the total of 27,450 and 8,432 from 68,000.

[18] See United States Counter Case, page 408.

[19] Taken from Alfred Fraser's estimates for American sealing fleet in Asiatic waters. Skins entered in United States ports.

[20] The smallness of the number, 2,199, suggests that either many of the vessels after clearing sailed directly for the Japan coast, or else the catches off the northwest coast were transshipped at Japan ports.

[21] The American catch for 1893 is based upon statistics compiled by A. Fraser and on file in the Treasury Department. The United States consul at Victoria states (Consular Reports No. 161, p. 279) that American schooners in 1893

transshipped at Yokohama and Hakodate between 17,000 and 18,000 skins. This is further confirmed by the report of the Canadian department of marine and fisheries for 1893, page clxviii, which gives the catch of American vessels landed at Hakodate as 18,587.

[22] The figures for the catches of Canadian vessels are taken from the report of the Canadian department of marine and fisheries for 1893, page clxvii.

[23] The London trade sales for 1893 account for the disposition of 109,669 pelagic skins.

[24] Compiled from the reports of collectors at ports of entry on the Pacific coast. These reports are on file in the Treasury Department.

[25] The figure 23,710 is obtained by taking the 6,836 skins noted under the caption, "Locality undetermined" in the letter of the Secretary of the Treasury to Congress, dated January 21, 1895 (Fifty-third Congress, third session, Ex. Doc. 243), and dividing them between the Asiatic and American herds in similar proportions as the other skins landed at United States ports in United States sealing vessels during 1894. The result would be: American herd, 6,152; Asiatic, 684. Adding 6,152 to the catch on the northwest coast (12,398) already given and the Bering Sea catch (5,160) already given, we have the total 23,710.

[26] Made up of skins as per records of collectors of customs on the Pacific coast, which credit 1,500 to Asiatic waters; 684 skins, previously referred to in note 25, and the 20,000 skins which it is estimated were transshipped in Japan (Ex. Doc. 243, Fifty-third Congress, third session, "Notes concerning catch for 1894," p. 4).

[27] Taken from report of Canadian department of marine and fisheries for 1894, page 9.

The figures 26,425 include one American vessel, whose catch was 84 skins.

The figures 49,843 contain the catches of three American vessels, which aggregated 490 skins.

The facts in the two foregoing paragraphs are given in a report of Fisheries Commissioner Costigo to the Governor-General of Canada, under date of January 9, 1895, page 9.

[28] Reports of collectors of customs at American ports of entry on the Pacific coast.

[29] Official statement sent by United States Consul Roberts at Victoria, under date of November, 1895, and on file in the Treasury Department.

[30] *Dead pups.*—The grand totals for 1894 and 1895 do not include dead pups. In 1894, by careful estimate based upon partial count, 20,000 pups perished, and in 1895, by actual count, 28,000. This would swell the known deaths, exclusive of the land catch in 1894 to 161,143 and in 1895 to 121,326. See note 37 for dead pups for 1896.

The pelagic catch for 1895 is further increased by a catch of about 10,000 skins taken by vessels clearing from Japanese ports.

[31] From returns of United States inspectors who examined skins landed in United States ports.

[32] From official returns of collector of customs, Victoria, British Columbia. Skins not inspected.

[Notes 33 and 34 omitted.]

Explanatory notes relating to catch for 1896.

[35] In averages per vessel relating to northwest coast catch the canoe catches are not included; British Columbia canoe catch, 2,353, included in Canadian northwest coast total.

[36] Total catch of American and Canadian vessels for 1896 further increased by a catch of 3,392 skins taken by vessels clearing from Japanese ports, and of 1,497 skins taken by natives in the passes of the Aleutian Islands.

[37] The grand total for 1896 does not include the loss of pups on the Pribilof Islands, amounting to 21,228 dead and to 1,546 dying at time of count.

[38] All log entries relating to American pelagic catch sworn to by masters of vessels, but most of them changed as to proportion of females upon examination of catches by inspectors of seal skins.

[39] Proportion of females in all Canadian returns taken from statements by masters of vessels. Catches not officially inspected as to sex.

[40] Data concerning catches of American vessels in all waters for 1896 are based on reports from United States custom-houses, supplemented by information collected by Mr. C. H. Townsend; data concerning catches of British Columbia vessels furnished by the Canadian collector of customs at Victoria; catches in 1895 of vessels belonging to Japanese ports furnished by United States consular officers in Japan. Catches of similar vessels in 1896 are from unofficial sources, are incomplete, and less than number actually taken.

Explanatory notes relating to catch for 1897.

[41] In averages per vessel relating to the northwest-coast catch, the British Columbian-canoe catch, amounting to 1,018, are not included.

[42] The total catch of the British Columbian and American fleets for 1897 is increased further by the catch of the Japanese sealing fleet during the year—16 vessels, 6,838 skins.

[43] The data from which were compiled the statistics relating to the American catch for 1897 were obtained from the official reports from U. S. custom-houses; the statistics of the British Columbian catch for the same period were obtained by the consul at Victoria, B. C., from custom-house records at that port; the figures showing the catch of the Japanese fleet were furnished by Dr. Leonhard Stejneger.

[44] The grand total of seals taken by United States vessels include 764 skins taken south of the award area by the schooners *J. Eppinger* and *Louisa D*, but undoubtedly from the herd frequenting the Pribilof Islands, and 224 skins which were taken off the Galapagos Islands by the schooner *Prosper*, of a species (*Arctocephalus phillipi*) distinct from that of the seals on the Pribilof Islands.

[45] Statements by masters of American vessels as to the sex of seals taken, verified in every instance by examination by inspectors at ports of entry. Proportion of females in Canadian catches taken from figures submitted by United States consul (see note 43); catches not officially inspected.

NOTES ON THE FUR SEALS OF GUADALUPE, THE GALAPAGOS, AND LOBOS ISLANDS.

ACCOUNT OF THE WRITER'S EXPEDITION IN SEARCH OF THE FUR SEAL OF GUADALUPE ISLAND IN 1892.

I was detached from the United States Fish Commission steamer *Albatross* at Seattle, Wash., on May 5, 1892, by the United States Commissioner of Fish and Fisheries, and directed to charter a small vessel at San Diego, Cal., for a trip to Guadalupe and San Benita islands, lying off the coast of Lower California, for the purpose of securing specimens of the Guadalupe fur seal, for the use of the Department of State in connection with the Bering Sea Tribunal of Arbitration about to convene at Paris, it having become necessary during the progress of the Bering Sea controversy to identify the species of seal inhabiting these islands. I first visited Guadalupe Island in October, 1884,[1] when in charge of the schooner *Laura* on a voyage in search of specimens of the elephant seal, for the United States National Museum. At that time stormy weather prevented us from examining the windward side of the island—where the animals were said to haul out—on account of the danger of keeping the schooner lying off a lee shore. After looking over the eastern shores in a hurried manner and shooting some goats to add to our stock of provisions, we sailed for the mainland of Lower California, which promised better results, and where we finally obtained, at San Cristobal Bay, 15 specimens of the elephant seal.

My second visit was made in February, 1889, in the Fish Commission steamer *Albatross*, but we spent only one day, and that at the southern end of the island, where we observed at a distance 3 seals, which appeared to be *Phoca vitulina*.

It was not until the present visit that I was able to examine the entire shore line of the island. According to Findlay's North Pacific Directory, Guadalupe Island is 140 miles off the coast of Lower California, its northern end being in latitude 29° 10′ 50″ north and longitude 118° 18′ 30″ west. It can be seen at a distance of 60 miles, and has near its northern end an elevation of 4,523 feet. It is very imperfectly represented on the charts. In 1880 and 1881 Capt. H. E. Nichols, U. S. N., commanding the Coast Survey steamer *Hassler*, made a reconnoissance of it "sufficient to give its general outlines and topography." The results of the *Hassler's* voyage have not been published, but according to Captain Nichols' chart in the archives of the United States Coast Survey, Guadalupe Island is $21\frac{3}{4}$ miles long by $5\frac{1}{2}$ to 6 miles in general width. Upon the northern end of the island grow scattered tracts of conifers, oaks, and palms. The southern part is treeless, but generally covered with a low sage brush.

According to Mr. J. N. Rose, United States Department of Agriculture, there are 145 species of plants known to the island, of which 29 are peculiar to it. Its flora is more closely related to that of California than to the adjoining region of Mexico. Many of the trees and plants once known to be abundant are now disappearing, chiefly on account of the presence of large numbers of goats.

Of the 36 species of birds known to Guadalupe, 9 are peculiar to the island, some

[1] Proc. U. S. Nat. Mus., 1885, pp. 90–93 (Recent captures of the sea elephant.—C. H. Townsend).

of them being reduced in numbers by cats, and one of the largest, the Caracara (*Polyborus lutosus*) has been nearly exterminated by the guns of former goat herders. As the island is at present uninhabited, the latter species of bird may reestablish itself.

During the greater part of the year dense fogs prevail about the more elevated parts of the island, which are in consequence rather fertile. Mr. W. E. Bryant, who resided upon one of the northern plateaus of Guadalupe during part of the winter of 1886, experienced considerable rain and occasional frost.

In May, after the subsidence of a northwest gale which had prevented our landing from the schooner for three days, I found the weather very warm. So far as I am aware no water is found upon the southern half of the island, the herds of goats ranging chiefly over the plateaus of the northern part of the island where there are a few springs. The goats are said to number about 10,000 at present, and a resident of San Diego is endeavoring to obtain a lease of the island for a goat ranch, the term of the former lessee having expired some time ago. The goats are killed for their hides chiefly, but small quantities of the flesh being saved. In dry seasons many of them perish for lack of water.

I left San Diego on the schooner *Santa Barbara*[1] on May 14, 1892, reaching Guadalupe Island on the 16th, the first landing being at the deserted settlement of North Point. We at once commenced a thorough search of the shores with the dory, rowing close under the cliffs, usually within a distance of 40 feet of the rocks, landing and entering the caves and volcanic holes which could not be inspected from the boat. By the 25th we had in this manner rowed almost entirely around the forty or more miles of coast line, followed at a mile or two from the shore by the schooner, to which we always returned at nightfall. The work was very laborious on account of the small size of our party and the limited time at our disposal, while rough weather made many of the landings dangerous in the extreme. We were most unfortunate in our equipment. Our 12-ton schooner, the only vessel then available at San Diego, was incapable of carrying a suitable hunting boat, and the work of exploring the island, devolving upon Messrs. Anthony, Streator and the writer, was further hampered by the added labor of standing regular watches with the captain and the cook in the care of the vessel. To the drawbacks in the way of equipment and crew must be ascribed our failure to secure a complete specimen of the rare Guadalupe seal.

During the exploration of the island only 7 fur seals were seen—none of them on land. I killed the only one which could be approached within shooting distance, but it sank before it could be reached.

The island was visited too early in the season to find seals on shore, the young not being brought forth until June, but on the site of a former rookery near Jacks Bay, on the west side of the island, 4 skulls were found which proved to belong to a species of *Arctocephalus*, which has since been described as *A. townsendi*, Merriam. The fur seals seen at Guadalupe were, with two exceptions, more than a mile off shore, the others having been found close to the rocks. One which seemed to be a male about 4 years old lay asleep with the flippers held out of the water in the manner characteristic of the species. Owing to the swell and thumping of our dory on the waves, it could not be approached near enough for an effective shot. Another, apparently a female, raising its head near the boat, I killed instantly with the rifle. It began sinking immediately and disappeared before we could reach it with the gaff.

[1] Party on board, George M. Hunt, master; A. W. Anthony, Charles Smith, C. P. Streator, and C. H. Townsend.

Guadalupe Island is thoroughly volcanic and has volcanic caves and holes along nearly every mile of its shore line, which were the favorite resorts of fur seals. Seal hunters finding them tightly packed in these places, killed them with guns and clubs. Frequently they were killed in caves so dark that their eyes were the only target to fire at, while at other times candles were used to disclose their hiding places. Young and old alike were taken. The young appear to have been brought forth in June and July and the species was present upon the island throughout the year. Its fur was worth about half that of the Northern fur seal, as taken on the Pribilof Islands, being worth about $15.

At the northwest side of Guadalupe, on May 23, 1892, we found "Sea Elephant" beach, a locality formerly frequented by elephant seals. This is one of the three sand beaches on the island. The others are at Jacks Bay, a few miles farther south, and at the village on the opposite side. At "Sea Elephant" beach we found 6 sea elephants sleeping near high water mark, which we shot. They were very slow in their motions and made scarcely any effort to get away. While we were skinning these, 2 others hauled out where we were working. The smallest of these we added to our collection, the larger one was not molested. It came and went several times during the afternoon and we frequently had our hands on it without its assuming any threatening attitudes. With the proper facilities it could have been taken alive.

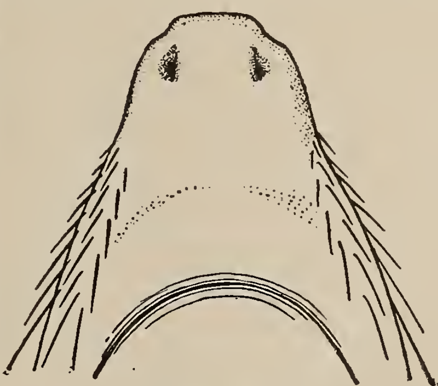


FIG. 1.—Nose of elephant seal from beneath.

In the meantime a heavy surf made it impossible to launch the boat, while the lofty cliffs not only prevented our ascent to the plateau of the island, but, extending into the sea on either side, imprisoned us on the beach, where we were without water or food. After repeated attempts we made our escape to the schooner late in the evening, without having been able to take any of the heavy elephant skins in our small boat. On the following day we recovered three of our prizes with great exertions and danger and were finally compelled to abandon the rest. The species brought back represent about the last of this exceedingly rare species. Captain Wentworth, of San Diego, counted 80 sea elephants upon this beach in 1883. We found nothing in the stomachs of those killed by us but small quantities of sand—a pint or more to each animal. The large animals were shedding their short, stiff hair at this season—May. The proboscis of the elephant seal is imperfectly represented in all figures of the species that I have seen. It is not rounded like that of the elephant or tapir, but flattened above and below, and in the largest male specimen we obtained is 8 inches long. It hangs downward as a flap, about 4 inches broad and 2 inches thick, entirely concealing the mouth, the nostrils being at the corners of its nearly square tip. It is very soft and flexible and in life is kept in constant motion, the usual position being a forward and downward curve. It is frequently turned upward, the animal in the meantime opening and shutting its mouth without any sound. In crawling, the belly alone is lifted from the ground as the animal hitches itself along.

About 30 sea lions (*Zalophus*) were seen at the time of our visit on one of the southerly outlying rocks of Guadalupe Island.

The Guadalupe fur seal formerly inhabited other islands off Lower California. It may have been the species exterminated on the Farallones, near San Francisco, by the Russians. It is reported that 5 seals were taken on Richardsons Rock, off San Miguel Island, one of the Santa Barbara group, in 1890. Morrell, in 1825, found no fur seals on this group of islands, but took 400 on San Martin, off Lower California, and reported having seen about 20 fur seals, 300 sea leopards, and 1,550 hair seals at Socorro Island.

During my own visit to the islands of the Socorro group, in March, 1889, no seals of any species were seen, but the shores were only partially examined. We saw no seals at Alijos Rocks during the same cruise, but Capt. Charles Haritwen saw two sea lions there in May, 1880. We found sea lions (*Zalophus californianus*) along both coasts of Lower California, and they inhabit also the Tres Marias Islands. Although

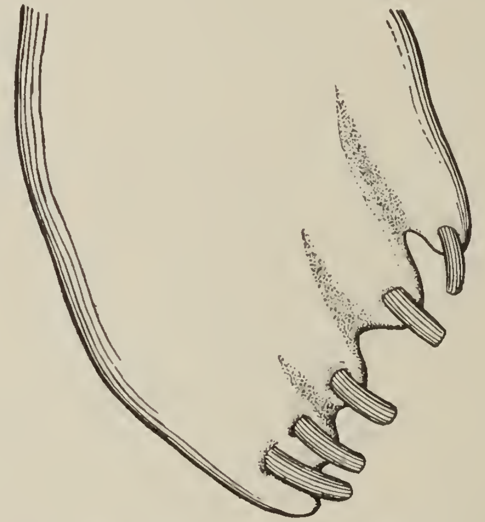


FIG. 2.—Left fore flipper of elephant seal, showing arrangement of claws.

several species of the seal kind have always existed in this region and at the Galapagos Islands, there are no records concerning the occurrence of any species of seals off the west coast of Central America.

We found no pinnipeds at Cocos Island, 300 miles off Costa Rica, during the cruise of the *Albatross* in 1891.

The lessees of the Commander Islands, Bering Sea, had the seals slaughtered upon Robben Island, Okhotsk Sea, in the vain hope of driving the remnant of the herd to the Commander Island rookeries. There are no records to show that the slaughter of seals upon the rookeries of Gaudalupe and San Benita islands ever resulted in driving the animals to other localities. From the history of the smaller seal rookeries of the Pacific Ocean it would seem that the fur seal can not be driven away to new islands, but stupidly lingers about its ancient haunts until extermination overtakes it. If the remnant of the race remaining near or on the shores of Guadalupe Island were protected by the laws of Mexico and by a resident guard upon the island, its reestablishment would be quite within the range of possibility.

After returning to San Diego, where we arrived on May 30, I obtained from a number of men who had formerly engaged in sealing at Guadalupe and the San Benita islands information concerning the habits and capture of this species of fur seal, with sworn statements as to its former abundance upon these islands. . The time at our disposal did not permit of a visit being made to the San Benita Islands, where, however, I observed numbers of *Zalophus* in 1884.

The following early reference to this species, brought to my attention by Dr. L. Stejneger, will be of interest in this connection:

In former days there was a great multitude of seals on the rocks of the Farallones, in the ocean opposite the Bay of San Francisco. The Americans of the United States have completely exterminated them there. On Guadalupe there is also found a species of sea bear, but these inhabitants of a hot climate are smaller than their brothers in the north. Their color is also less silvery.[1]

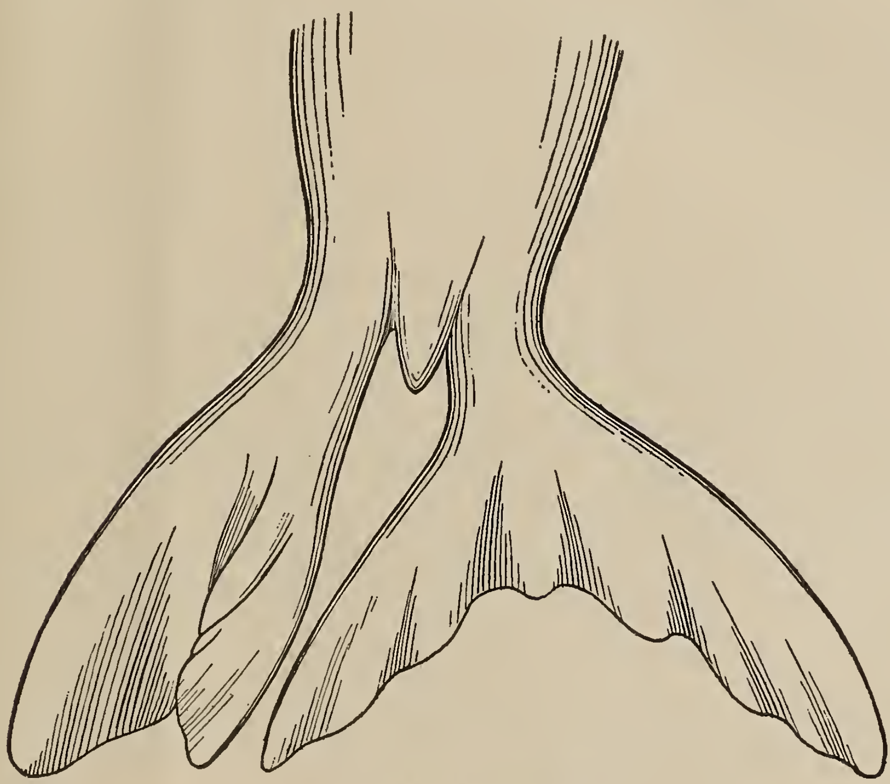


FIG. 3.—Hind flippers of elephant seal.

PARTIAL RECORD OF FUR SEALS TAKEN ON GUADALUPE AND SAN BENITA ISLANDS FROM 1876 TO 1892.

1876–77: Mr. George W. Chase, of San Diego, Cal., killed a few fur seals on San Benita Island, and reports that they were accompanied by pups.

1877: The late Capt. Charles Haritwen, of Alameda, Cal., resided on Guadalupe Island in 1877 in connection with the island goat ranch. He informed me that several vessels were sealing there then, one of which he remembers to have taken about 300 and another 500 seals. Seal skins at that time were worth only $2.50 each.

[1] Baer in Wrangell's Stat. Ethn. Nachr. Nordwest. Amerika, St. Petersburg, 1839, p. 39.

1877: Captain Kathgard, of San Francisco, took 15 fur seals from Guadalupe, and states that about 1,000 were secured by other parties.

1879: About 1879 Messrs. James Borges and Fred Sisson obtained 1,550 fur seals on Guadalupe and San Benita islands, both adults and young being taken. The skins sold in San Francisco at $10 and $15. (Statement by Hunt and Chase.)

1880: Captain Haritwen took 104 fur seals on Guadalupe Island between May 1 and 23, 1880. They were taken at several points on the island, but chiefly on the west side, where the largest rookery contained 600 or 700 seals.

At the easternmost of the San Benita Islands 2 fur seals were taken on May 24. There were three other vessels sealing off Guadalupe at the same time, one of which, remaining longer than the others, took 500 seals. This vessel reported that the young were born about the middle of June.

The seal skins were of good quality, and those in Captain Haritwen's catch sold at $15 each.

1880: In 1880 George W. Chase again sealed at Guadalupe Island, taking 185 in in June, 150 in July and August, and 75 in September. The skins were worth $15 each at that time.

There were 3,000 or 4,000 seals there that year, but other vessels came and seals soon became scarce. They were found breeding in June and July, and were present every month in the year. They were observed at times about 100 miles west of Guadalupe. Seals were observed at Guadalupe on trips made by Chase since 1880, but they were not hunted.

1883: In 1883 Capt. George E. Wentworth, of San Diego, sealed at Guadalupe, making four trips in November, December, January, and February. About 4,000 seals were seen and 2,000 taken. Other vessels were there, and the seal rookeries were practically broken up during that season.

1885: In 1885 James M. Niles, of San Diego, made six trips to Guadalupe Island, finding seals present during most months of the year. About 2,000 were seen and 200 killed. There were pup seals in plenty, which he believed to have been born in June.

1885: Seals also taken at Guadalupe by Captain Cannon. (Statement by Haritwen.)

1885. F. Lupp, sloop *Puritan*, saw 5 seals, 1 killed in a cave.

1890: George M. Hunt, of San Diego, visited Guadalupe in 1890 on the schooner *Hunter*. Only 4 fur seals were seen.

1891: In December, 1891, George M. Hunt visited Guadalupe Island for the purpose of fur sealing, taking 5 adults on the east side and 1 pup on the northwest side. Seven other pups were seen.

In June, 1891, Messrs. Burke and Farwell took 4 seals on San Benita Island. (Statement by Hunt.)

1891–92: Capt. F. M. Gaffney found no seals at Guadalupe.

1892: The writer visited Guadalupe May 16–25, 1892, in the interest of the State Department. Seven fur seals were seen, one of which was killed but not secured. Four skulls were obtained.

1893: Mr. A. W. Anthony, of San Diego, states that 36 seals were taken in 1893.

1894: Mr. Anthony reports the capture of 15 seals in 1894.

This incomplete record accounts for 5,575 fur seals killed at Guadalupe between 1876 and 1894.

DESCRIPTION OF THE GUADALUPE SEAL.

The following description of the Guadalupe seal (*Arctocephalus townsendi*) as a new species, is by Dr. C. Hart Merriam, and was published in the Proceedings of the Biological Society of Washington for 1897, pages 175 to 178:

Recently I have compared the skulls collected at Guadalupe by Mr. Townsend with a series of skulls of *Arctocephalus australis* or *phillipi* from the Galapagos Islands, also collected by Mr. Townsend, and find the two to be very distinct species. In view of these facts it seems particularly appropriate that the new species should bear Mr. Townsend's name, which I take pleasure in bestowing upon it.

The material on which the new species is based consists of four skulls picked up on the beach. One of these, the type, is an adult male which has lost the teeth and lower jaw. Another is a young adult female with both jaws and all the teeth. The remaining two are very imperfect, lacking both the jaws and face.

The species seems doomed to speedy extermination and so far as known no museum in the world has a single specimen. It is hoped that our National Museum will be able to secure complete specimens before it is too late.

Arctocephalus townsendi sp. nov. Guadalupe fur seal.

Type locality.—Guadalupe Island, off Lower California. Type No. 83617, ♂ ad., U. S. National Museum. Collected on the beach on west side of Guadalupe May 22, 1892, by C. H. Townsend.

Cranial characters.—Contrasted with skulls of *Arctocephalus* (*australis* or *phillipi*) from the Galapagos Islands, skulls of *A. townsendi* differ in somewhat smaller size; much shorter rostrum; shorter nasals; larger and more freely open incisive foramina; heavier and shorter ascending branches of premaxillae, which do not push backward along the nasals as in *australis;* smaller, flatter, and smoother audital bullae; much narrower and more deeply excavated palate; narrower postpalatal notch; broader and heavier jugals; broader zygomatic processes of maxillae, which are expanded to form a broad floor under the anterior half of the orbit; larger, broader, and more rounded anterior nares in the male, and absence of sagittal crest between frontals.

The most important characters are the exceedingly narrow and excavated palate, flat audital bullae, short and thick ascending arm of premaxilla, and broadly expanded zygomatic root of maxilla, forming a floor under the anterior half of the orbit. There are also tooth characters: the first upper molar (fifth molariform tooth) is mainly posterior to plane of anterior root of zygoma; both upper true molars are double rooted, and the last upper premolar is incompletely double rooted.

In the female of *townsendi* the narrow and deeply excavated form of the palate is even more emphasized than in the male, and the postorbital constriction is very much narrower than in the female of *australis*.

Measurements of male skull of Arctocephalus townsendi (the type).

	Mm.
Greatest basal length (gnathion to occipital condyles)	256
Basal length (gnathion to basion)	243
Basilar length of Hensel (basion to incisors)	233
Palatine length (gnathion to postpalatal notch)	120
Postpalatal length (postpalatal notch to basion)	125
Zygomatic breadth	151
Lateral series of teeth (canine to last molar inclusive)	88
Distance between canines	22.5
Distance between third pair of molariform teeth	22.5
Breadth (anteroposterior) of zygomatic root of maxilla between inferior lip of antorbital foramen and orbit	21

MEASUREMENTS OF SALTED SKIN OF ELEPHANT SEAL.

Following are the measurements of the largest of the male elephant seals killed on May 23, the salted skin being greatly shrunken:

	Ft.	In.
Length, nose to end of tail	8	10
Length, nose to end of flipper	11	
Length, nose to end of eye	1	3
Length, nose to end of upper lip		8
Length, tail		4
Length, bare part of fore flipper	1	3
Width, bare part of fore flipper		7
Length, longest whiskers		6½
Length, longest bristles over eye		4
Length, outer claw, longest		1¾
Length, inner claw, shortest		1½
Width across back to end of fore flipper	6	
Width across tips of hind flipper	2	3
Width between eyes		7
Whiskers, 48 on each side.		
Bristles over eye, 8 each side (their positions opposite to back of eye).		
Rear and lower whiskers longest (front one-half inch long) grading back to longest.		
No trace of claws on hind flippers; claws black and broad.		
Outer claw (width)		½
Inner claw (width)		¼
Spread of claws		6½
Space between first and second claws		¼
Space between second and third claws		½
Space between third and fourth claws		1¼
Space between fourth and fifth claws		2

NOTES ON THE FUR SEALS OF THE GALAPAGOS ISLANDS.

The history of the extermination of the Galapagos fur seal (*Arctocephalus philippii*) is similar to that of the Guadalupe seal; an unrestricted slaughter of male and female, old and young alike, whenever and wherever found. The notes relating to its capture in recent years were furnished me by sealers who were engaged in hunting it.

During the voyage of the *Albatross* to the Galapagos Islands in 1891 we were informed that a scattered remnant of the herd still frequented the more inaccessible rocks of the archipelago.

The Galapagos fur seal was usually found on beaches overhung with cliffs, and sought caves during the day to avoid the heat. The young were usually born in caves, and were observed at all times during the summer. The species was found present at the islands all the year round and does not appear to have migrated at all.

The history of the Galapagos seal furnishes additional proof of the fact that fur seals cling to their ancient and accustomed breeding places with the greatest persistence. So certain are they of returning to their old breeding ground, that the reestablishment of the different species would undoubtedly result from a complete protection of these places, and the result would be the building up of valuable seal fisheries for the future. The later sealing voyages to the Galapagos, from 1880 to 1887, resulted in the killing of all the seals that could be found. The log book of Captain Haritwen's voyage in 1880, now in my possession, shows that seals taken at that time frequented certain localities on Culpepper, Albemarle, Narborough, Tower, Wenman, and

Abingdon islands. During the long-continued Bering Sea controversy, when all matters pertaining to the world's seal fisheries received a general overhauling, the records of the Galapagos seal fishery were looked up, but no one supposed that the race of seals there had in any degree revived. It was a matter of surprise to those interested in the subject that during the past month (December, 1897) a vessel arrived at San Francisco from the Galapagos with a catch of 224 seals. This shows that the few that had escaped the slaughter of the last voyage, made just ten years before, had reestablished themselves on the identical rookeries where Captain Haritwen's catch had been made, and the nucleus of a herd existed there unknown to anyone. There is no doubt that it could have been developed into an important seal fishery if the fact had been discovered in time to prevent its destruction by raiders. It is probable that individuals have escaped this latest slaughter, and that by the protection of the rookeries a fishery could be established.

PARTIAL RECORD OF FUR SEALS TAKEN ON THE GALAPAGOS ISLANDS.

1816: During Fanning's voyage, in 1816, 8,000 seals were taken at the Galapagos Islands.

1825: In Morrel's voyage it is recorded that a few seals were taken at the south end of Albemarle Island.

1872–1880: Capt. C. W. Reed made four sealing voyages to the Galapagos Islands between 1872 and 1880, during which about 6,000 seals were taken. The skins are said to have been less valuable than those from Guadalupe, Santa Rosa, and Santa Cruz islands.

1879: Capt. W. P. Noyes found "more seals than in 1897" (his latest voyage).

1880: In 1880 the late Capt. Charles Haritwen, of Alameda, Cal., sealed on the Galapagos Islands, taking 261 seals between June 28 and August 30, from Culpepper, Albemarle, Narborough, Tower, and Wenman islands. Many young pups were seen, which he thought were born in July. Many seals were seen on the southwest side of Wenman, the southeast side of Narborough, and the west side of Abingdon islands, but no landings could be effected at these places. The seals taken at Narborough were procured at the northwest point. The fur was poor, the skins selling at $5 each.

1882: Captain Haritwen stated that he knew of a vessel which took 800 seals at the Galapagos about 1882.

1885: Capt. F. M. Gaffney, in 1885, obtained about 1,000 seals between August 30 and December 8.

1887: Capt. Samuel Smith, of San Francisco, took 1,200 seals from the Galapagos Islands about 1887, the skins of which sold for $7 each.

1897: Capt. W. P. Noyes, of the schooner *Prosper*, of San Francisco, visited the Galapagos Islands in 1897, and between July 16 and October 19 secured 224 seals, 139 of which were females. Although the log-book records of this voyage state that the seals were procured at distances varying from one-half to 7 miles from shore, the master subsequently stated that some of the animals were killed in caves and elsewhere on land. The positions given in the log show that the catch was made in the vicinity of the old sealing localities on the islands above mentioned. These incomplete records account for 17,485 fur seals killed at the Galapagos Islands, but probably represent only a small proportion of the numbers actually taken.

NOTE TO ACCOMPANY A PHOTOGRAPH OF ONE OF THE SEAL ROOKERIES OF LOBOS ISLAND, URUGUAY.

When in Montevideo, Uruguay, in January, 1888, I procured a photograph, taken in 1886, showing a portion of Lobos Island covered by seals. It represents the southern fur seal (*Arctocephalus australis*), and is interesting, as it seems to be the only one to be found representing southern seals of any species.

The small rookeries of Lobos Island illustrate the good results following the careful protection of the fur seal upon its breeding grounds. Although situated directly in the track of commerce and within 5 miles of Maldonado, a town more than one hundred and fifty years old, a profitable seal fishery has been maintained to the present time.

Commercial sealing was carried on here prior to 1820. The present lessees of the island, operating under the direction of the Government of Urugnay, placed upon the London market, from 1873 to 1897, 319,746 salted skins, or an average of over 13,000 a year. Lobos Island is less than a mile in length, is low, brushy, and has a few houses near its center. The odor and the noise from the rookeries are noticeable on passing vessels.


GUADALUPE ISLAND
LOWER CALIFORNIA
Showing explorations made by C.H.Townsend in 1892
for the Department of State, relating to
the species of fur seal inhabiting Guadalupe Island.
Scales
Stat. M.
Naut. M.
Base map furnished by the U.S.C.&G.Survey.
From a reconnaissance in 1881
by Lieut. Comdr: H.E.Nichols U.S.N.
Commanding U.S.C.&G.S.Str: Hassler:
Soundings in fathoms
G U A D A L U P E Ip
Cone
Steeple
White Bluff
North Point
Black Rock
Landing
1st Bluff
Elephant
2nd Bluff
Red Peak
Track of Schooner
Track of dory
3rd Bluff
Round Top
Nipple Pt.
Jack's Pt.
Red Mt.Pt.
Red Mt.
TRUE NORTH
VARIATION 12°37'E.
Low Pt.
Landing
Red Hill
Finger
1034.5'
1021.8'
635'
Flag
1144.9'
Ho.
Observation Spot
Lat. 28°55'18"
Long. 118°15'09"
988.7'
Big I.
Beach Sta.
Rock Pile
Toro Mt.
WHALERS BAY
Toro I.
Black Rocks
Zapato
Sea Lion Rookery
NOTE:
Track of Schooner Santa Barbara
" " dory
Fur Seals killed
" " observed
" " -skulls collected
Elephant Seals killed

A PORTION OF THE SEALING FLEET IN VICTORIA HARBOR, OCTOBER, 1894.

From a photograph by C. H. Townsend.

OFFICERS AND INDIAN HUNTERS OF THE CANADIAN SCHOONER FAVORITE, 1894.

From a photograph by Miller and Townsend.

SEALING CANOES AT NEAH BAY, NORTHWEST COAST.

From a photograph by Miller and Townsend.

SEALING CANOE.

From a photograph by Miller and Townsend.

FORKED SPEAR, SPEAR POINTS AND LINES, KILLING CLUB, PADDLE, AND CANOE BAILER.

HOISTING ABOARD THE CANOES.

From a photograph by A. B. Alexander.

AMERICAN SCHOONER COLUMBIA WITH CANOES IN TOW.

From a photograph by N. B. Miller.

CANOE LEAVING THE SCHOONER.

CANOE RETURNING.

CANOE UNDER SAIL.

From photographs by C. H. Townsend.

PART OF THE SEALING FLEET AT UNALASKA, JULY, 1896.

From a photograph by C. H. Townsend.

LANDING AT ST. PAUL VILLAGE, LOOKING TOWARD THE ENTRANCE TO THE SALT LAGOON.

From a photograph by C. H. Townsend.

THE VILLAGE OF ST. PAUL, LOOKING TOWARD ZOLTOI SANDS.

From a photograph by C. H. Townsend.

DESERTED VILLAGE, SOUTHEAST END OF GUADALUPE ISLAND. IN THE BACKGROUND, CAVES FORMERLY FREQUENTED BY SEALS.

From a photograph by C. H. Townsend.

ELEPHANT SEAL, *Macrorhinus angustirostris*, SHOWING THE USUAL POSITION OF THE PROBOSCIS AND MANNER OF ARCHING THE BODY IN PROGRESSION.

By A. H. Baldwin, from sketches and measurements by C. H. Townsend.

ROOKERY OF THE SOUTHERN FUR SEAL, *Arctocephalus australis*, ON LOBOS ISLAND, URUGUAY.

From a photograph.

X.—REPORT OF AN EXPEDITION IN SEARCH OF THE FUR SEAL OF GUADALUPE ISLAND, LOWER CALIFORNIA, JUNE, 1897.

INCLUDING A SURVEY OF THE ISLAND AND NOTES ON THE ANIMAL AND PLANT LIFE OF THE REGION.

By WILBUR WILSON THOBURN, Ph. D.,
Professor of Bionomics, Stanford University.

JUNE 8, 1897.

MY DEAR SIR: You are hereby appointed assistant to the Commission of Fur Seal Investigations, to take charge of the expedition to Guadalupe Island.

It is understood that yourself and assistants are to serve without salary, but that all necessary expenses of the trip will be paid by the United States Treasury. It is understood that Prof. R. L. Green shall be assistant in charge of the topographic survey of the island and that Prof. Charles B. Wing shall have charge of the photography.

You are directed to take the steamer *Gedney*, of the United States Coast Survey, at San Francisco on June 16; to provide yourselves with instruments for topographic reconnoissance; with material for the collection and preservation of specimens of natural history, and with apparatus for photographing all objects of interest which you may find on the island.

You are directed to give special attention to the fur seal rookery which is supposed to be near the middle of the western side of the island. Should you find such a rookery actually present, you are directed to count the seals in the different categories; to take photographs of the individual animals and of the rookery as a whole; to preserve in formalin three pups and three young male skins, and, if possible, the skin of an adult male; and skeletons of three adult males and of as many young males should be procured, if possible. In general, you will ascertain all that can be found out in regard to the natural history of the animal, with special reference to the comparison between it and the fur seal of the north.

Further, as full an investigation of the natural history of the island as is practicable should be made. This should include the collection of any reptiles and mammals that may be found; of the fishes and marine invertebrates in the tide pools, and as far as possible the birds and plants.

To this end you will utilize all the facilities which may be given by the officers and crew of the *Gedney*, and your stay on the island is at your own discretion unless orders to the captain of the *Gedney*, Lieutenant-Commander Osborn, require him to leave at any particular time. On leaving you may proceed back with the *Gedney* to San Francisco, or, if the reasons for doing so justify the expense, you may proceed to San Diego and return by rail.

Any information concerning the past or present occupation of the island by the sea elephant should be carefully noted.

In general, the first work of the expedition is to secure information in regard to the fur seal and to secure specimens of the seal, which is an undescribed species.*

Yours very truly,

DAVID S. JORDAN,
Commissioner in charge of Fur Seal Investigations.

Dr. W. W. THOBURN,
Assistant to the Commission of Fur Seal Investigations,
Stanford University, California.

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*This fur seal has since been described by Dr. C. Hart Merriam as a new species, *Arctocephalus townsendi.* Proc. Biol. Soc. Wash., July 1, 1897.

Following the instructions given in the letter above, we left San Francisco on June 16 on the steamer *Gedney* and reached Guadalupe Island on the morning of June 21. We remained eleven days, and during this time we carefully studied the 50 miles of coast line, landing when it was possible or running the steamer or launch so close inshore that every detail could be closely observed. Nearly the entire eastern and southern shores were explored on foot and about half of the western shore. The northwestern shore, where most of the caves are located, could not be reached on account of the heavy surf, but it was possible to run the steamer within 500 feet of the surf line and carefully observe every point by means of the glasses.

The interior of the island was thoroughly explored and nearly every form of bird and insect and plant life seen was collected. A list of these forms is appended to this report. No reptiles were found.[1] A list of the fish collected is given below.

To Professors Green and Wing fell the very difficult and often dangerous work ot exploring the interior of the island, while I gave most of my attention to the coast line. Lieut. Commander A. P. Osborn, commanding the *Gedney*, put his ship and crew at our disposal, and from him and his officers we received most efficient help. A complete survey of the shore line and a sketch of the island was made by the officers of the *Gedney*. A copy of this sketch map is transmitted with this report.

The shore line is everywhere composed of ragged masses of rock freshly fallen from the cliffs above and seems too unstable to allow the growth of marine forms or of tide-pool life. There is, for these tropical waters, very little life, and the invertebrates that were found were small in size and not very numerous.

There are no kelp beds about the island, and everywhere but in a little cove on the south side of the island, where it is comparatively shallow, the water is very deep a short distance from the shore. This may be the explanation of the small number of water birds. During the ten days I saw but two shags and eight gulls. The only water bird that seemed quite common was a night-flying petrel. On the northwestern coast are numerous caves into which the waves break. It was in these caves that the fur seal was formerly found in large numbers.

A very careful study of the 50 miles of coast line was made with special reference to the present or past occupation by the fur seal. In some places it was impossible to land on account of the high surf. In these cases the boat was run as close inshore as possible and every object visible was examined with glasses. Unfortunately, the sea was too rough to make a complete and minute examination of all the caves. But in the repeated trips around the island and six trips along the northwest shore, where most of the caves are located, no fur seal or bones other than the bones of goats were seen. Two sea lions (*Zalophus californianus*) were seen on an outlying rock off Steamer Point (see map). From the bluffs, which on the west coast are from 500 to 1,000 feet high above the shore, the coast line was carefully studied, but no seal were noted on the rocks or in the water. On the south side of the outer island (see map) is a rookery of sea lions (*Zalophus californianus*). A count made at 8 o'clock a. m. showed 10 bulls, 50 cows, and 31 pups. This rookery was repeatedly examined in hopes of finding fur seal among the sea lions, but none were seen. One day was spent on the rookery sketching and photographing the sea lions. The adults were quite timid and took to the water if we approached within 40 feet of them. Though the bulls tried to herd the cows back on to the rocks and frequently succeeded, none of them would come near us, nor did any of the bulls come ashore while we were on the rookery. The

[1] In Bull. Cal. Acad. Sci., Vol. I, p. 220, Prof. E. L. Greene speaks of seeing two or three small lizards.

pups were quite fearless and crawled around our feet. We took one skin and a skeleton and two pups. On the rookery we found a cow that had been dead two or three weeks, and evidently shot. There were everywhere signs that the island is frequently visited, and the unprotected fur seal whose hide is said to be worth $15 has probably been almost, if not entirely, exterminated by those who visit the island for other purposes.

As to the presence or absence of fur seal on the island at the present time, I can only say that if there are any left they are few. During the eleven days we were at Guadalupe parties were in various parts of the island, all on the lookout for specimens, and none were seen. Mr. A. W. Anthony, of San Diego, who visited the island a few months before our party, says that he saw two or three then, though he failed to secure them.

In this connection we may put on record certain notes furnished concerning these seals. Mr. Anthony, under date of November 26, San Diego, writes:

It would be impossible for me to give you any idea of the number of fur seal still left at Guadalupe Island. That a few are left there I know, for I have seen two or three the past spring, and none have been killed since. There are, however, very few left, and these are scattered and are only to be found in a few caves that are exposed only at low tide. I can give you no landmarks whereby these cows could be found; but I think they are confined to the weather (northwest) and eastern sides[1] of the

I have made several trips to the island, the first with Mr. Townsend in 1892. We failed to obtain any specimens. The following year, however, 36 seals were killed there, and again 15 were taken the second year after our visit. Since then the sealers have considered these seals extinct, but they are again talking of sealing the island.

In conversation with those who sealed there when the species was common I learn that the old bulls left the females and pups as soon as the latter were a week or so old, and were not again seen until the following year. It is thought that they go to sea, but it is far more likely that they resort to caves opening below the surface of the water, since the species seems to be resident only on the island, and has never been seen, so far as I can learn, east of the Los Benitos Island, not even hauling on Cerros Island, 20 miles east of the Benitos, when they were common on the latter.

I think all are gone from the Benitos, since I have called there four times in the past two years and have not found any. I am, however, satisfied that enough are still on Guadalupe to restore the herd in time; but absolute protection is necessary and, for all I can see, impossible.

Since learning that the Guadalupe seal belonged to the southern genus I fully expected to find some about the Revillegigedo Islands, thus connecting them with the Galapagos species, but a careful search about those islands failed to bring to light evidences of seals of any species.

Jacks Bay, where Mr. C. H. Townsend found four skulls of fur seal in May, 1892, and Sea Elephant Beach, on the northwest side, were both visited by Professors Green and Wing; but a careful search revealed neither seal nor elephant seal, nor did they find any parts of the skeleton of either animal.

The fish collected about the island were identified by Dr. C. H. Gilbert, and the list is given below. Except in the tide pools, which were worked by Professor Green, no thorough study of the fish was made. Bonito and yellow-tail were quite common and were caught by trolling from the steamer.

Gyraplcurodus francisca Girard.
Carcharhinus fronto (Jordan and Gilbert).
Trachurus symmetricus (Ayres).
Paralabrax clathratus (Girard).
Girella nigricans (Ayres.)
Hypsypops rubicundus (Girard).
Pimelometopon pulcher (Ayres).
Iridio semicinctus (Ayres).
Clinocottus analis (Girard).
Caulolatilus princeps Jenyns.
Remora remora (Linnæus).

[1] The eastern side was so thoroughly examined by our party that I feel justified in saying that there were none on that side during the period of our visit.—W. W. T.

THE BIRDS OF GUADALUPE ISLAND.

The absence of water birds was constantly noticed. In one trip of 18 miles along the western shore I saw but two gulls (*Larus occidentalis*), two cormorants, and one sooty albatross. Nowhere did we see any signs of the extensive breeding grounds so common on the islands nearer the Mexican shore.

But two forms of water birds were at all common. The first was the night-flying petrel (*Oceanodroma leucorhoa macrodactyla*). This was abundant about the ship at night when we were anchored near the cliffs, and specimens were repeatedly captured alive. It was attracted by the fires of parties camping on the shore and was frequently mistaken for a bat.

The other water bird that was seen in large numbers was called by the sailors "sea pigeon." We met them in large numbers some distance from the island, either resting upon the surface or flying close to the water, but we could not get near enough to identify them. It may have been the black-vented shearwater (*Puffinus gaira*) which Mr. Walter E. Bryant saw here. The following list includes the birds identified during the ten days from June 21 to July 1. I have followed the paper on the Ornithology of Guadalupe Island, by Walter E. Bryant (Bul. Cal. Acad. Sci., Vol. II, 269).

1. **Larus occidentalis.** Western gull.

Two specimens, seen nearly every day on the rocks along the southern shore.

2. **Oceanodroma leucorhoa macrodactyla.** Bryant's petrel.

This little bird was very common on dark nights. It would fly around the ship uttering a peculiar cry. Occasionally one would strike the rigging and fall to the deck or enter the cabin. Several specimens were secured in this way and kept alive several days.

3. **Buteo borealis calurus.** Western redtail

Two specimens were seen over the southern part of the island. It was frequently seen in the southern part. No specimens were secured.

4. **Falco sparverius.** American sparrow hawk.

5. **Colaptes rufipileus.** Guadalupe flicker.

Three specimens were secured among the pines at the northern portion of the island.

6. **Micropus melanoleucus.** White-throated swift.

A swift of some kind was occasionally seen about the higher parts of the island. None were secured for positive identification, and these may have been some other species.

7. **Carpodacus amplus.** Guadalupe house finch.

Very common about the springs on the top of the island.

8. **Junco insularis.** Guadalupe junco.

Very common among the pines and cypress trees of the summit.

9. **Pipilo consobrinus.** Guadalupe towhee.

One specimen.

10. **Salpinctes guadeloupensis.** Guadalupe rock wren.

Very common everywhere, especially among the rocks along shore.

GUADALUPE ISLAND SPIDERS AND INSECTS.

By William Appleton Snow,
Assistant in Entomology, Leland Stanford, Junior, University.

Class ARACHNIDA.

Order ARANEIDA.

1 **Lycosa** sp.
Immature male. One specimen.

2. **Habrocestum** n. sp. ?
"Probably new, but as it is not adult, I would rather not describe it, although its coloration is doubtless characteristic."—Banks in litt. Two specimens.

3. **Callilepsis insularis** n. sp. Banks MS.
"Closely resembles *Callilepsis pluto*, from Washington State." Two specimens.

4. **Marptusa californica** Peck ?
One immature specimen.

Class HEXAPODA.

Order ORTHOPTERA.

1. **Trimerotropis lauta** Scudd.
Known only from Guadalupe. Ten specimens.

2. **Gryllus guadelupensis** Scudd. MS.
One specimen. There were also several immature Acrididæ.

Order COLEOPTERA.

Calosoma semilæve Lec.
Amara insignis Dej.
Amara californica Dej.
Dermestes vulpinus Fabr.
Trogosita virescens Fabr.
Pristoscelis sp.
Colaspidea cuprascens Lec.
Monoxia consputa Lec.
Cœlotaxis punctulata Horn.
Cœlotaxis muricata Horn. ?
Helops bachei Lec.

Order NEUROPTERA.

1. **Myrmeleon** sp.
One specimen.

Order HEMIPTERA.

1. **Lygæid.**
One specimen, fragmentary.

2. **Psyllid.**
One specimen, fragmentary.

Order DIPTERA.

1. **Anthrax** sp.
Two specimens, in very poor condition.

2. **Eupeodes volucris** Osten Sacken.
One specimen, male. A Western species, which extends as far eastward as western Kansas.

3. **Eristalis tenax** Linn.
One specimen, male.

4. **Mesogramma** sp.
A single shrunken and discolored specimen.

5. **Drosophila** sp.
One specimen.

6. **Sarcophaga** sp.
Four specimens.

7. **Compsomyia macellaria** Fabr.
One specimen, male.

8. **Lucilia cæsar** Linn.
Four specimens.

9. **Calliphora vomitoria** Linn.
One specimen.

All of these insects were preserved in alcohol. The more delicate of them—the diptera—were consequently somewhat shrunken and discolored.

Judging from this little collection, the insect fauna of Guadalupe Island can not differ markedly from that of some parts of California.

REPORT ON THE PLANTS OF GUADALUPE ISLAND.

By William Russell Dudley,
Professor of Systematic Botany in Leland Stanford Junior University.

The collection of plants made on Guadalupe Island in 1897 was gathered during the last week in June by Profs. Rufus L. Green, Charles B. Wing, and Wilbur W. Thoburn. The dry season was, of course, well advanced, and the collection is chiefly interesting as showing what is to be found in bloom in the summer.

The island had been visited by Dr. Edward Palmer, who collected from February till May, 1875; visited all parts of the island, and obtained 131 species of plants. These were published by Sereno Watson in the *Proceedings of the American Academy of Arts and Sciences*, XI, 105. Of these, 21 were peculiar to the island. Dr. Palmer again visited Guadalupe Island in 1889, for a short time. A list of Dr. Palmer's last collection was reported upon by Dr. J. N. Rose in the Contributions to the U. S. National Herbarium, I, 21. Here 4 new species are published and 29 species are listed as peculiar to the island.

Prof. Edward L. Greene next collected there seven days during the last half of April, 1885. He added several to Palmer's list, including several new species. His observations, together with a revised list of the plants of the island, were published by the *California Academy of Sciences*, Bulletin, 1, 214.

Dr. F. Franceschi, of Santa Barbara, collected there during December, 1892, and a part of January, 1893, and published an interesting series of notes on his observations in Zoe, (San Francisco), IV, 130.

A. W. Anthony and T. S. Brandegee visited the island in September, 1896, for a short time, and again in March, 1897, and have already distributed a limited number of herbarium specimens from there.

About 135 species of flowering plants have been reported. The Stanford University party brought back 37 species, of which 3 (a *Talinum*, a *Frankenia*, and a *Phyllospadix*), have not before been reported and belong to genera new to the island.

Note.—The Arachnida were determined by Mr. Nathan Banks; the orthoptera, by Mr. S. H. Scudder; the Coleoptera by Mr. Samuel Henshaw.

Our party landed at the anchorage at the south end and explored the dry central valley occupying the south half of the island; they also explored the northern half from the west anchorage, and from that on the northeast side. The northwest and much of the central part remained unvisited, chiefly on account of the dryness and heat and the difficulty of transporting water; therefore the collection could not have been by any means exhaustive.

Destructive of vegetation as are the goats, they are debarred from visiting the southern half of the island in the dry season by the distance from the only fresh water—the springs at the north end. If anyone could make a thorough survey of the summer flora of the south end, he would find apparently the natural conditions nearly undisturbed, and would be rewarded probably by new discoveries.

The Stanford party report, as all others have done, that the woody plants of the island are doomed if the present conditions continue. They made careful search, but were unable to discover that a single young or seedling tree had éscaped destruction by the goats. Many dead but no living junipers were seen, and the cause of the death of so many of the cypresses appears to have been demonstrated. The goats strip off the living bark of the latter in places, and the tree in its effort to repair the injury forms a new somewhat hypertrophied growth, leaving a dead streak underneath. The increase and decay of these dead spots finally leaves but a shell of living bark and wood near the base of the tree, and the winter winds overturns it years before the time of its natural death.

The presence of a considerable amount of dead wood in the southern part of the island has been observed by collectors previous to ours, and it was supposed to be the juniper; but the structure of the specimens brought home agrees well with that of the cypress and not with the wood of the juniper collected on the mainland. The cypresses, therefore, probably extended over the southern half of the island until destroyed by the goats, and their disappearance may have caused the disappearance of subperennial springs, as none exist in that region.

It was gratifying to find *Phyllospadix* existing on Guadalupe. It is another link connecting this flora with central California. It is, moreover, the most southern station reported to me, the next northerly being at Ensenada, in the northern part of Lower California. It is the most insular also.

The flowering plants are given below, and the few mosses, lichens, and algæ brought back will be reported elsewhere.

FLOWERING PLANTS COLLECTED IN THE SUMMER OF 1897 ON GUADALUPE ISLAND.

Eschscoltzia ramosa, E. L. Greene.

All parts of the island. Only a few in flower.

Oligomeris subulata, Boiss.

Near the northeast landing.

Silene gallica, L.

Spergularia moerothica, Heynh.

In fruit. Densely glandular-tomenton. Abundant among rocks, south end of island.

Frankenia grandifolia, Cham. and Schlecht.

On the side of the bank near the northeast anchorage.

Talinum Guadalupense, n. sp.

Leaves thick and fleshy oblanceolate, 2 to 5 centimeters long, all radical. Root fusiform, fleshy, broadening at top into a short rhizoma extending laterally. Flowering panicles 3 to 5 decimeters in height, ascending, naked except for the deltoid acuminate scarious bracts at the bases of the divaricate, scattered branches which occupy the upper half. Flowers in terminal close clusters. Sepals 2, roundish, persistent. Petals rose-colored, broadly oborate, nearly 1 centimeter long. Stamens numerous. Slender exserted style with a 2 to 3 lobed stigma. Capsule broadly ovoid acute. Walls three-valved, splitting from above. Placenta basal. Seeds disk-shaped, numerous.

Sphaeralcia?

Material scanty. Near northeast landing.

Malva borealis, Wallm.

Erodium Cicutarium, L'Her. Alfilarilla.

In fruit.

Erodium moschatum, L'Her.

In fruit. Contrary to Professor Greene's experience in 1885, the Erodiums have become widely extended over the island and form the favorite food for the goats.

Rhus Laurina, Nutt. Laurel sumach.

In flower. Collected from the shrubs mentioned by Franceschi in the old crater on the northeast side of the island. The only ones seen.

Trifolium microcephalum, Pursh.

In fruit, north end of island.

Hosackia ornithopus, Greene?

Too fragmentary for exact determination; near northeast landing.

Mentzelia micrantha, Torr. & Gr.

North end, in the canyon.

Cactus Goodrichii (Scheer.), Kuntze. (*Mamillaria goodrichii* Scheer.)

In fruit. Not many specimens observed, and all confined to the south end of the island.

Opuntia prolifera, Engelm. Prickly pear.

Abundant near the northeast part of the island, also near the west side anchorage, and scarce at the south end in the central valley.

Mesembryanthemum crystallinum. L.

Near south anchorage.

Filago Californica, Nutt.

Franseria camphorata, Greene.

Hemizonia frutescens, Gray. Guadalupe tar weed.

In full flower. Abundant in the south part of the island on very rough, rocky lava soil, or sand near the red lava cones. Reported by Palmer in 1875 as very rare, by Greene as abundant. It may have increased, as goats do not relish it. It is remarkable as a suffrutescent species in a genus of annuals, and was so observed by Dr. Palmer and by our collectors in 1897, as evidenced by specimens.

Perityle incana, Gray.

This fine species was in full flower. Abundant in southern part of island.

Perityle Grayi, Rose.

In flower and frequent in the canyon above the northeast landing. (This is the *P. Emory* of Watson's and *P. Californica* of Greene's list.)

Centaurea Melitensis. L. Napa thistle.

Along the trail near north end. Collected also by Dr. Palmer in 1889.

Sonchus oleraceus, L. Sow thistle.

Gilia Nevinii, Gray.

In fruit. (The *Gilia multicaulis millefolia*, Gray of Watson's list.)

Phacelia floribunda, Greene.

In fruit and flower. Canyon at the north end.

Krynitzkia maritima, Greene.

Wrongly referred in Watson's report on Palmer's collection of 1875 to *Eritrichium angustifolium* Torr.; included later by Gray under his *K. ramosissima*, from which it was separated by Greene. Bull. Cal. Acad. 2:204.

Mirabilis Californica, Gray.

Chenopodium murale, L.

Atriplex Palmeri, Gray.

In fruit. In the central valley at south end.

Cypressus Guadalupensis, Watson. Guadalupe cypress.

Excellent young flowers and fruits. Its time of flowering must therefore be much later than *C. macrocarpa*, the Monterey cypress, with which Dr. Masters has been inclined to unite it. The bark on sections of limbs 6 inches in diameter scales off in irregular flakes, suggesting the *Platanus*, and photographs of the native groves show a broad, round head in isolated trees. The stringy bark and spire top of *C. macrocarpa* are well known. Moreover, the seeds in the latter are nearly twice as many and often only half as large as in *C. Guadalupensis*.

Pinus insignis, Dougl. var. **Binata**. Engelm. Guadalupe pine.

Few, not more than fifty, on the northeast ridge.

Phyllospadix Torreyi, Wats. Sea grass.

Scarce, near the west anchorage and the south anchorage. Only a single flowering branch was obtained and no fruit. The leaves and spadix are more attenuated than in the California plant, but the inflorescence and abundant root-stocks and leaves are of similar habit. Not reported so far South elsewhere.

Brodiaea capitata, Benth.

Bulbs of what is apparently this species were obtained.

Erythæa edulis, Watson. Guadalupe palm.

Prof. R. L. Green obtained photographs of this beautiful island palm and observed it in three canyons opening the central valley above the south anchorage, in one canyon on the west side, and on the northeast side. Fifty or more trees in each canyon.

Polypogon monspeliensis, Desf.

Common about the springs.

Hordeum murinum, L. Wild barley grass.

Abundant over the island, especially in the more fertile northern part.


North Point
Abandoned Barracks
4035
Steamer Pt.
Rock
West Anchorage
Sunken Rk.
South Bluff
SKETCH OF
GUADALUPE ISLAND
WEST COAST OF LOWER CALIFORNIA
By the Officers of the U. S. Coast Survey Str. Gedney
Lieut. Comdr. A. P. Osborn U. S. Navy Commanding
JUNE 1897.
Heights in feet
250 feet Curves
(sgd.) A. P. Osborn
Nautical Miles

XI.—OBSERVATIONS DURING A CRUISE ON THE DORA SIEWERD, AUGUST-SEPTEMBER, 1895.[1]

By A. B. Alexander.

Pursuant to instructions from the Hon. Marshall McDonald, United States Commissioner of Fish and Fisheries, to secure passage on a pelagic sealing vessel for the purpose of making a cruise in Bering Sea, with the object of gathering information concerning the pelagic habits of fur seals, the methods employed for their capture at sea, their food, the proportion of each sex represented in the catch, etc., I left the *Albatross* at Unalaska, the middle of July, 1895, to await the arrival of the sealing fleet. Subsequently accommodations were obtained, through the kindness of Capt. H. F. Siewerd, on his vessel, the *Dora Siewerd*, a schooner of 100 tons register, and one of the largest in the fleet. She carried 18 canoes and 2 boats, and a crew of 36 Indians and 9 white men. As two Indians go in a canoe, the spearsmen and boat steerers were equally divided.

The writer went on board the *Siewerd* in the evening of July 27, but owing to stormy weather she did not sail until the morning of the 31st, getting under way in company with 27 other sealing vessels. The wind being light we were obliged to anchor off Ulakhta Head. Hand lines were put over here and fishing carried on for two hours, resulting in the capture of 22 cod and 4 halibut.

Early in the afternoon, with a light wind from the eastward, we worked toward Cape Cheerful, which, the next morning (August 1), bore southeast 25 miles, the fleet by this time being considerably scattered. At 9 a. m. 2 sleeping seals were observed, and shortly afterwards the vessel was hove to and the canoes put over. Each hunter among the Indians was anxious to secure the first skin, a superstition prevailing that he who kills the first skin at the beginning of a cruise will be attended with good luck during the remainder of the season. No time was lost in getting the canoes in the water, as a number of other vessels in sight had already lowered their boats. After the canoes had gotten about 2 miles ahead, the vessel followed in their wake; and as the day was clear they could be seen for a long distance. Occasionally a sail would be seen to lower, which indicated that the canoes were among seals.

Before entering into a discussion of the details of my observations it may be well to state that the positions of each day's catch will be found in appended Table No. 1,[2] the same corresponding with those given in the vessel's official log. The noon position each day is shown in Table No. 2,[2] in which is also recorded the direction and

[1] Reprinted from Seal Life, Pt. II, Senate Doc. 137, 1895. [2] Here omitted.

force of the wind, the barometer reading, and the temperature of the air and water. The temperature of the water was taken 5 feet below the surface. The material found in the stomachs of seals has been labeled with reference to the noon position.

In the afternoon we passed numerous patches of seaweed and kelp. In a few instances seals were seen with their heads and flippers thrust up through this floating material. Occasionally they would dive and swim a short distance, soon returning to the surface, however, rolling over and over in the tangled seaweed, but sometimes stopping in their play on the alert for danger. When on sealing ground, hunters always carefully inspect floating seaweed, and, as a rule, if there are seals about, they are almost sure of finding one or more in each large patch. Late in the afternoon we passed close to such a patch, covering a considerable area, in which 6 seals were playing. They paid no attention to the vessel, although within 100 yards of them. A hunter with a shotgun could have captured 2 or 3 of the number, and an Indian with a spear would have secured at least 2.

At 5 p. m. the canoes returned with a catch of 42 seals. Three of the males were about 5 years old, all the others of both sexes being from 2 to 4 years old. Their stomachs were nearly all empty, a few containing some material, which, however, was too much decomposed to be identified. The hunters reported seeing but few seals asleep, and these appeared uneasy. Most of those observed awake were finning. No great body of seals had been noticed, and in such pleasant weather, if there had been many on the ground, 18 canoes and 2 boats could have picked up 100 or more. This number of boats, traveling, as they do, in a path from 10 to 15 miles wide, must necessarily see nearly every seal within that belt. The few seals seen traveling to-day were going toward the northwest.

The chief of the tribe reported hearing the discharge of firearms a short distance to windward of his canoe, but he could not tell to what vessel the boat belonged.

The next day, August 2, the boats were lowered at 7 a. m. The weather bid fair for a successful day's hunt, the wind being north-northwest and light, and the sea smooth. In the early part of the forenoon we jogged close to 3 seals playing. Frequently they would roll over several times, stop suddenly to scratch themselves, and stand upon their heads with their hind flippers about 2 feet out of water. They repeatedly performed this operation. When quite near them one of the seals lifted its head up, but the sight of the vessel caused no alarm. Having no boat to lower or spear to throw, a loud noise was made by shouting and beating upon a tin can. This did not have the effect of frightening them, but a light thump on the rail of the vessel caused them to dive instantly, and when next seen they were about 200 yards away. Pausing to look at the object which had frightened them, they then swam rapidly away in an easterly direction.

From the above it would appear that seals are ordinarily but little frightened by the presence of vessels, provided they are to leeward of them. Had we been on the windward side the seals would have taken alarm almost instantly, and would either have dived or swam rapidly away.

At 1 p. m. a heavy fog bank appeared in the northwest, and shortly afterwards the canoes and one boat returned. The other boat had evidently gone astray, but as the weather was smooth no great anxiety was entertained for her safety. Forty-five seals were brought on board, 26 being males and 19 females. All the females except 2 were with milk. Their stomachs were mostly empty.

Through the night the weather continued foggy. Early the next morning, August 3, a sharp lookout was kept for the missing boat, and also for seals. No attempt had been made to lower the canoes although the sea was comparatively smooth. The light fog which hung over the water, in connection with the fact of the missing boat, caused the Indians to hang back. At 7 a. m. a sleeping seal was observed under our lee close aboard, but not in a position to detect us by the sense of smell. A canoe was soon launched and started in pursuit, but the short choppy sea made it somewhat difficult to capture it. In calm weather, or at times when there is only a light wind stirring, a canoe in approaching a seal is generally paddled directly from the leeward, but in a choppy sea, such as prevailed on this occasion, an Indian always approaches side to the wind, which brings the canoe in the trough of the sea and prevents it from making any noise that would disturb the "sleeper."

About noon the missing boat returned, bringing the skins of 2 seals, 1 male and 1 female.

At 1 p. m. another sleeping seal was observed close under our lee. In ninety-nine cases out of a hundred a sleeping seal will awaken when a vessel is close to it to windward, but not so with this individual, for it slept on wholly unconscious of danger and was easily captured. At this time the weather showed signs of clearing, and soon afterwards the canoes were lowered. The vessel continued jogging to the westward under sealing canvas. One vessel was in sight. Three hours later the canoes began to return, the wind having increased in force, accompanied by a choppy sea, which prevented seals from sleeping. They were reported scarce, and the few taken bore out this statement. The day's hunt amounted to only 13 skins, 6 males and 7 females. Four of the females were with milk. Two of the males were quite large, about 5 years of age or over, the others from 3 to 4 years. Very few seals had been observed from the canoes, and those noticed awake were traveling to the southwest.

In the morning of August 4 the weather was foggy and the wind northwest and moderate. White hunters would not have hesitated about going out in this kind of weather, but the Indians indulged in considerable unnecessary talk and paid no attention to a few scattering, sleeping seals that were observed among patches of seaweed. It was only when an occasional glimpse of the sky was seen through the clouds and fog and indications of good weather were plainly visible that the Indians showed a disposition to hunt. At 10 o'clock all the boats went out. At the time of lowering two other sealing vessels were in sight. During the absence of the canoes no seals were observed from the vessel, although floating seaweed was plentiful.

The canoes returned early in the afternoon, on account of a heavy fog bank which suddenly shut down. Only 16 seals had been taken, 8 males and 8 females. Their stomachs were entirely empty, which would seem to indicate a scarcity of surface fish in this locality. One of the hunters spoke the schooner *Annie C. Moore*, which reported having taken 65 seals, a comparatively poor catch, considering that the weather had been fairly good.

The following day (August 5) the weather was not suitable for sealing, owing to fog and mist most of the time. The wind was from the west-southwest to east-southeast, gradually increasing from a gentle to a fresh breeze, accompanied by a sea sufficiently choppy to prevent seals from sleeping. One "sleeper," however, was observed from the vessel and captured.

On stormy days a lookout is kept by the hunters, and the one who first sees a seal is entitled to stand in the bow of the canoe as spearsman. At such times three men go in a canoe, the weather usually being too rough for one man to manage it. No selection of canoe is made, the most handy one being used, and also the first spear that can be gotten hold of.

In the afternoon we stood to the east-southeast 18 miles and during the night to the south by west 17 miles, sighting Unalaska Island on the morning of the 6th. The weather was stormy and blowing a moderate gale from southeast, with falling barometer. The noon observation placed us in latitude 55° 01′ north, longitude 168° 07′ west, which showed that we had been in a strong southerly current for the past twenty-four hours. Later in the day we ran 19 miles on a northwest course and hove to on the port tack under a two-reefed foresail and fore-staysail and trysail. In the evening we passed close to the schooner *San Jose*. During the night the wind hauled to the southwest and decreased in force to a very fresh breeze. At times during the following day the sea was very rough, not wholly due to the wind, but caused by a strong current running to the southward. At noon the fog and clouds cleared enough to enable us to get an observation—latitude 54° 56′ north, longitude 167° 27′ west. In the afternoon we stood to the northward at a rate sufficient to offset the effect of the current. Late in the day we spoke the schooner *Walter L. Rich*, which had taken only 65 seals. She had been cruising to the westward of our present position, near the 60-mile zone, and while in that region had seen but few seals.

Toward evening two young seals played about the vessel for some time. They were enticed quite near by whistling, but not close enough to spear. It is only rarely that seals are speared from the deck of a vessel. The young will often approach very near and play about, sometimes for an hour or more, but keeping out of reach. Occasionally, however, their curiosity overcomes their customary prudence, and at such times they are generally captured.

In the morning of August 8 there were indications of clearing weather, with rising barometer and an occasional clear spot in the sky. A dozen or more seals in bands of three and four were noticed, causing considerable commotion among the Indians. A week of the sealing season had already passed and only a few seals had been captured, in consequence of which the Indians were becoming restless. At 8 a. m. wore ship and shook the reef out of the foresail, but in a short time the fog again settled down and remained so for the remainder of the day.

In the afternoon we saw quite a large number of seals, more than at any time since entering the sea. They were not moving in any particular direction. Orcas or killer whales were plentiful, and kept close to the seals, but they did not have the effect of driving them from the ground. The sealers claim that the orcas destroy large numbers of seals annually, especially in and about the numerous passes through the Aleutian Islands and off the coast of Japan. Many hunters say that when out in their boats it is not an unfrequent occurrence to see orcas devour seals. One hunter on board of the *Seward* informed me that on two occasions, off the Japan coast, orcas attempted to take the seals that he had shot. During the afternoon we saw five other of the sealing vessels.

On August 9 the canoes were put over for the first time in five days. The white hunters made a start at 9 a. m., the weather having moderated, and being prompted so to do by the sight of a sleeping seal. The Indian hunters held back for a time, but several other seals being observed, the remaining canoes were lowered. During most of the time while the hunters were absent numerous birds and whales and several porpoises were observed about the vessel. Early in the afternoon the wind began to increase in force and the canoes to return. By 4 o'clock they were all on board, having secured 20 seals, of which 13 were males and 7 females. The stomachs were nearly all empty, a piece of squid being taken from one and a few fish bones from another. One of the females had lost a hind flipper and shot were found in two of the skins. One of the seals represented by these skins had been recently wounded, the other probably some time early in the spring, the shot being found encysted. All females were in milk; the males were all young bachelors.

Two vessels, the *F. M. Smith* and *Saucy Lass*, were in sight at the time the canoes returned. The captain of the former came on board and reported having taken 105 skins. He also said that the schooner *Triumph* had obtained 283; *Maud S.*, 240; *C. D. Rand*, 100, and the *Saucy Lass* between 60 and 70.

On the following morning (August 10) the weather was cloudy and cool. At 7 o'clock the canoes and boats started out. At the time of their going the sea was long and rolling and the temperature of the water 2 degrees below that of the air. When the air is a great deal colder than the water experienced hunters do not as a rule expect to find many sleeping seals. They state, however, that there are exceptions to this rule, but in most cases extra cold air makes them restless and very difficult to approach within spearing distance; but with shotguns they may when in this condition be killed with comparative ease.

In the middle of the forenoon two vessels were sighted. Only one seal was noticed from the vessel. This individual was "mooching," a term used by the hunters to indicate swimming at the surface of the water with only a very small portion of the body exposed, occasionally thrusting the head out far enough to breathe. Seals frequently swim this way on raw, cold days, when they may readily be shot with guns, but are not easily approached with spears.

At 2 p. m. the Indians began to return, much earlier than they should have done, having lost patience and become discouraged. They lack the persistence and judgment of the white hunters, and will give up the chase on the slightest pretext. The latter, on the contrary, will remain out as long as a chance remains of adding another skin to their catch. One hunter, however, had secured 14 seals, the largest catch of any one canoe since entering the sea. The total number of seals in the day's catch was 73, 18 being males and 55 females. Their stomachs, like those previously examined, contained but little food; only a few pieces of fish and fish bones were found. In one of the canoes 3 female seals had been skinned; of those brought on board 3 were without milk. When asked if the seals skinned in the canoe were in milk, the Indians said they had not noticed. If the condition of the seals had been observed the same answer would have been given, for as soon as these Indians learn that certain information is wanted they are very reticent, and but little dependence can be placed in what they do say. Seemingly, they have been taught to look with suspicion on every person in search of sealing data.

The canoes that went to the northwest of the vessel were more successful than those that went in other directions, and the one that brought in the 14 seals hunted about 6 miles to the northwest of all the other canoes in that locality. A great many traveling seals were observed, all bound to the northward. Nearly all information concerning the direction in which seals were traveling was obtained from the white hunters. Indians, as a rule, pay but little attention to traveling seals, generally attempting to capture only those that are asleep, but sometimes they will endeavor to spear them when rolling and finning.

In two of the seals taken shot were found, the wounds being comparatively fresh—not more than a week old.

On August 11 the canoes and boats went out at 5 o'clock, light wind and cloudy weather prevailing all day. In the afternoon sleeping seals, two and three in a bunch, were frequently observed from the vessel. Whales were plentiful from sunrise until dark. The smoke of a revenue cutter could be noticed to the southwest all the morning, the sight of which caused our canoes to hover much nearer the vessel than usual, the Indians having a dread of all Government vessels. At 10 a. m. a canoe belonging to the schooner *Triumph* came alongside with 5 seals. Our canoes began to return at 5.30 p. m. and continued to come in until 7 o'clock, when the last one arrived. The largest catch was 10 skins, and one canoe obtained nothing. Sleeping seals were reported in small bunches from 1 to 2 miles apart. The hunters who happened to be near these bunches did fairly well, but a few miles to the southwest only few seals were found. Traveling seals were also plentiful among the bunches. Considering the fine weather prevailing and the number of seals observed from the vessel, the catch was comparatively small, only 89 having been taken—10 males and 79 females. Sixty-five of this number were examined. The stomachs in 49 were empty, 13 contained liquid matter, and 7 material which it would be possible to identify; the latter was preserved. A large number of canoes hunting on the same ground tends to destroy the chances of a good catch by any of them. Canoes from other vessels were in close proximity to ours and none of them did well. This day's catch was made 12 miles north and 9 miles west from that of the day before.

On August 12 the hunters made an early start, the weather being cloudy and cool, the wind from the westward and light; sea smooth; temperature of air and water the same. Later in the forenoon a heavy fog bank threatened to envelop us, and shortly after noon it came in thick, causing all the canoes to return, having obtained only 15 seals.

On August 13 the weather was unsuitable for sealing, being cloudy and threatening; the wind fresh from the southwest and west-southwest. In the morning we were in company with the schooners *Triumph* and *Sapphire*, of Victoria, the former having taken 500 skins and the latter 450 skins. Captain Siewerd and the writer went on board of the *Sapphire*. It had been noticed that the water about us was very dark in color, much darker than usual, and it had also been observed that in localities where we had taken the most seals the water had been the most discolored. Captain Siewerd had on more than one occasion noticed that seals frequent water of this character in considerable numbers, and had noted the fact in his log. Captain Cox, of the *Triumph*, stated that when in Bering Sea last year he got most of his catch in this locality, namely, latitude 54° 56′ north, longitude 168° 15′ west. He found seals at the commencement of the voyage in water very much discolored, and he endeavored to keep in such water as much as possible. This experiment resulted in his averaging 126 seals for each time the canoes were lowered during the month of August, 1894. On the strength of meeting with such good success, he has been cruising this season on the same ground, and is now more convinced than ever that seal life is more abundant in discolored water than in clear water. Captain Cox attributed the poor catch of seals on August 11 to the great number of canoes roaming over a comparatively small area. On the day mentioned the *Sapphire* took only 68 seals and the *Triumph* 73. A few days before a large bull seal was captured by the *Sapphire* with two spears embedded in its body.

On the forenoon of the next day (August 14) the weather did not bid fair for sealing, the sea being choppy and the wind fresh from the west-southwest. No seal life was observed until the middle of the day, when one seal was noticed asleep not far from the vessel, and so soundly that the flapping of the canvas did not disturb it. It was captured. Its stomach was empty.

At 12.15 p. m. the weather began to show signs of moderating, and soon afterwards the canoes were lowered in latitude 55° 3′ north, longitude 167° 45′ west, where a number of seals were observed playing. The good weather was of short duration, however, the canoes returning by 3.15 p. m., a heavy fog having settled over the water. The white hunters did not come in until nearly dark, thus showing the difference between the two classes. The fog lifted in about an hour after the Indians returned, but they could not be induced to go out again. In several instances where Indians have become discouraged and wanted to return home, they have, in order to accomplish their purpose, broken their spears and smashed their canoes, thereby breaking up the voyage. Previous to about two years ago there was no law in British Columbia regulating the conduct of Indian hunters on sealing vessels, and the result was that every possible advantage was taken of the situation. Under the law recently passed Indians are now held accountable as much as white men for the success of the voyage.

The boats containing the white hunters brought back 4 seals, making the total number for the day 30, of which 14 were males and 16 females. The females were all adults, and with milk; the males were small, from 3 to 4 years old. Only three stomachs contained food. In one young male's stomach was found a number of squid beaks; in the stomach of a female, a piece of squid; and in another, material resembling partly digested crustaceans.

The water through which we had passed was considerably discolored, and the few seals taken were captured where crustaceans were the most abundant. In the evening large flocks of guillemots, petrels, and auks were noticed, apparently feeding. No small fish being noticed, it was supposed that the birds were feeding on minute surface life.

On August 15 the weather was very pleasant, only light airs disturbing the water, and a finer day for sealing could not be desired. By 5 a. m. all the boats had left the vessel, not returning until about the same hour in the evening. A considerable number of sleeping and traveling seals were in sight most of the day. Those that were traveling were not, so far as was observed, going in any one direction. Sometimes a bunch of two or three would suddenly start toward the southeast, swim rapidly for a few minutes, stop, and go in an opposite direction. Frequently four or five would make a complete circle around the vessel at a distance of a quarter of a mile. In a few instances young seals came and played about, diving and swimming, etc.

An abundance of seals was seen from the vessel, but, as they occur in bands more or less widely separated, it was not certain that the canoes and small boats would get among them. All through the day whales and birds were numerous and the water was very much discolored, signs now looked upon as favorable indications for a successful day's hunt.

At 4 p. m. the boats began to return, and by 6 o'clock they had all arrived except one. The day proved fairly successful, 99 seals having been taken—31 males and 68 females. Nine was the highest catch and 1 the lowest by a single boat or canoe. They were by far the largest seals yet obtained, only 8 of the females being under 3 years of age. All of the stomachs were examined, but only 10 of the number contained food—some a small amount of liquid matter and others Alaskan pollock and what appeared to be pieces of cod.

In the evening the wind began to freshen from the east-southeast, and later the stars were visible for the first time since we had entered the sea. All through the night the wind was fresh, causing a choppy sea by morning. During this time we had worked 20 miles to the westward. A sharp lookout had been kept for the missing canoe, and a torchlight was displayed at frequent intervals.

No boats were lowered during the day, the conditions being unfavorable. The wind did not blow hard at any time, but was strong enough to prevent the seals from sleeping. In the afternoon we spoke the schooner *Louis Olsen*, which had taken 30 seals the day before. At 4 p. m. we attempted to sound in latitude 55° 15′ north, longitude 168° west, but got no bottom, although we were close to the edge of the bank. Just before dark a young seal came alongside and began to play about the vessel, first on one side and then on the other, affording great amusement to the Indians. After a good many wild throws it was captured and proved to be a female.

On August 17 a fairly good day's work was accomplished. Light airs prevailed from southeast and east-southeast, with frequent calms. Light fog and showers occurred several times during the day, but they were not heavy enough to prevent seals from sleeping. Early in the morning a young seal came alongside and was taken. At 6 a. m. all the canoes were lowered; after their departure no seals were seen from the vessel. Early in the afternoon a canoe belonging to the schooner *San Jose* boarded us and reported that vessel as having 530 skins. At 7.30 p. m. our hunters returned, bringing 85 seals—28 males and 57 females. All of the females were exceptionally large; the males were all young bachelors from 4 to 5 years old. A careful examination was made of the stomachs, only 6 of which contained food. In one stomach was found small pieces of squid; in the others small bones and pieces of fish. The catch to-day was not very evenly distributed among the boats, the highest bringing in 14 and four 1 each.

On August 18 the wind was from the southeast by south to south-southwest, decreasing from a stiff to a gentle breeze. The sea was choppy in the morning, and a long rolling swell prevailed in the afternoon. The weather was foggy and variable, all of which conditions were unfavorable for sealing. At noon there were signs of clearing up, and shortly after that the canoes were lowered in latitude 55° 51′ north, longitude 168° 32′ west. The Indians had no great desire to go out, and probably would not have ventured had it not been that the schooner *Willard Ainsworth* was a short distance away and had already lowered her boats. Five other vessels were also in sight. At the end of three hours the hunters returned, having secured only 2 seals—1 male and 1 female. Very few seals had been seen, the only "sleepers" being the 2 that were captured. The others were traveling in various directions.

The next day, August 19, rain prevented seals from sleeping. At 8 a. m. the canoes were lowered, but the weather did not give promise of satisfactory results, even in case seals were plentiful. The canoes remained out only two hours, returning with 2 males and 2 females. Their stomachs, like those of yesterday, were empty. The mate of our vessel while absent had boarded the schooner *Florence M. Smith*, and learned that she had taken 546 seals. On the 15th she secured 160 seals; her position on that day having been not far from where we hunted—latitude 55° 08′ north, longitude 167° 40′ west. He was also told that our canoe which went astray on the 15th had taken 12 seals, making our total catch for that day 111 skins.

Shortly after the boats returned a sleeping seal was observed close aboard, and although it was raining hard it slept on, wholly unmindful of the weather. Such an occurrence is very unusual, for it is seldom that seals rest well while it is raining, unless they have become thoroughly exhausted by a long spell of rough weather. Later in the afternoon a few traveling seals were seen; they frequently changed their course, but the general direction of their movements was northwesterly. We had been in discolored water all day, but late in the afternoon we suddenly jogged out of it into clear water. The noon observation, latitude 54° 56′ north, longitude 168° west, indicated that we were in a strong south-southwest current.

On August 20 a very satisfactory catch was made, the wind being a light breeze from the westward, and the sea smooth. A light fog hung low over the water at times, occasionally clearing for the space of half to three-quarters of an hour, which enabled the hunters to keep track of the vessel. The boats were lowered at 4.30 a. m., at which time seven other sealing vessels were in sight. During the afternoon we frequently saw canoes lower their sails, indicating that they were among seals. We could not tell to which vessel they belonged, as both boats and vessels were well mixed up together.

One canoe returned early in the afternoon with 11 skins, and by 7 p. m. 111 seals had been landed on deck, 44 being males and 67 females. Sixty-two of the latter were nursing females. All the males were from 4 to 5 years old except 2, which were about 6 years old. Squid and pollock made up the bulk of the food found in their stomachs, a few being gorged with it. In proportion to the number of seals taken, however, only a few contained food. The squid and pollock were in a comparatively fresh state. From the stomach of one male an eelpout was taken.

It is a fact worth mentioning that all the seals taken by us to-day were found in "streaks" of discolored water from 1 to 3 miles wide, and extending nearly in a north and south direction. The character of the water could hardly be accounted for by our close proximity to the bank, for if such had been the case it would have been the same all over. It had previously been noticed that these discolored bands ran parallel to each other in northeast and southwest or northwest and southeast directions. Water in this condition would not ordinarily be noticed from the deck of a steamer unless on the lookout for it. The mate reported seeing an abundance of Alaskan pollock jumping and many traveling seals in pursuit of them.

Most of the seals taken to-day were captured asleep, only four having been awake when speared. The latter were "mooching."

In and about the neck of a male seal were found several shot wounds, with blood oozing from them. Another seal had a bullet hole close to its right forward flipper.

On the morning of August 21 there was every indication of favorable sealing weather. The sky was dark and cloudy, but the wind was light and the sea smooth. The Indians went out at an early hour. Not long after their departure we spoke the schooner *Agnes McDonald*, which had picked up our hunters who went astray on the 15th. The *McDonald* reported having 900 skins. Her white and Indian hunters were equally divided as to numbers, and the former had taken between 40 and 50 more seals than the latter.

The Indians of the Northwest coast have always been of the opinion that white men could never become expert in the use of the spear, and this spring they ridiculed the idea when told that white hunters were to be employed on a few vessels. If white men will only exercise the same patience when hunting with spears as with shotguns, they will soon become as proficient in its use as the Indians. Such a result would be greatly to the advantage of captains and vessel owners, as the Indians have had the opportunity heretofore of dictating their own terms.

At noon a heavy fog settled down, causing the boats to return; but fairly good results were obtained, 69 seals being taken—12 males and 57 females. The males were small, ranging in age from 2 to 4 years. Forty-eight of the females were exceptionally large, 4 medium in size, and 2 about 2 years old. The first mentioned were all with milk, the others without. An examination of their stomach showed that they had been feeding largely on squid, Alaskan pollock, and salmon, a considerable amount of which could not have been in their stomachs more than a short time, as it was very fresh in appearance.

The mate reported seeing, while hunting, a small school of squid, but observed no seals among them. The other white hunters noticed numerous small fish jumping, and frequently seals in pursuit of them. The fish could not be approached near enough to determine their species.

At the time of lowering the canoes a dead whale was seen to windward, about 1½ miles distant. We kept in sight of it all day. In the evening, after the work of skinning had been finished, a party of Indians went to it and brought back a quantity of blubber. The head had been cut off. Numerous birds were hovering over the carcass and many were feeding on it, but no seals were noticed near at hand.

On August 22 the boats were lowered at an early hour, the weather being similar to that of the day before, with light and gentle winds from the westward. At the time of lowering four other vessels were in sight, directly to windward. This, of course, placed our boats in a bad position, as a windward berth is superior to all others. When following in the wake of other boats only poor results are to be expected, as the windward hunters disturb the sleeping seals.

At noon a hunter on the *Agnes McDonald*, who came on board, reported his vessel as having 920 skins, the highest catch for one day having been 253, and the next highest 180. The 253 seals were taken on the 15th, and not far from our position on that date. The hunter informed the writer that on the day before he speared a large male just as it came to the surface with a red rock-fish in its mouth. The fish was alive, and as it was not at all mutilated it was taken on board and cooked. He also stated that he speared a sleeping seal close to the floating carcass of a dead one. Indians claim that seals will not remain where carcasses are floating, but this is not always true, for on several occasions we had noticed seals among such objects.

At 4 p. m. a heavy fog set in, putting an end to further hunting for the day. Forty-four seals composed the catch, 12 being males and 32 females. The males were all young bachelors and all the females were in milk except 2. The stomachs of 33 were empty, 11 contained pieces of squid, salmon, pollock, and numerous fish bones.

In the evening we shaped our course to north-northeast, and during the night ran 25 miles in order to get near our position of the 21st. In the morning the weather was unfit for sealing, and as the day advanced the chances grew less favorable.

At 10 a. m. we sounded in 90 fathoms, the first time we had been on soundings since leaving Unalaska. At 4 p. m. our longitude by observation was 168° 05′ west, latitude at noon 55° 28′ north, near where the 69 seals had been taken on the 21st. In the evening we were boarded by officers from the revenue cutter *Rush*.

On August 24 the weather was too variable to entertain hopes of success at hunting. A heavy, wet fog in the morning, combined with a moderate breeze and choppy sea, prevented an early start. At 7.30 a. m. a slight clearing caused the canoes to be lowered. The signal gun was kept firing at short intervals until 10 o'clock, when the fog entirely cleared. The spell of good weather was of short duration, however, for at noon a squall from the north brought all the hunters back. In the short time that the boats were out 21 seals were taken. This was encouraging, for it indicated that we were on good sealing ground. Most of the seals captured were restless, few being sound asleep, or, in sealers' parlance, they did not "lay up" well. The mate came across two seals sleeping side by side, one of which was speared. Instead of the other one becoming alarmed and diving, as is usually the case, it remained near its struggling companion until the latter was hauled into the boat. The food found in the stomachs of the seals to-day did not vary much from that recorded in those previously examined in this locality, namely, squid, squid beaks, salmon, pollock, and fish bones. The males were comparatively large; the females were all adults and with milk.

During the night we stood to the westward 50 miles, and then hove to.

The weather on August 25 prevented sealing, being cold with a fresh breeze from north to north by east, accompanied by a rough sea. The vessel was hove to under sealing canvass. Excellent observations were taken, it being the first time the sun had remained out for any length of time since the cruise began. All day birds had been numerous, and occasionally a sleeping seal was observed; sometimes two and three were seen together. This, combined with the great number of birds, assured us that we were on good ground. We frequently wore ship in order to hold our position. In the evening rain squalls passed over.

On the morning of August 26, the wind and sea having subsided, the canoes were lowered in latitude 55° 15′ north, longitude 170° 53′ west. The weather was pleasant but cool, the air being 2 degrees colder than the water. This difference, according to the theory of many sealers, would cause seals to "lay low," or, to put it in clearer terms, they would sleep with less of their body exposed.

In view of the number of seals observed before the boats went out, a large catch was anticipated, nor were we disappointed, for in the evening when the last canoe had returned there were 157 seals on deck.

The opinions advanced to the effect that seals are more plentiful where birds occur seem to be entitled to consideration, and it is very probable that had we not heeded their presence yesterday, and had sailed by them, our catch to-day would not have been large. Our captain had become thoroughly convinced of the value of these signs after years of experience.

The canoes were all back at 6.30 p. m., having been absent over twelve hours. In the forenoon seals were inclined to be restless, but occasional warm rays of sun in the afternoon caused them to sleep soundly. It was noticed that a large portion of to-day's catch was speared either in the breast or back, close to the forward flippers, indicating that the seals slept soundly, with their bodies largely exposed, which gave the hunters an opportunity to strike the most vital part. Aside from the favorable condition of the weather, the absence of other vessels from the ground materially aided in increasing the day's catch.

In only 12 stomachs was food found which could be identified, the others being empty. In the full stomachs were observed squid, pollock, and one piece of salmon. Fifty of the 62 males were 4 to 5 years old, the other 12 about 3 years old. Ninety-two of the females were adults, and 2 under 3 years of age.

All through the night of the 26th and the morning of the 27th the weather was calm, or nearly so. At daybreak a light fog hung over the water; in the middle of the day it cleared away. On the strength of yesterday's success the hunters went out at an early hour. From the vessel scattering seals were observed all through the day. The water was very much discolored, and whales and porpoises were abundant, but there was a marked scarcity of birds as compared with yesterday. At noon a good observation of the sun was taken, which placed us in latitude 55° 10′ north, longitude 170° 47′ west.

At 4 p. m. the hunters began to return, and at 7.30 o'clock the last one had arrived. The catch nearly equaled that of yesterday, amounting to 146 seals, 68 being males and 78 females. It will be seen by this that there are times when the sexes are nearly equally distributed, but as a rule the majority of seals taken at sea are females. Sixty of the 146 seals were opened; food was taken from 6 males and 14 females, consisting of squid, pollock, and a small quantity of fishbones. The stomachs of the females opened contained a greater quantity of food than the males. Thus far, in the examination of stomachs, it had been noticed that those of the males contained much less material than the females.

Most of the males caught to-day were very young, 3 and 4 years old; the females were much larger. Seventy-four of the latter were in milk; those that were not were from 2 to 3 years old.

On the morning of August 28 the weather looked favorable for a repetition of the previous day's work. The hunters were well clear of the vessel at 5.30 o'clock, at which time another vessel and the smoke of a steamer could be seen low on the horizon. In the middle of the day a canoe belonging to the schooner *James G. Swan* came alongside and reported that vessel as having 860 skins. During the latter part of the day the weather became threatening. The barometer had been falling rapidly since noon, the wind had shifted from southwest to southeast, and no seals had been observed from the vessel. At 6 p. m. the hunters returned, bringing 57 seals. Two of the males were large, the others were all small.

As soon as the canoes and boats were hoisted in and secured for the night, a single reef was put in the foresail and a reefed trysail set, and preparations made for stormy weather. At dark the wind began to increase in force, and by midnight it was blowing a moderate gale, which continued until the following noon. Occasional heavy rain squalls passed over, which kept the sea down somewhat. In the evening two sleeping seals were noticed, which was unusual under the circumstances.

In the morning of August 30 the wind had again increased to a moderate gale, and since midnight had changed 2 points to the southward. The sea was very rough; weather clear and sunny.

At 10 a. m. wore ship and lay to on the starboard under close-reefed sails. Both in the forenoon and afternoon we saw scattering seals. They were seemingly not bound in any particular direction, and most of them were playing. One was observed asleep.

We had been in comparatively clear water all day, but late in the afternoon suddenly jogged into discolored water. At 5.30 p. m. the jib was set, and we stood on a southeast by south course, so as to give the 60-mile limit a wide berth, the wind and sea for the past twenty-four hours having carried us toward it. We worked to the south and west all night. In the morning of August 31 the wind and sea had gone down considerably, and one vessel was in sight. At noon we were in latitude 55° 11′ north, longitude 170° 05′ west. We spoke the schooner *Enterprise*, of Victoria, with 1,387 skins on board. She reported the schooner *Libbie*, with 1,040 skins, and the *Carlotta Cox*, with 600. The last-named vessel carried only 6 boats, and white hunters, which speaks well in their favor as seal hunters with spears.

Shortly after meridian we passed several sleeping seals, but the condition of the weather prevented the hunters from going out. About two hours later several more were seen, and at 4 p. m. we came across a bunch of "sleepers." At this time the weather showed signs of clearing, and 7 canoes were lowered, but they were out only a short time when the weather again became threatening. Eleven seals was the result of this short trial, 5 being males and 6 females. They were all very small and only one contained food. Four of the females were without milk.

Through the day we had been in markedly discolored water, and the other indications were favorable to the presence of a considerable body of seals on this ground, which turned out to be the fact, as proved by the results of the hunting on the following day.

The wind had been moderate all through the night, and in the morning of September 1 a light air was moving from the southwest, the sea being smooth. The sky was cloudy and the air cool, but as the day advanced it grew warmer. Whales could be heard blowing through the night, and at daylight a number were seen close by; also immense flocks of birds. At 5.30 a. m. the hunters started under very favorable conditions, the sea being smooth and nothing in the atmosphere indicative of a change. The wind being very light, the vessel remained in one position most of the day. Numerous seals were observed, both awake and asleep. The former were moving only slowly, seldom going over 100 yards, and spending most of the time in finning, rolling, and scratching themselves. In the afternoon we were boarded by the revenue cutter *Rush*. At 5.30 p. m. the canoes began to return, each one bringing a good catch, the largest amounting to 25 seals, the smallest to 11. The total catch was 336. This was a phenomenal day's work, affording the greatest number of seals ever taken in Bering Sea in one day, except that the schooner *Sapphire* in 1894 captured about 400 in the same length of time. There were 120 males and 216 females. The stomachs of those opened showed a remarkable scarcity of food. The material from 8 males and 10 females was all that was in suitable condition to identify, and consisted chiefly of squid, although pollock and what looked like cod made up a portion of the food preserved. Taking into consideration the amount of surface life observed from day to day, it has appeared remarkable that so few seals should have food in their stomachs.

To-day both Indian and white hunters reported numerous seals, finning, rolling, and asleep. In the early part of the day they were inclined to be restless, but in the afternoon the warm sun caused them to sleep soundly, and so plentiful were they that sometimes it was a hard matter to decide which one to spear first. Of course, where seals sleep so near together, those in close proximity to the one speared are liable to be disturbed, but there were enough others in the near vicinity to keep the hunters busy without paying much attention to the disturbed ones. They were reported as lying about like logs, as far as the eye could reach. The hunters claimed that in all their experience they had never before beheld anything like the sight presented. Small schools of squid, pollock, and other fish were plentiful. One of the white hunters reported seeing several Atka mackerel, and from the description given it is possible he was correct. The day had been a perfect one for sealing, and no other vessels were on the ground.

During the night we jogged to the southwest 14 miles. In the morning of September 2 the hunters were out at an early hour, weather being clear and pleasant, the sea smooth, and the wind light from northeast by north. At 10 a. m. two of the canoes returned, the hunters claiming that the air was too raw and chilly for the seals to sleep well, there being 2 degrees difference between the air and water. Only a few scattering seals had been seen, and they were rolling and finning. It was not long before all the canoes returned, bringing altogether 10 seals—6 males and 4 females. Three of the latter were nursing females. Their stomachs were comparatively empty, what little food they contained being of the same character as on the previous day, namely, squid.

At 4 p. m. an observation of the sun placed us in latitude 55° 22′ north, longitude 170° 36′ west. At this time we saw several patches of seaweed in which seals were finning and playing. We spoke the schooner *Enterprise* and learned that she had captured 236 seals on the 1st, about 12 miles south of our position. We were also informed that a number of other vessels had been very successful, which would indicate that the seals covered a considerable area on that day and were not wholly confined to our immediate vicinity.

September 3 was cold and cloudy, the wind being northeast and fresh, the sea short and choppy. A few "mooching" and finning seals were occasionally seen; no travelers were observed. At 5 p. m. we spoke the schooner *Ainoko*, which had taken 750 skins. For the past week she had been cruising in the vicinity of Akutan Pass, but had not found seals abundant enough to remain on that ground. Last season good catches were made there. She was now bound to the westward in search of a large body of seals which had been reported a few days previous by the revenue cutter *Grant.*

We continued to jog to the northward for about 20 miles and then hove to. All the afternoon scattering seals had been observed, most of them in our wake. They would follow the vessel for a half hour at a time, seemingly through curiosity. At times during the night seals could be heard playing around us. In the morning several bunches were noticed close by, a few playing, but the majority going in a northwesterly direction. In the early part of the day the barometer began to fall, the weather became threatening, with the wind east and sea rough. At 10 a. m. wore ship and jogged to the southeast under snug canvas, wind a moderate gale from the east-northeast. From daylight until dark more seal life had been observed from the vessel than at any previous time since entering Bering Sea. Our attention was especially attracted to the character of the water, which had the appearance of being filled with minute surface life. Birds were numerous, and an occasional whale was in sight.

During the next three days stormy weather prevailed, the wind being east-northeast and blowing from a moderate to a strong gale; the sea was heavy most of the time. On the morning of the 7th the wind had subsided to a moderate breeze. During this long spell of boisterous weather seals were frequently observed, some playing and others traveling in a southwesterly direction. Birds were plentiful most of the time. At noon on the 7th we were in latitude 56° 22′ north, longitude 171° 50′ west, and it was quite evident that we had encountered a strong northwesterly current. At 8 p. m. wore ship and stood to the southeast so as to give the 60-mile zone a wide berth. A vessel cruising near this line without getting an observation for several days, and having no means of knowing the direction of the current, is very apt to be from 30 to 40 miles out in her reckoning.

At 6 a. m. on September 8 the hunters were making preparations to lower, the sea being smooth and a light breeze blowing from the eastward; the weather was cloudy. At 10 a. m. the hunt was interrupted by a heavy, damp fog. Ten seals had been obtained—7 males and 3 females. Five of the former were between 4 and 5 years old; the other two were very small, about 1 year old; the females were all nursing cows. The stomachs of these seals were nearly all empty. Only a few of the hunters saw seals, and according to appearances there were but few in this locality. Two of the boats rowed and sailed fully 15 miles each without encountering a single one. Fish and other surface life were correspondingly scarce. As our position—latitude 56° 35′ north, longitude 172° 20′ west—placed us very near the bank, the scarcity of seals was surprising.

While a number of the canoes were waiting alongside to be hoisted on board a small seal came up in our wake, apparently attracted by the blasts of the fog horn and remaining unconscious of danger until one of the canoes had closely approached it and the spear had been poised for striking. It was captured.

At 3 p. m. we made all sail and stood to the southeast. Shortly after this the fog lifted for a short time and an observation of the sun was taken, placing us in latitude 56° 32′ north, longitude 172° 45′ west.

The next morning we had made 50 miles in a southeast direction; the weather was pleasant, the sea smooth, and the sky periodically clear. A few seals were noticed early in the day. At 9 a. m. the presence of 3 seals, supposed to be sleeping, prompted two hunters to launch their canoes, but they dived just as the spears were being thrown. The appearance of seals, however, acted as an incentive for all the canoes to go out, but they soon returned in consequence of fog. Nine seals only were obtained, 4 being males and 5 females. Although fish were reported jumping, nothing was found in the stomachs of these specimens.

In the night we had worked to the east-southeast, and in the morning we were in latitude 55° 50′ north, longitude 171° 49′ west. At 5 a. m. a sleeping seal was speared close to the vessel; its stomach was well filled with food, consisting apparently of Alaskan pollock. At this hour the weather was very foggy and the Indians were not inclined to start. Presently, however, the fog lifted somewhat and several more seals were seen. A signal gun could now be heard, indicating that a sealing vessel was near and that her boats were out. This circumstance stimulated the hunters to action, and in a short time the canoes were hoisted out. As the fog cleared, birds, whales, and porpoises could be seen to the northwest, and also flocks of petrel on the water close by. The season being now well advanced, the hunters were expected to take advantage of every opportunity, and, moreover, on the strength of their previous good success, they were quite eager to add a few more skins to the number on board. The weather could no longer be trusted for any length of time, and that proved to be the case on this day. At 11 a. m. the fog became so dense that the captain was as anxious to get the hunters back as they were to return. Seventeen seals composed the catch, 5 being males and 12 females. Eleven of the females were nursing cows, and the males were all young. One canoe obtained 5 of the number, all of which were asleep and separated just far enough so the noise made in capturing one did not disturb the others. A considerable number of "rollers" and "finners" was noticed, but the damp fog seemed to prevent them from sleeping. Had the day been warm it is probable that a good catch would have been secured.

In proportion to the number of seals taken, a greater amount of food was found in their stomachs than on any previous occasion. Squid and pollock, mixed with crustaceans, composed the greater part of the material identified. Squid beaks were very conspicuous in every stomach in which food was found. As in previous cases the stomachs of the females were much better filled than those of the males.

The second mate while out hunting had boarded the schooner *Triumph*, whose gun had been heard earlier in the day. She reported having 1,800 skins. The day before she took 20 skins 30 miles to the eastward of our present position. For the past few days she had been gradually working to the westward, but only a few scattered seals had been noticed. To-day her hunters brought in 42 skins. Captain Cox expressed the opinion that if good weather should prevail for a few days encouraging results would follow, as there was every indication that seals were plentiful on this ground. The elements were against us, however, and for the next four days the weather was rough and boisterous.

On September 11 the wind blew a very fresh breeze, varying in direction from south by east to southwest, accompanied by a rough sea. No seals were seen, but many birds were about. During the night of the 11th and the morning of the 12th the wind increased in force and hauled to the westward. The sky was filled with heavy clouds, the air was raw and chilly. Occasionally we wore ship to hold our position. Scattering petrels and other sea birds were frequently seen, but only one seal was sighted during the day. At sundown the barometer began to rise. In the evening the sky cleared and the stars came out, but the sea continued heavy and was accompanied by a flying scud.

On September 13 the wind varied in force from a light to a stiff breeze, with changeable weather, rain, mist, fog, and rough sea, occasionally clearing. Birds were plentiful, one of which was seen to dive close to the vessel and bring up a fish about 10 inches long. In the afternoon 3 seals were observed sleeping side by side, the vessel almost running over them before they awoke. They must have been much exhausted from loss of sleep in the recent gale.

In the morning of September 14 the wind had again increased to a moderate gale. The weather was foggy and misty at times, with a heavy, rough, and tumbling sea.

Two seals were observed in the forenoon. Near noon we ran into an area of discolored water, in latitude 55° 20′ north, longitude 171° 25′ west, in which were a number of seals. Notwithstanding the very rough condition of the sea and the moderate gale prevailing, several of them were asleep. Their bodies were but little exposed, and it was only when we were quite near them that they could be made out. The gale finally broke, and in the morning of September 15 only a light variable air was moving. The sea had also gradually gone down with the wind. At 7.30 a. m. several seals were observed and the canoes were lowered. Two sleepers were captured a short distance from the vessel. At 11 a. m., however, a heavy fog and mist settled down, accompanied by a cold wind from the northwest, which had the effect of bringing back the hunters, all of whom were on board at 1.30 o'clock, having captured 24 seals—16 males and 8 females. Pieces of squid were found in the stomachs of some of them. Fourteen of the males were very small, and 2 between 4 and 5 years old. The females were larger, 5 being with milk. The hunters reported seeing a large number of seals rolling and finning.

Numerous birds and a great many whales were in sight all day. At noon we were in latitude 55° 10′ north, longitude 170° 06′ west, which was not far from the position where we had taken 157 seals on August 26 and 146 on August 27. The color of the water varied but little on these dates, the strips of discoloration also running in the same general direction. It would appear as though these bands of discolored water were governed chiefly by the currents, being but little affected by the wind. Late in the day the fog gave way to occasional rain squalls. Birds were exceedingly abundant, and we frequently sighted scattered seals, the most of which were playing. In the evening several hail squalls passed over, after which the sky cleared.

Preparations were made to lower the canoes on the following morning, but the work was interrupted by the sudden breezing up of the wind from the westward. In the afternoon the clear weather suddenly changed to mist and rain, with an occasional squall. Only 2 seals were seen, 1 asleep and the other playing. A canoe was lowered for the "sleeper," but it was lost sight of in the choppy sea. Whales and birds were plentiful all day, and in some places immense flocks of petrel were sitting on the water. They were evidently feeding on small marine organisms, for as soon as we had jogged past they would settle down in the same spot from where they had been frightened.

Early in the evening a sealing vessel passed to windward with her flag set, indicating that she was homeward bound. The sight of this vessel put the Indians in high glee, for the season was now getting late and they were anxious to go home.

On September 17 the weather was a repetition of that of the previous day. In the early part of the day we saw 9 seals circling around in various directions and occasionally rolling and finning. Observing this number of seals from the vessel with a choppy sea running was a good indication that under better conditions they would be found plentiful. At noon the weather showed signs of moderating, but the Indians could not be induced to venture out on account of a few squally looking clouds low on the horizon. At 2 p. m. two white hunters started out, but after a two hours' hunt they returned empty handed. Only 4 seals had been seen, 3 finning and 1 asleep. At the time the boat left the vessel the water was comparatively clear, but about 3 miles to the northwest it came into very much discolored water, in which birds were plentiful and a few fish were seen jumping.

Early in the following morning, September 18, the canoes were lowered, the wind being light from the southeast and the sea smooth. The barometer indicated no change, but in a short time the wind began to increase. No seals were observed either by the small boats or from the vessel during the day.

On September 19 the weather was similar to that of the previous day. Four seals were seen, 2 asleep, the others traveling to the north-northeast. The former did not awake until the swash of the water from our bow struck them. In the evening we headed for Unimak Pass. As the season was now late, it was thought inadvisable to remain longer in the sea. The condition for the last ten days had convinced the captain that little, if any, more sealing weather could be expected.

The next morning we sighted the schooner *San Jose*, which had made a catch of 600 skins. Her captain came on board and reported that until recently he had been hunting northwest of the Pribilof Islands. In that region seals were abundant, but the weather had been too stormy to operate. On September 13, in latitude 58° 30′ north, longitude 172° 30′ west, several hundred seals had been observed, but the sea was too rough for lowering the boats. In the latter part of August the *San Jose* had hunted near Unimak Pass, but few seals were found there.

At 10 a. m., the wind being light, 8 of the canoes were put over, but at 2 p. m. a dense fog settled down. Ten seals were secured, 4 males and 6 females. They were all small and their stomachs were empty. On this ground birds were plentiful and one orca was observed. At 2.45 p. m. we continued on our course, and at 6 p. m. Cape Cheerful bore abeam about 15 miles. The next day we were off the northern entrance of Unimak Pass, four other sealers being in sight. In the evening we cleared the southern entrance of the pass and shaped a course for Cape Flattery. On the morning of October 8 we anchored off Uclenet, an Indian village, situated on the north side of Barclay Sound, Vancouver Island, where most of our Indians belonged. We reached Victoria on October 8, having been twenty days on the passage home.

OBSERVING SEALS.

In sealing weather hunters do not wait until seals have been seen from the vessel before lowering the boats. They start out as early as possible and search for them, as otherwise the catch of the entire fleet would be small. Very often, when no seals are observed from the vessel's deck, the boats will be among bunches of them only a mile or two away, and, on the other hand, it sometimes happens that when scattered seals are noticed from the deck the boats may be cruising over barren ground. As a rule, however, the number observed from the vessel is small as compared with the number sighted from the boats. A vessel while jogging will naturally frighten a great many which lie in her path; the flapping of the canvas and the creaking and slatting of the booms arouse the sleepers long before they can be seen and give them ample time to escape. In the early days of pelagic sealing the boats used to be stationed at different distances and in different directions from the vessel and would drift, waiting for seals to come near. This method, however, proving unremunerative, it was given up, and the hunters began to cruise, which custom they have continued to follow ever since.

MANNER OF COUNTING THE SEXES.

Considerable controversy has arisen from the accounts rendered by the sealing captains regarding the proportion of male and female seals taken in the North Pacific Ocean and Bering Sea. Previous to the time when sealing vessels were required to enter the number of each sex taken in their official logs little thought was given to this question, and it was always claimed that the two sexes occurred in almost equal numbers. All sealers knew which sex predominated but clung to their original story, and there was no one who could controvert their assertions, although there was every reason to doubt them. An order from the United States Treasury Department requiring the catch of all American sealers to be examined on their arrival in port was the means of throwing considerable light on the subject, and the information gained from this source fully established the fact of the great preponderance of females.

It has generally been supposed by most sealers, and the view is still held by many, that if it were known that a greater number of females than males were taken it would greatly affect and possibly restrict their privileges when the time came for a readjustment of the pelagic regulations. The fact has generally been lost sight of that the condition of the rookeries at the end of five years will have the most weight in deciding the matter.

That pelagic sealers should pay little attention to the sexes of the seals taken was but natural, as they had no object in determining which sex predominated; the thought uppermost in their minds being to capture as many seals as possible.

No check is placed upon the official logs of the Canadian sealers by the custom-house officials at Victoria, who accept such records as authentic. If the skins landed at Victoria were subjected to the same rigid examination as those landed in United States ports, little or no difference would be found in the proportion of each sex represented in the catch by the vessels of the two countries. It seems strange that on several occasions when American and Canadian sealers have hunted on the same ground and in close proximity to each other, the catch of the former has always been composed largely of females and the latter of males. There are days when more males than females are taken, but such times are not frequent. It is only fair, however, to state that a number of both American and Canadian sealing captains have admitted the truth to the writer, and all United States hunters with whom he has conversed admit that the majority of seals captured off Japan and around the Commander Islands are females.

During the season of 1894 the schooner *Louis Olsen* kept an account of the seals taken off the coast of Japan, and it was found that out of 1,600 two-thirds were females. In 1895 the schooner *Brenda* obtained 896 seals on the same coast, fully two-thirds of which were also females, according to the statement of one of her hunters. In nearly every instance where the writer has spoken with hunters on this subject they have admitted that in all waters where the northern seal herd is found, with one exception, females largely predominate. This exception is the Fairweather ground, where, a few years previous to the beginning of the close season now in force, most of the pelagic sealing was carried on during the month of May. On this ground, as recorded by the writer in a previous report, is found a great number of large males, and, according to the statement of all sealers and of others, it is now quite well established that large breeding males frequent this ground in greater numbers than any other known region.

It may be well to illustrate briefly a few of the conditions under which the record of seals is kept. When seals are brought on board in small numbers it is very easy to identify the sex, but when they arrive in large quantities, a hundred or more, it requires considerable time to examine each one, and sealers have, to them, more important duties to attend to. If oftens happens that the hunters are forced to return on account of bad weather or an approaching storm, at which times the safety of the canoes and vessel is of more consequence than the determination of the character of the catch. When the boats and canoes are being hoisted in, the officers and men are stationed at either side of the vessel to do this work, as well as to keep the records, and, as is to be expected, in the bustle and excitement a very correct account of the sexes is not given In many cases the seals are not examined at all. By the time the last canoe is lashed on board the weather is rough and stormy and the hunters are anxious to go below; and if it be dark the seals will be left until morning for skinning. No further examination is made, and, right or wrong, the first account rendered is accepted. The fact of the matter is that in only a few cases is the sex correctly recorded.

Inaccuracies in this respect also result when the seals are skinned in the boats. Upon arrival at the vessel the skins are at once thrown into the hold without examination, and nobody knows or cares whether they are male or female.

Although United States revenue cutters have the privilege of boarding vessels and overhauling the catch made in Bering Sea, the conditions under which this work is carried on, however zealous the officers may be, render it difficult for the sexes to be separated, and they return to their ship little wiser than when they came.

CONDITIONS OF THE FEMALE SEALS TAKEN BY THE DORA SIEWERD.

Of the 982 female seals secured by this vessel, 882 were opened and examined by the writer. Of this number 839 were found to be adults, and 668 were clearly in milk. Many of the remaining 171 may also have been nursing females, which at the time of their capture had not obtained sufficient nourishment to cause their milk glands to fill.

SEALS MADE SHY BY HUNTING.

Inquiry was made of several captains and hunters as to whether seals were as easy to capture this year as last in Bering Sea. They all give it as their judgment that seals were more difficult to approach this season than in 1894. Captain Cox, of the schooner *Sapphire*, said he had noticed a marked difference in that respect, and attributed it to the hunting that had been carried on. In many cases they appeared to be unusually shy when there was no apparent cause for it.

FOOD OF SEALS.

The material which has been found in the stomachs of seals taken in different parts of Bering Sea indicates that only a small percentage is composed of fish which inhabit deep water. It is only reasonable to suppose, however, that when seals are in shallow water they feed both on bottom fish and on those swimming near the surface. A not uncommon component of their food is the red rockfish, which occurs both in deep and shallow water and possibly also near the surface at times, which would account for its being found in the stomachs of seals captured where the water is 100 fathoms or more deep.

On August 22, 1895, in latitude 55° 04′ north, longitude 168° 35′ west, the head of a macrurus was found in the stomach of a male seal. This group of fishes inhabits considerable depths, and much speculation arose as to how it had been obtained by the seal. It was subsequently learned, however, that the *Albatross* had been dredging in deep water near our position from the 18th to the 22d, and during that time there had been thrown overboard many rejected specimens, among which were a number of macruri, which would be apt to float for some time at or near the surface if not molested.

It has been claimed that seals will not eat dead fish, but this is a mistake, for the writer has seen them devour salmon that had been dead several days.

Surface fishes, and especially squid, seem to be the natural food of the seal. In the stomachs that have been examined a variety of material was found, such as pieces of Alaskan pollock, salmon, and other fishes, but it has also been observed that in localities where squid are plentiful very little other food may be looked for. I am informed by hunters that on the coast of Japan and off the Commander Islands squid occur in great abundance, and that it is not an uncommon sight to see a half dozen or more seals together feeding on the tentacles of octopus floating on the surface. Sealers usually find squid plentiful off the island of Kadiak, and in that locality they have often been found in large quantities in the stomachs of the seals.

WHITE HUNTERS AT A DISADVANTAGE.

The white hunters on the *Dora Siewerd* did not have the same opportunity ot getting seals as the Indians for several reasons, one of which was that, as a rule, they were the last to leave the vessel in the morning and the first to return at night. They were expected to hoist out all the canoes, and in the evening to hoist them in again, stow them away, and lash them. Indians are useless in this kind of work, and upon their arrival alongside their duties have ended, as the skinning of the seals devolves upon the steersmen.

The Indians, therefore, had every advantage in respect to hunting. On leaving a vessel the boats nearly always form a line so that each will have a clear space to windward. When all the boats start out together they are all on an equal footing; but when one or two boats, as was the case with our white hunters, are obliged to follow in the rear of others, their chance of seeing many seals is greatly lessened, for they are hunting in water already passed over, but the situation improves as the boats become more widely separated. Sometimes, also, a sudden change of wind favors the last boats to go out and places them to windward, a coveted position which they could not otherwise have secured, a windward position being always considered the best. In perfectly calm weather one position is as good as another.

Record of the position of the vessel and of the catch of fur seals each day by the sealing schooner Dora Siewerd during a cruise in Bering Sea in August and September, 1895, showing also the number of each sex taken daily as entered in the official log of the vessel.

1895.	Lat. N.	Long. W.	Males.	Females.	Total.	1895.	Lat. N.	Long. W.	Males.	Females.	Total.
	° ′	° ′					° ′	° ′			
Aug. 1	54 28	167 08	36	6	42	Aug. 22	55 06	168 38	20	24	44
2	54 41	167 51	26	19	45	24	55 26	168 30	10	11	21
3	54 43	167	7	6	13	26	55 15	171 55	74	83	157
4	54 37	167 20	8	8	16	27	55 08	171 45	68	78	146
9	54 42	167 43	14	6	20	28	55 06	170 43	28	29	57
10	54 58	167 31	18	55	73	31	55 02	170 10	5	6	11
11	55 10	167 40	29	60	89	Sept. 1	55 28	170 26	191	145	336
12	55 02	167 48	6	9	15	2	55 25	170 50	6	4	10
14	55 03	167 45	14	16	30	8	56 32	172 50	7	3	10
15	55 08	167 40	48	51	99	9	55 51	171 56	4	5	9
15			(a)	(a)	12	10	55 55	171 45	5	12	17
17	55 15	168 30	38	47	85	15	55 18	170 06	16	8	24
18	55 21	168 32	1	1	2	20	54 36	167 33	5	5	10
19	54 56	168	2	2	4						
20	55 15	168 15	44	67	111	Total			756	809	1,577
21	55 28	168 05	26	43	69						

a On August 15 a canoe went astray, but afterwards returned, bringing in 12 skins, of which the sexes were not determined.

Record of the catch of fur seals and of the number of each sex taken daily by the sealing schooner Dora Siewerd during a cruise in Bering Sea in August and September, 1895, as determined by A. B. Alexander.

1895.	Males.	Females.	Total.	1895.	Males.	Females.	Total.
Aug. 1	34	8	42	Aug. 22	12	32	44
2	26	19	45	24	10	11	21
3	6	7	13	26	62	95	157
4	8	8	16	27	68	78	146
9	13	7	20	28	14	43	57
10	18	55	73	31	5	6	11
11	10	79	89	Sept. 1	120	216	336
12	3	12	15	2	6	4	10
14	14	16	30	8	7	3	10
15	31	68	99	9	4	5	9
15	(*a*)	(*a*)	12	10	5	12	17
17	28	57	85	15	16	8	24
18	1	1	2	20	4	6	10
19	2	2	4				
20	44	67	111	Total	583	982	1,577
21	12	57	69				

a On August 15 twelve skins were taken, of which the sexes were not determined.

Approximate ages of the seals and the number of nursing females taken during the cruise of the sealing schooner Dora Siewerd in Bering Sea in August and September, 1895, based upon examinations made by A. B. Alexander.

1895.	Males. Number taken.	Males. Age.	Females. Number taken.	Females. Age. *a*	Number of nursing females	Number not examined.
		Years.		*Years.*		
Aug. 1	3	5	5	ad.	5	
	21	3	3	2		
	10	2				
2	18	3	17	ad.	17	
	8	2	2	2		
3	6	3 to 5	6	ad.	6	
			1	2		
4	5	4	4	ad.	4	
	3	5	4	2		
9	12	4	7	ad.	6	
	1	5				
10	1	6	55	ad.	47	
	8	4				
	9	3				
11	10	3 to 5	70	ad.	50	24
			9	2		
12	2	4	9	ad.	9	
	1	5	3	2		
14	12	3	16	ad.	16	
	2	4				
15	27	5	60	ad.	58	
	4	4	8	2		
16			1	ad.		
17	20	4	57	ad.	35	
	8	5				
18	1	3	1	ad.	1	
19	2	4	2	ad.	2	

1895.	Males. Number taken.	Males. Age.	Females. Number taken.	Females. Age. *a*	Number of nursing females.	Number not examined.
		Years.		*Years.*		
Aug. 20	35	4	67	ad.	62	
	9	5				
21	5	4	54	ad.	48	
	4	3	3	2		
	3	2				
22	12	4	28	ad.	28	
			4	2		
24	10	5	11	ad.	11	
26	50	4 to 5	92	ad.	65	72
	12	3	3	2		
27	65	3 to 4	78	ad.	74	60
	3	4 to 5				
28	14	3 to 5	43	ad.	37	
31	5	3 to 5	6	ad.	4	
Sept. 1	119	3 to 4	216	ad.	80	156
	1	5				
2	6	4 to 5	4	ad.	3	
8	5	4 to 5	3	ad.	3	
	2	1				
9	4	2 to 3	3	ad.	3	
			2	1 to 2		
10	5	2 to 4	11	ad.	11	
			1	1		
15	14	2 to 3	8	ad.	3	
	2	4 to 5				
20	3	3	6	ad.		
	1	5				

a All females above 2 years old are classed as adults, "ad."

XII.—FUR-SEAL HUNTING IN THE SOUTHERN HEMISPHERE.[1]

By Dr. J. A. Allen.

Fur seals formerly existed in great numbers along portions of the southern coasts of South America, South Africa, Australia, and New Zealand, on the outlying islands off these coasts, and also on many of the pelagic islands of the southern oceans. Seal hunting for commercial purposes began here during the closing decades of the last century, and as early as the beginning of the present century the industry had assumed gigantic proportions. The skins at this time and for many years after were taken to the Canton market and exchanged for teas, silks, and other well-known products of the Chinese Empire. The price obtained for the skins was small in comparison to their value in later years, usually ranging from 50 cents to $4 or $5 per skin. Yet the sealing business proved immensely profitable, and led to an indiscriminate and exterminating slaughter. One after another of the populous seal rookeries was visited and reduced to the verge of extermination, followed by new voyages of discovery in search of new sealing grounds, which in turn were quickly despoiled. Every seal that could be obtained was killed regardless of age or sex. The fur seals generally selected for their homes barren, volcanic islands, situated in stormy seas, often inaccessible except to the most venturesome, skillful, and hardy seamen. The seals that escaped the hunters usually owed their preservation to the inaccessibility of their haunts.

Sealing first began in the southern hemisphere at the Falkland Islands about 1784. The immense fur-seal rookeries at the islands of Mas-á-Fuera and Juan Fernandez were first visited in 1793, where millions were taken during the next fifteen years. In the year 1800 the South Georgian rookeries were attacked and speedily exhausted. In 1801 the sealing fleet at this island numbered thirty vessels, while an equal number of vessels were employed during the same year in sealing off the coast of Chile. At about this date sealing began on the Patagonian coast in the archipelago of Tierra del Fuego, at St. Marys Island, off the coast of Chile, and at the St. Felix group. In 1803 and 1804 voyages were made to the coast of Australia, Borders Island, and the Antipodes. In 1804–1806 seal rookeries were discovered at the Crozet and Prince Edward islands. In 1820 the immense wealth of seal life at the South Shetlands was discovered and the seals nearly exterminated in a single season. At the Auckland Islands sealing began to be vigorously prosecuted in 1822 and 1823. At these and numerous less noted fur-seal resorts sealing has been intermittently prosecuted from the date of their discovery till the present time, although of late years the catch has been small, and in many instances the vessels have made losing voyages. At most

[1] Reprinted from Proc. Fur Seal Arb., Appendix to U. S. Case, Vol. I, p. 365.

of the fur-seal resorts above mentioned there are now not enough seals left to make it worth while to attempt to capture them. At all of them the slaughter has been indiscriminate and to the highest degree improvident; since, if the killing had been wisely regulated, tens of thousands of seals might have been taken annually at each of a dozen to twenty of the larger rookeries without any undue decrease in the seal population.

In contrast to this may be cited not only the history of the seal rookeries in Bering Sea, but those at Lobos Island, Auckland Island, and on the west coast of South Africa, where the killing has been more or less stringently regulated by the several governments to whose jurisdiction these seal rookeries pertain.

In the following pages a succinct general history is given of each of the principal rookeries and fur-sealing grounds of the Southern hemisphere.

FALKLAND ISLANDS.

The first cargo of fur-seal skins obtained at the Falkland Islands, or probably from anywhere south of the equator, appears to have been secured by the American ship *States*, from Boston, about the year 1784. In 1792 several vessels obtained full cargoes of fur-seal skins at these islands, and they were visited by one or more vessels nearly every year as late as 1800, and subsequently at less frequent intervals till the present time, as the Falkland fur seals were less abundant than at many of the islands off the coast of Chile and elsewhere in the Southern seas. Yet the vessels which first visited them seem to have found little difficulty in securing good cargoes of fur-seal skins. Later the rookeries became nearly exterminated. According to the affidavit of Capt. James W. Budington, a close season, lasting from October to April, was established in 1881, but owing to the granting of licenses for killing during the close season the ordinance was of little benefit to the seals. About 1886 the annual catch varied from 50 to 500 skins. So far as our knowledge extends, there are still a few fur seals left at these islands.

As supplementary of the foregoing account we may quote the following, taken from Venning's report,[1] in the department of marine and fisheries for 1895. The incident seems to us to need verification, which we are unable to obtain. There is no good reason why the skins could not have been taken off the coast of California, and their reported similarity to skins usually "secured by the British Columbian fleet" suggests this. We give the account for what it is worth. Mr. Venning reports it as follows:

> Perhaps one of the most noteworthy incidents in the industry this year is the catch by the schooner *Director*, in the North Atlantic Ocean, off Falkland Islands, of 620 seals.
>
> Inquiries were instituted for the purpose of collecting any information in connection with the incident which might be of interest to the question of the sealing industry generally.
>
> It was ascertained that Capt. Frederick W. Gilbert, of the schooner *Director*, 87 tons register, with a crew of 25 men, sailed from Halifax, Nova Scotia, on the 20th of December, 1894, bound for the Asiatic side of the North Pacific Ocean.
>
> On reaching the tenth degree of south latitude, the master was obliged to change his course, by reason of his supply of provisions and water being insufficient to enable him to complete his voyage.
>
> The run from Halifax to the Falkland Islands was made in forty-eight days. While off the southern end of the islands he encountered several groups of seals. He consequently devoted thirty-six days to sealing in that neighborhood, as well as off the east and west end of Staten Island, resulting in the capture of 620 seals, which he took to the port of Victoria.

[1] Pamphlet entitled "The Bering Sea Question," etc. Venning, 1895, p. 15.

The captain reports that he was compelled to suspend his sealing operations, owing to a change in the weather, which became quite stormy, and, as it was getting late in the season, he proceeded on his voyage to Victoria, reaching there on May 21, 1895.

Captain Gilbert reported that all the seals were secured at sea, far distant from any of the sealing preserves, and were shot in the same manner as are those taken in the North Pacific Ocean by the Victoria sealing fleet. He met with no interference.

In reply to the inquiries made, it was ascertained that no record existed of the landing, in the past, of any seal skins at a British Columbia port which did not form part of the catch of the sealers operating in the North Pacific Ocean, either on the American or Asiatic sides thereof.

The skins are reported to have been in good condition, and to be of the same kind as those usually sold by Messrs. Lampson & Co., London, and are classed and known with the Lobos Island seal skins, from the mouth of the River Platte, and bring about the same prices as those taken in the North Pacific Ocean.

The character of the skins is represented as being very similar to that of those usually secured by the British Columbian fleet.

MAS-Á-FUERO.

The island of Mas-á-Fuero, situated off the coast of Chile, in latitude 34° south (about 400 miles west of Valparaiso), when first discovered, in 1563, swarmed with fur seals. The island seems to have been first visited for fur seals by the ship *Eliza*, Capt. William R. Stewart, of New York, in 1792. This vessel secured a cargo of 38,000 skins, which were taken to Canton and sold for $16,000. In 1798 Capt. Edward Fanning, of the ship *Betsey*, from New York, took 100,000 seal skins to the Canton market, nearly all of which were obtained at Mas-á-Fuero. He estimated at the time of his leaving Mas-á-Fuero there were still left on the island between 500,000 and 700,000 seals.[1]

Capt. A. Delano, writing of the same subject, says:

> When the Americans came to Mas-á-Fuero, about the year 1797, and began to make a business of killing seals, there is no doubt but that there were 2,000,000 or 3,000,000 of them on the island. I have made an estimate of more than 3,000,000 that have been carried to Canton from thence in the space of seven years. I have carried more than 100,000 myself, and have been at the place when there were the people of fourteen ships or vessels on the island at one time killing seals.[2]

It is therefore scarcely a matter of surprise that in 1807, according to Captain Morrell,[3] "The business was scarcely worth following. * * * In 1824 the island, like its neighbor, Juan Fernandez, was almost entirely abandoned by these animals." In other words, the seals had become so nearly exterminated that there were not enough left to render the pursuit of them profitable. In later years the island has been visited at intervals by fur-seal hunters and small catches obtained. As late as 1891 Capt. Frank M. Gaffney states (affidavit) that on visiting the island for fur seals he saw 300 or 400, and took 19, showing that a few are still to be found at Mas-á-Fuero.

JUAN FERNANDEZ.

The island of Juan Fernandez, situated a few miles to the eastward of Mas-á-Fuero, was formerly the home of immense numbers of fur seals. Dampier, who visited this island in 1683, says:

> Seals swarm as thick about this Island of John Ferando as if they had no other place in the World to live in; for there is not a Bay or Rock that one can get ashore on that is not full of them. * * * These at John Ferando's have fine, thick, short Furr; the like I have not taken notice of anywhere

[1] Voyages, etc., pp. 117, 118. [2] Narr. Voy. and Trav., 1817, p. 306. [3] Voyages, etc., p. 130.

but in these Seas. Here are always thousands, I might say possibly millions of them, either sitting on the Bays, or going and coming in the Sea round the Island; which is covered with them (as they lye at the top of the Water playing and sunning themselves) for a mile or more from the shore. When they come out of the Sea they bleat like Sheep for their young; and though they pass through hundreds of others' young ones before they come to their own, yet they will not suffer any of them to suck. The young ones are like Puppies and lie much ashore; but when beaten by any of us, they, as well as the old ones, will make toward the Sea, and swim very swift and nimble; tho on shore they lie very sluggishly, and will not go out of our way unless we beat them, but snap at us. A blow on the nose soon kills them. Large ships might here load themselves with Seal Skins and Trayne Oyl, for they are extraordinary fat.[1]

Seal hunting began at Juan Fernandez at the same time as Mas-á-Fuero, the two islands being but a few miles apart and the fur seals frequenting them belonging to the same herd. Owing to the early settlement of this island (it had a population of 3,000, according to Delano, in the year 1800) the seals probably found the island an uncongenial resort almost before the sealing business fairly began, as Delano, writing in 1800, says there were not then any seals on any part of it.[2] Subsequently the island appears to have been visited at intervals by sealers in search of fur seals, but always with poor success. Although not yet extinct there (see affidavit of Capt. Frank M. Gaffney, who reports seeing a few fur seals there in December, 1891), the number left is too small to possess any commercial importance.

GALAPAGOS ISLANDS.[3]

The Galapagos Islands, situated under the equator, about 600 miles west of Ecuador, are the home of fur seals, which probably belong to a different species from that formerly so abundant farther south. The Galapagos seals reside at the islands throughout the year. They are said to breed in caves and to bring forth their young at

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[1] A New Voyage Round the World, etc., 1697, pp. 89, 90.

[2] Voyages and Travels, etc., 1817, p. 313.

[3] The following facts regarding the cruise of the schooner *Prosper* during the summer of 1897 to the Galapagos Islands were obtained by Mr. George A. Clark, secretary of the Fur Seal Commission, in a recent interview with the captain of the vessel, William L. Noyes.

The captain said: "The group of islands, known as the Galapagos, from certain interesting turtles found there, lie under the equator and in the region of the ninetieth degree of west longitude. They are 600 miles off the shores of Ecuador, to which they belong, and were uninhabited until a penal colony, now abandoned, was planted there. The climate is tempered by the cool currents of the ocean. The shores are broken and precipitous, marked by cliffs. Parts of the surface reach an elevation of 3,000 and 4,000 feet. There are five islands of considerable size in the group and ten small ones.

"I sailed from San Francisco May 9, 1897, in the schooner *Prosper*, a vessel of 23 tons register, owned by George W. Kneass & Co., of San Francisco, and carrying a crew of five men. We arrived at Wenman Island, one of the Galapagos group, lying in 1° 20′ north latitude, July 17, and, landing, found seals with their young already born. The breeding grounds occupied by the seals were rough bowlder beaches. The animals did not haul inland to any great extent, and were not found upon the sandy beaches. The seals were not very numerous. In the hope that more seals would appear later and in order to let the pups grow, we left Wenman Island and sailed to the south of the equator.

"On a certain island in 8′ south we found more seals, and a number were killed which contained unborn pups. This we found to be characteristic of the seals south of the equator. Some killed as late as September were still bearing, and, I should judge, would not be delivered until some time in October or November.

"In October we returned to Wenman Island, finding and taking a few seals, but none of the pups we left in July. On another island I saw a single pup alone swimming in a little pool.

"The waters about the island were infested by sharks of the man-eating type. One of these we killed while at anchor beside the vessel. Its stomach contained the flesh and bones of an adult seal, all seasons. The supply here appears never to have been abundant. Delano, writing in 1800, says: "These islands afford some seals of both the hair and fur kind, and I think a vessel might procure several thousands of the two kinds upon the whole cluster of islands, as all of them afford some."[1] They were frequently visited later, and Captain Fanning states[2] that in 1816 he obtained there 8,000 fur seals and 2,000 hair seals. Capt. Benjamin Morrell mentions taking a few fur seals at the south end of Albemarle Island in November, 1825,[3] and doubtless many have been taken at the Galapagos since that date. Capt. Charles W. Reed (affidavit) states that in 1872 he took 3,000 fur seals at these islands, and about as many more during three subsequent voyages between this date and 1880. In 1885 Captain Gaffney (affidavit) obtained 1,000 fur seals there.

ST. FELIX, ST. AMBROSE, ST. MARYS ISLANDS, ETC.

Many of the small islands off the coast of Chile, from the Strait of Magellan northward, were formerly inhabited by colonies of fur seals. Even before the annihilation of the seal rookeries at Juan Fernandez and Mas-á-Fuero, these islands were visited by sealers, from some of which they reaped rich harvests. Delano, writing in 1801,

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I believe that the sharks must have eaten the pups we saw at the time of the first visit to the island in July.

"We killed one seal which had a flipper bitten clean off, probably by a shark. In one case we saw a bull seal lying on the surface of the water and a few feet under him were a number of hungry-looking sharks. They did not seem inclined to attack him, but he evidently watched them closely.

"While the sharks were not seen to touch the living seals when uninjured, they on one occasion attacked a wounded one which had succeeded in getting into the water and was endeavoring to escape. They were probably incited by the taste of the blood.

"The seals were often found in caves and under the great bowlders. In one cave to which there was but a small opening I shot and dragged out three in succession, one appearing as soon as the other was taken away. Inside the cave, which could not be entered, sounds from other seals could be heard.

"The seals were very tame and manifested no fear. We used the rifle in killing them, whether in the water or on shore. In the water we got as close as possible, which was usually 6 or 8 feet. We did not lose any of the seals shot in the water. A few killed on shore near the edge rolled off and sank in deep water before we could get to them. We killed all we could find.

"The seals evidently do not migrate. They do not seem to have a definite rookery life, as on the islands of the north. At one island we saw a number of yearlings and a score of old bulls lying about, but apparently no cows. At another island a number of bulls seemed to be scouring the caves and shores as if in search of cows.

"There is not the marked difference in size between the male and female that is characteristic of the northern seals. A typical bull would be about 5 feet in length. The nose seemed shorter and blunter. The fur is more uniformly dark shade. The throat and belly do not show the lighter colors found in the northern seals. There is little or no difference in shade between the back and under parts of the body except in rare cases which show a patch of lighter brown on the flank. The fur seems everywhere shorter, and is particularly short on the belly, probably because the animal spends so much of its time on land.

"We probably did not get all the seals, but there were few left. I visited the islands in 1879, at which time there were more seals than in 1897. Our total catch numbered 224 skins, of which, according to the examinations in the custom-house, 85 were males and 139 females.

"In former years a great many skins were taken on the Galapagos Islands. One catch of 5,000 was lost through imperfect curing. The catch of the *Prosper* was brought in in good condition, having been dry-salted first and then kept in pickle until arrival in port, when they were again dry-salted,

"We left the Galapagos Islands on October 22 and reached San Francisco on December 14."

[1] Voyages and Travels, p. 381.

[2] Voyages, p. 410.

[3] Narrative of Four Voyages, etc., 1832, p. 221.

speaks of St. Felix and St. Ambrose islands as being visited by the sealers, the greater part of the catch being taken from St. Felix, the larger island of the group.[1]

In 1816 Capt. Edward Fanning took 14,000 fur-seal skins at St. Marys.[2] He also speaks of having visited these islands in 1801 and finding there a small fleet of American sealers, five ships and a schooner.[3] While it is impossible to give even approximate statistics of the catch, the aggregate number of seals taken must have been large.

At some of these islands small remnants of the former herds still exist, as shown by the affidavits of Capt. Frank M. Gaffney and George Fogel. The latter states that in 1870 he saw at Chiklaway thousands of fur seals; in 1891, however, there were "no seals worth mentioning." In December, 1891, Captain Gaffney saw only two fur seals at St. Felix and St. Ambrose islands, where formerly they were so abundant. At Rees Islet (latitude 46° 45′ south, longitude 75° 45′ west) during a stay of two weeks in December, 1891, he obtained one seal. He says, however, that they still breed there, but that the Chilians go there and kill all they can obtain, as has been the case for many years at other islands off the Chilean coast. Hence there is little opportunity for the recuperation of the seal herds.

TIERRA DEL FUEGO AND THE PATAGONIAN COASTS.

The group of islands south of Patagonia known as Tierra del Fuego, with which may be here included the Diego Ramirez group, are celebrated for the number of sea elephants and fur seals which they have yielded to commerce, as are also the coasts and outlying islands of Patagonia. Without going into details as to the former abundance of fur seals in this general region, it may suffice to show that at present the species is practically extinct, at least in a commercial sense. Says Captain Buddington (affidavit), great numbers were formerly taken on the east coast of Patagonia; at the present time there are no seals there. There are not enough on the Patagonian coast to pay for hunting them. He says that in 1881 he took 600 fur seals on the western coast, at Picton Landing. In 1889 he again visited this coast and obtained only four skins.

At Tierra del Fuego and the adjacent islands he took 5,000 skins during the season of 1879–80; in 1891–92 he obtained only 900, and these came from another part of the coast. Formerly thousands of skins were taken there, "but the animals are practically extinct there to-day."

Mr. George Comer states (affidavit) that he spent the years 1879 to 1882 about Tierra del Fuego and the coasts of Patagonia and Chile, on a three years' sealing cruise. During these three years, he says, "our catch was 4,000 seals, 2,000 of which were taken the first year, and we practically cleaned the rookeries out."

The testimony of Capt. Caleb Lindahl (affidavit), a sealer of long experience, is to the same effect. He states that in October, 1891, he went on a sealing cruise to the South Seas, starting in sealing off the coast of Patagonia and sealing there and in the neighboring seas till the following March. He says:

> The seals are nearly all killed off down there, so that we got only about twenty skins. It is no use for vessels to go there sealing any more. I was there twelve years ago on a sealing expedition and the rookeries were full of seals. Now they are nearly all gone. They never gave the seals a chance to breed there. They shot them as soon as they came up on the rocks.

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[1] Voyages and Travels, p. 354. [2] Voyages, etc., p. 411. [3] Ibid., p. 306.

The so-called "Cape Horn" catch, which presumably includes all of the fur seals taken off the coasts of South America and the various outlying islands and archipelagos to the southward, from 1876 to 1892, aggregates a total of about 113,000 skins, varying in different years from about 17,500 in 1880 to less than 1,000 in 1886, but averaging for the last ten years about 3,500 annually.[1]

LOBOS ISLAND.

The fur-seal rookery on Lobos Island, off the mouth of the Rio de la Plata, and belonging to the Republic of Uruguay, is one of the few that have escaped annihilation at the hands of the seal hunter. Many fur seals were taken here prior to 1820. Captain Morrell[2] found men stationed there to take seals in 1824, and Captain Weddell,[3] writing in 1825, refers to Lobos Island as being farmed out by the Government of Montevideo for sealing purposes, under regulations designed to prevent the extermination of the seals. As evidence that the matter has been long managed with discretion may be cited the statistics given in the affidavits of Messrs. Emil Teichmann and Alfred Fraser (of the firm of C. M. Lampson & Co., of London), which show that the catch for the last twenty years has averaged about 13,000 a year, or a total of some 250,000 fur-seal skins. This throws into strong relief the folly of the exterminating slaughter of fur seals that has been waged unremittingly for nearly a century throughout the Southern seas.

SOUTH SHETLAND ISLANDS.

The South Shetlands constitute a numerous group of small islands situated about 300 miles south of Cape Horn. Sealing began here in 1819, when the American brig *Hersilia*, from Stonington, Conn., and an English vessel from Buenos Ayres obtained cargoes of very fine fur-seal skins. News of the discovery of this new sealing ground quickly spread, and before the end of the following year a fleet of 30 vessels (18 American, 10 English, and 2 Russian) had reached the South Shetlands to gather in the valuable pelts of the hapless seals. Captain Weddell, writing in 1825, gives the following account of slaughter which ensued.

> The quantity of seals taken off these islands by vessels from different parts during the years 1821 and 1822 may be computed at 320,000, and the quantity of sea-elephant oil at 940 tons. This valuable animal, the fur seal, might, by a law similar to that which restrains the fishermen in the size of the mesh of their nets, have been spared to render annually 100,000 fur seals for many years to come. This would have followed from not killing the mothers until the young were able to take the water, and even then only those which appeared to be old, together with a proportion of the males, thereby diminishing their total number, but in slow progression. This system is practiced at the River Plata. The island of Lobos, at the mouth of that river, contains a quantity of seals, and is farmed by the Government of Montevideo, under certain restrictions, that the hunter shall take them only at stated periods, in order to prevent extermination. The system of extermination was practiced, however, at the South Shetlands; for whenever a seal reached the beach, of whatever denomination, he was immediately killed and his skin taken, and by this means, at the end of the second year, the seals became nearly extinct. The young, having lost their mothers when only three or four days old, of course died, which at the lowest calculation exceeded 100,000.[4]

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[1] Affidavit of Emil Teichmann, of London firm of C. M. Lampson & Co.
[2] Voyages, p. 154. [3] Ibid., p. 142. [4] Voyages, etc., pp. 141, 142.

The history of the South Shetland seal fishery, since this indiscriminate and exterminating slaughter, is thus given by C. A. Williams in his report to a committee of Congress on Merchant Marine and Fisheries, in 1888.

> In 1872, fifty years after the slaughter at the Shetland Islands, the localities before mentioned were all revisited by another generation of hunters, and in the sixteen years that have elapsed they have searched every beach and gleaned every rock known to their predecessors and found a few secluded and inhospitable places before unknown, and the net result of all their toil and daring for the years scarcely amounted to 45,000 skins; and now not even a remnant remains save on the rocks off the pitch of Cape Horn. The last vessel at South Shetland this year of 1888, after hunting all the group, found only 35 skins, and the last, at Kerguelan Land, only 61, including pups. So in wretched waste and wanton destruction has gone out forever from the southern seas a race of animals useful to man and a possible industry connected with them. And it is plain, without the aid of the law to guide and control, no other result could have been expected or attained.

The narrative is brought down to date by the following testimony from the affidavit of Capt. James W. Budington:

> The shores of these islands were once covered with seals, but there are practically none there now. I don't think 100 skins could be taken from there at the present time, while I have known of one vessel taking 60,000 in a season.

He adds that in the season of 1871–72 six vessels took about 12,000 skins, and that in 1873–74 a fleet of seven vessels took about 5,000. Up to 1880 from 100 to 200 were taken annually. Since 1880 the rookeries were not worked until 1888–89, when Captain Budington took 39 skins, and 1891, 41 skins.

SOUTH GEORGIA ISLAND.

The island of South Georgia is situated about 300 miles east of Cape Horn, in about latitude 55 degrees south. When the island was first discovered sea elephants and fur seals were abundant on its shores. Capt. Edmund Fanning, of the American corvette *Aspasia*, visited this island in 1800 and secured a cargo of 57,000 fur seals, and states that 16 other vessels procured at the same island, between November, 1800, and February, 1801, 65,000 fur-seal skins, making a total of 112,000 skins taken there in a single season.[1] The slaughter continued during the succeeding years until the supply of skins was exhausted, the total number of fur-seal skins taken here during these early years being estimated by Captain Weddell at none less than 1,200,000. He also states, writing in 1822: "These animals are now almost extinct."[2] During many years following this period of slaughter the island was rarely molested by sealers, but so few seals had been left alive that their increase was very slow. Captain Morrell, in November, 1822, vainly searched its shores for several days for fur seals.[3] Capt. James W. Budington states (affidavit) that on visiting the island in 1874 he took 1,450 skins, and that in 1875 five vessels secured 600; the next season (1876) four vessels obtained 110. The island was not worked again till January, 1892, when Captain Budington took 135 fur-seal skins, "none, however, coming from the old rookeries," which had become practically exterminated long before. "The seals of South George," says Captain Budington, "are practically extinct."[4]

Mr. George Comer, who visited the island in 1885 and 1886 as mate of a sealing

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[1] Fanning, Voyages, p. 299. [2] Voyages, p. 53. [3] Voyages, p. 58.

[4] See also affidavit of Alfred Fraser, of the firm of C. M. Lampson & Co., London.

vessel, says (affidavit): "We heard reports of the number of seals formerly taken there, but we did not get a seal, and saw only one." He took three there, however, in 1887.

SANDWICH LAND.

Early in the present century many fur seals were taken at Bouvette Island and Sandwich Land, small islands a few hundred miles southwest of South Georgia, but when visited by Captain Morrell in 1822 he found not a single fur seal at Sandwich Land, and succeeded in procuring only about 200 at Bouvette Island.[1]

According to Captain Budington (affidavit), in 1875–76 the southern island of Sandwich Land was searched unsuccessfully for seals, but about 2,000 were taken that season on the northern island, where also, in the season of 1876–77, six vessels took about 4,000. The next year's catch, however, did not exceed 100 skins. During the season of 1880–81 the island was again visited, but no seals were taken. In 1891–92 about 400 were obtained and about 200 more were seen. Prior to 1871 the Sandwich Land group of islands had not been worked for twenty-five or thirty years, during which time the seals had greatly increased in numbers and had become very tame. At first they were easily killed with clubs, but since 1880 it has been necessary to shoot them. Old and young were killed indiscriminately, only young pups being left, which were killed by buzzards or died of starvation. Captain Budington further adds that "seals in the Antarctic regions are practically extinct, and I have given up the business as unprofitable. The whole annual catch for seven vessels has not exceeded 2,600 skins for the last four years."

TRISTAN DA CUNHA ISLANDS AND GOUGH ISLAND.

The Tristan group of islands, situated in the South Atlantic about midway between South America and the Cape of Good Hope, was first visited for fur seals in 1790 by Captain Patten, of the American schooner *Industry*, of Philadelphia, who secured 5,600 skins. Large numbers are said to have been subsequently obtained there, probably from the smaller islands of the group, Inaccessible and Nightingale islands. The latter is apparently still frequented by a few fur seals.

Gough Island, somewhat to the southward of the Tristan group, formerly abounded with fur seals. Captain Morrell, writing in 1829, says:

> This island used to abound with fur seal and sea elephants, but they were so much annoyed by their relentless persecutors that they have sought more safe and distant retreats, perhaps some lonely isles in the southern ocean as yet unknown to that fell destroyer, man. These places might be easily found, however, if merchants were willing to risk the expense of the attempt.[2]

Fur seals appear to have survived at Gough Island, however, till the present time. Mr. George Comer states (in his affidavit) that his vessel put six men on the island in 1887, where they remained nine months, taking about forty to fifty skins. He adds: "Years before the English had had the working of Gough Island and had run the business out, so there were practically no seals there."

PRINCE EDWARD AND CROZET ISLANDS.

The Prince Edward Islands are situated about 900 miles southeast of the Cape of Good Hope. They formerly yielded a large supply of both fur seals and sea elephants.

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[1] Morrell's Voyages, pp. 58, 59, and 66.

[2] Voyages, p. 356.

About 1806 Capt. H. Fanning, in the American ship *Catherine*, of New York, obtained a full cargo of fur seals at these islands, as did other vessels the same year. At that time the islands were frequented by vast numbers of seals, but definite statistics respecting the number taken are not available.[1]

The Crozet Islands are in the same latitude (about 46° south) as Prince Edward Islands and Kerguelen Land, and about half way between these two groups. The first sealer to visit them was Captain Fanning, in 1805; but, although he found an abundance of fur seals there, he passed on to the Prince Edward group. Later both sea elephants and fur seals were taken in large numbers, seal hunting being carried on here for many years. At Possession Island, the largest of the group, Capt. Lindesay Brine, R. N., refers to finding, in 1876, "hundreds of seals, which were resting on the damp grass bordering on the stream which at this point enters the sea."[2]

In 1887, according to George Comer (see his affidavit), a sealing party was left by him on these islands for five months, but they took only three seals. The English at Cape Town, says Mr. Comer, had recommended us to go there because, they said, that "formerly they had taken a great number of skins there."

KERGUELEN LAND.

This large island, also known as Desolation Island, which lies in the southern Indian Ocean, in about latitude 49° south and in about longitude 69° east, has long been celebrated for the great numbers of sea elephants taken there. It has also furnished a small supply of fur seals. Sealing began here as early as 1830, and has continued till the present time, mainly for sea elephants. Mr. H. M. Moseley, of the *Challenger* expedition, states that in January, 1874, two of the whaling schooners then at the island "killed over 70 fur seals on one day and upwards of 20 on another at some small islands off Howes Foreland. It is a pity," he adds, "that some discretion is not exercised in killing the animals. * * * The sealers in Kerguelen Land kill all they can find."[3]

Respecting its still more recent history, the following may be cited from the affidavit of Mr. George Comer, who spent five months there in the winter of 1883 and 1884, obtaining six seals. He says further: "About 1850 this island was visited by an American who practically cleaned off the seals. The captain I shipped with—Joseph Fuller—visited the island in 1880 and took 3,000 seals—practically all there were—and this was the increase for thirty years from 1850." Heard Island, about 300 miles south of Kerguelen Land, which has been a noted hunting ground for sea elephants, appears to have never been much of a fur-seal resort.

BORDERS ISLAND, ANTIPODES ISLANDS, BOUNTY ISLANDS, AUCKLAND ISLANDS, ETC.

About the beginning of the present century the occurrence of fur and hair seals in considerable numbers along the southwestern coast of Australia and in the vicinity of Tasmania and New Zealand was made known by Cook, Bass, Flinders, Anson, Peron, Ross, and other early navigators. A little later, stimulated by these reports,

[1] Fanning's Voyages, pp. 336 and 338.

[2] Geogr. Mag., 1877, p. 267.

[3] Notes by a naturalist on the *Challenger*, p. 189.

the adventurous sealers discovered an apparently almost inexhaustible supply of these animals on the numerous small islands off the southeastern coast of New Zealand. Borders Island was discovered by Captain Pendleton, of the American brig *Union*, of New York, in 1802. Although he reached here toward the end of the sealing season, he secured some 14,000 fur-seal skins. He also visited Antipodes Islands, where he left a crew of men to take seals and await the return of the vessel from Sydney, New South Wales, which, however, was lost on a subsequent cruise to the Fiji Islands. On the receipt of this sad news at Sydney, "Mr. Lord chartered a ship and proceeded with her to the island of Antipodes. At this place the officers and crew whom Captain Pendleton had left there had taken and cured rising of 60,000 prime fur-seal skins, a parcel of very superior quality."[1]

Polack states that Macquarie Island was discovered by a sealing master in 1811, who procured there are a cargo of 80,000 seal skins.[2]

Mr. A. W. Scott states, on information furnished by a professional sealer named Morris:

> In New South Wales the sealing trade was at its height from 1810 to 1820; the first systematic promoters of which were the Sydney firms of Cable, Lord & Underwood, Riley & Jones, Birne, Hoak & Campbell. * * * To so great an extent was this indiscriminate killing carried that in two years (1814–15) no less than 400,000 skins were obtained from Penantepod, or Antipodes Islands alone, and necessarily collected in so hasty a manner that many of them were imperfectly cured. The ship *Pegassus* took home 100,000 of these in bulk, and on her arrival in London the skins, having heated during the voyage, had to be dug out of the hold, and were sold as manure, a sad and reckless waste of life.[3]

According to other authorities, the New Zealand sealing industry ceased to be a paying investment prior to 1863.

Respecting the Auckland Islands, Morrell says:

> In the year 1823 Capt. Robert Johnson, in the schooner *Henry*, of New York, took from this island and the surrounding islets about 13,000 of as good fur-seal skins as were ever brought to the New York market. * * * Although the Auckland Isles once abounded with numerous herds of fur and hair seals, the American and English seamen engaged in this business have made such clean work of it as scarcely to leave a breed; at all events, there was not one fur seal to be found on the 4th of January, 1830.[4]

Early in the present century many fur and hair seals were taken from Bounty Isles, near the southern end of New Zealand; from the Snares and the Traps, from Stewarts, Chatham, and Campbells islands, and also from other islands to the southward of New Zealand; but at most of these points they appear to have become very soon practically exterminated. A few survived the general slaughter, and in recent years, under the protection of the government of the colony of New Zealand, have so far increased that there have been of late years a small annual catch of fur seals in the New Zealand waters, amounting to from 1,000 to 2,000 per year.[5]

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[1] Fanning, Voyages, etc., p. 326.
[2] Polack, New Zealand, II, p. 376.
[3] Scott, Mammalia, Recent and Extinct, Pinnata, pp. 18, 19.
[4] Morrell, Voyages, p. 363.
[5] Affidavit of Emil Teichmann.

ST. PAUL AND AMSTERDAM ISLANDS.

These islands are situated in the southern Indian Ocean (about latitude 38° south, longitude 77° 35′ east) midway between the Cape of Good Hope and Australia; were first visited by Capt. Henry Cox in May, 1789. He says:

> On first landing we found the shores covered with such a multitude of seals that we were obliged to disperse them before we got out of the boat. * * * We procured here a thousand skins of very superior quality, while we remained on the island of Amsterdam, besides several casks of good oil for our binnacles and other purposes.[1]

Lord Macartney, who touched at Amsterdam in 1773, found five men here collecting seal skins for the Canton market. He says of the seals:

> In the summer months they come ashore, sometimes in droves of 800 or 1,000 at a time, out of which 100 are destroyed, that number being as many as five men can skin and peg down to dry in the course of a day. * * * Most of those which come ashore are females, on the proportion of more than thirty to one male.[2]

I find no definite reference to sealing at these islands in later years, but it is probable they were not overlooked by the enterprising sealers who, during the next fifty years, explored every nook and corner of the southern seas in search of prey. Scores of voyages are simply credited, in Mr. A. Howard Clarke's statistical history of fur sealing (already cited), however, simply to the "Southern Seas." M. Charles Vélain, who visited these islands in 1874 with the French Transit of Venus Expedition, reports that they were at that date still visited by considerable herds of fur seals.[3]

WEST COAST OF SOUTH AFRICA AND ADJACENT ISLANDS.

As early as the year 1790 sealing voyages were made to the west coast of South Africa, and a greater or less number of fur seals appear to have been taken there at intervals from that time till the present. In October and November, 1828, Capt. Benjamin Morrell cruised along the west coast from Cape of Good Hope to Walfish Bay, in about 23° south, searching for seals. From his narrative it appears that he first met with them at a small island in latitude 31° 32′ south, about half a mile off the coast.[4]

At Ichaboe Island, 8 leagues north of Angra Pequena, he found great numbers of fur seals, and "took about a thousand of their skins in a few days." He speaks of the island as the resort of "multitudes of fur seals;[5] as many fur-seal skins here as was practicable." He passed on a few leagues farther to Mercury Island (latitude 25° 42′ south, longitude 14° 58′ east), where he took about a thousand fur-seal skins. At Bird Island, about 1 degree farther north, he obtained "the skins of 1,400 fur seals at one time, although the landing was very bad."[6] "As the season (November) was not sufficiently advanced for the seals to come up in their usual numbers on the islands and rocks" south of Walfish Bay, he made an excursion into the interior and again visited these islands about the end of December. He then took a few seals from Bird

[1] Cox Voy. to Teneriffe, Amsterdam, etc., p. 10.

[2] Sir G. Staunton, Account of an Embassy from the King of Great Britain to the Emperor of China, I, p. 210.

[3] Cf. J. W. Clark, Proc. Zool. Soc. London, 1875, p. 653.

[4] Morrell, Voyages.

[5] Ibid., p. 294.

[6] Ibid., pp. 295, 296.

Island, and made an attack upon those on Mercury Island. "The rush of my little party," he says, "was simultaneous; every nerve and muscle was exerted, and we reached the opposite side of the rookery, killing several seals on our way, when we found that the other party, under command of Mr. Burton, had been stopped in 'mid-course' about the center of the rookery by the immense number of seals that began to pour down the steep rocks and precipices like an irresistible torrent, bearing down their assailants, and taking several men nearly into the sea with them. * * * Several hundred fur seals were left lifeless on the shore and rocks." Owing to a fatal accident to one of his most valued men, due to a heavy breaker engulfing three of the party, the island, with its wealth of seals was immediately abandoned and the vessel returned directly to the Cape of Good Hope, having taken in all about 4,000 seals.[1]

In 1830 Capt. Gurdon L. Allyn, with the sealing schooner *Spark*, of New London, Conn., visited Ichaboe Island, but arrived too late in the season (January 14) to secure many fur seals. He found the carcasses of about a thousand from which the skins had been removed by sealers who had preceded him the same season. He says, speaking of the coast generally:

> The coast was well sealed, and we could only glean a few from the roughest rocks. * * * We found a few seals at each landing, * * * and by the 6th of September had taken 600 seal skins.

He secured small catches at intervals during the following months, and started for home on March 31, 1831, with a cargo of 3,700 skins. In 1834 he made another voyage with two vessels to the same coast, visiting Ichaboe, Mercury, and Bird islands. The first season's work amounted to only 800 skins, the seals being scarce and shy. Respecting the next season (1835) he says:

> The seals having been harassed so much, the prospect was slim for the next season, but by putting men on the small rocks to shoot them, and by great diligence we managed to secure about 1,000 skins to both vessels, which was a slim season's work.[2]

Sealing seems to have been abandoned for some years following on the African coast, owing to the low price of seal furs and the scarcity of the seals. It has, however, since been resumed and placed under restrictions by the government of the colony of the Cape of Good Hope, the seal islands being rented to a sealing company under certain stipulated conditions, and poaching rigorously prohibited. The yield is small but steady, averaging about 5,000 skins per annum.[3]

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[1] Morrell, Voyages, pp. 304–306.

[2] Capt. G. L. Allyn. The Old Sailor's Story, as quoted by Mr. A. Howard Clarke.

[3] Affidavit of Emil Teichmann, of the London firm of furriers, C. M. Lampson & Co.

XIII.—THE ROOKERY MAPS OF THE PRIBILOF ISLANDS.

By Jefferson F. Moser,
Lieutenant-Commander, U. S. N.

In the instructions of May 9, 1896, given prior to the detail of the *Albatross* to assist the Fur-Seal Commission, the following work was outlined:

> The correction of inaccuracies in the shore lines of the rookery maps; the location of Mr. Townsend's landmarks; the determination of the length and width of, at least, the most important rookeries by actual measurement, where this could be undertaken without disturbing the seals; the establishment of rookery outlines by plane-table surveys, discriminating accurately as to the limits of breeding and hauling grounds as indicated by Mr. Townsend.

In subsequent instructions of date of May 13 I was directed to determine discrepancies between the maps of Elliott, Townsend, Stanley-Brown, and Drake, and to verify the accepted ones. As these instructions were afterwards modified by a different detail of the vessel, it was impossible to carry out the original orders in their entirety, but I was able to ascertain what the differences in the maps are and how they may be remedied.

The *Albatross* was at the islands of St. George and St. Paul from July 8 to 18, and when the conditions were in the least favorable not a moment was lost in making observations in the field for the verification of the rookery maps.

I was supplied with a set of the Stanley-Brown rookery maps on a scale of 264 feet to 1 inch. A set of the same maps showing the areas of 1895 and shore line corrections by Drake with Townsend's criticisms, and also a set of the Elliott maps, were furnished me. Before arriving at the islands a set of the Stanley-Brown maps were prepared with Drake's shore-line corrections in black, and Elliott's shore line transferred, so far as it was possible, in blue. The Elliott shore line, as taken from the prints furnished, was a bad misfit, as will be seen from the records accompanying my fuller report to the Fish Commission, and it rarely stood the test of an instrumental angle.

I desire, however, to say that the Elliott maps furnished seem to be a photographic enlargement to fit the scale of the Stanley-Brown maps. It is plain to be seen that the enlargement of any map, even by the most expert draftsman, necessarily enlarges the errors, and when enlarged by photography, unless done by special appliances, and by an expert in this particular line, other errors are introduced. It is hardly fair to test a map with instruments in the field unless the original work is at hand, and this holds good not only with the Elliott maps but with the Stanley-Brown maps, for it is well known that the wet print in drying is very appreciably distorted. I will only add that the topography of the Elliott prints as issued to me is so very vague and indefinite that it is next to impossible to do anything with them; I should call them sketches.

I had several interviews with Mr. Joseph Stanley-Brown upon the methods employed in making these surveys and learn as follows: The triangulation of St. Paul on the general map of the islands, scale 1:60,000, was done by Dr. Thomas C. Mendenhall in 1891, when he served as one of the American commissioners in the investigation of the fur seals. The topography was supplied by Mr. Stanley-Brown. Dr. Mendenhall was on St. Paul from July 29 to August 9, and during that time investigated the seal question, made observations for gravity, and did the triangulation. A base was measured on the east side of the Lagoon with an ordinary steel tape, and, from what I can learn, no pressure balances were used and no corrections for temperature or curvature were applied, and no signals were erected. I should call this triangulation a reconnoissance, and think Dr. Mendenhall claims no more for it. The topography by Mr. Stanley-Brown was filled in by methods which I will refer to later. The survey of St. George on the general chart, scale 1:60,000, was the work of Mr. Stanley-Brown.

The rookery surveys, scale 1 inch to 264 feet, were made with a plane table according to Geological Survey methods, and are entirely independent of those previously mentioned. Each sheet stands by itself; that is, each rookery is a separate survey and the rookeries on the different sheets were not connected. The bases were measured with an ordinary steel tape and no corrections were made nor pressure balances used. The azimuths were observed by means of a compass attached to an ordinary geologist's clinometer. Cairns were built of loose rock at prominent points and flags placed in favorable positions for observation points. No regular signals were built, nor were angles observed nor computations made. The plane table was placed over each end of the base successively and different points cut in, after which these points were occupied and others made. No high or low water line was observed; the water line was cut in at the height it happened to be when the observations were made. The contours were traced with an aneroid barometer. The scale of the original sheets is the same as that published—1 inch to 264 feet, or 20 inches to the statute mile.

We tested these maps as thoroughly as our limited time would permit. The sheets accompanying the fuller report will show the large number of angles observed, and the data, though more or less incomplete, is sufficient to show thoroughly what has been done in the past and what is required for the present and future. I do not think Mr. Stanley-Brown claims great accuracy for his maps. I should call them a fair reconnoissance. They are not accurate in the sense of a finished survey; they lack detail, and what is given is in most instances badly represented and indefinite; the lines and symbols leave one constantly in doubt as to what is intended to be understood. Yet, considering the means employed, the facilities, and the methods, it is surprising to me that they are as good as they are. These surveys by Mr. Stanley-Brown are no doubt the very best for these islands that have ever been made, and he deserves nothing but praise in carrying out the work under the many trying conditions.

When the rookeries were so full of seals that a few tens of thousands, more or less, was a matter of no importance, these maps served their purpose and served it well; they were a good general guide. They satisfied the demands at the time they were made, but as the number of seals have been so much reduced and it is necessary to make an estimate within small limits, we are unable with these maps to make an eye survey of the areas occupied by the herd.

The present need requires a topographical map of the rookeries so accurate and in such detail that a person from an accessible position and commanding the rookeries may, map in hand, sketch in accurately the areas occupied by the breeding seals which are inaccessible. With the Stanley-Brown maps it is difficult to establish oneself in position, and if established the same difficulty is experienced in recognizing the reference points; this bowlder, that gorge, this slope, that projecting ledge are not indicated, or if indicated are indefinitely shown or out of position. The result is that one is in doubt how to sketch the rookery areas, and after they are sketched one is equally uncertain as to their accuracy.

But if a map executed in the highest style of the topographer's art now existed it would fail to satisfy the immediate demands, unless many reference points positive in their character were located on the rookeries, maintained by the Government, and accurately represented on the map. Every prominent land feature might be indicated and contours multiplied, and yet we would be unable to sketch in the desired area properly, in most instances, without artificial marks. It must be remembered that when it is desirable to map the areas occupied by breeding seals the rookeries are inaccessible. No man could possibly invade the breeding grounds without suffering probably the loss of his life; therefore measurement is impossible. Nor is it practicable, in my opinion, to locate stations from which instrumental observations can be made for the purpose of cutting in the limits of the breeding ground. Exceptionally the harems are spread out in plain view, but generally a single station on shore commands only a few harems. In fact, in some instances they can only be seen from seaward.

I can not too strongly dwell upon the necessity of well-located artificial marks on the rookeries for reference points. These should be numerous and occupy seal area if possible. Crosses have been painted on some of the rocks and seem to wear well. I would therefore suggest for the purpose serial numbers painted in white on the largest bowlders and ledges where the breeding grounds impinge on the shore, and that are visible from prominent points. A hole drilled in the rock or a cross cut with a chisel would serve to identify it in the event of the paint being worn off.

It must be remembered that these islands are surrounded by ice during the winter, and that under its influence bowlders may be moved. Hence the necessity of fixing these bowlders with reference to located positions on the cliffs, so that the reference may be tested in case of doubt. On the slopes occupied by the breeding herds which are not reached by the ice, and where no prominent natural features exist, heavy posts projecting a foot or two from the ground might be adopted. With these reference points well located on a good topographical map on a liberal scale the areas occupied by the seals can be sketched within very narrow limits of error.

The work originally laid out for this vessel, namely, to correct inaccuracies of rookeries and shore line, to properly locate Townsend's landmarks, to determine length and width of at least most important rookeries by actual measurement, to establish outlines of rookeries by plane table, or, in other words, to correct the existing maps and furnish a set of rookery maps that were correct in every detail, was impracticable, even if the original order had not been modified by a different detail, and for the following reasons:

By reference to the Stanley-Brown maps, on which the angles observed by the party on board the *Albatross* this year have been set down, it will at once be seen that the maps are as a rule in error. In some places the error is small, in others large. In other words, the maps are not topographically correct. If, therefore, any one of these data is accepted with the intention of making corrections, a start is made with an error from the initial point, and the corrections are no correction at all, but must necessarily be in error. I was asked quite frequently to locate different features on or near the rookeries. I did it simply to satisfy the person making the request, but I knew the location was an error.

In a few words, then, I do not hesitate to say that it is impracticable to correct the present rookery maps and hope to obtain thereby maps that are topographically correct, because there is no absolute data from which to make the correction. If you accept the Stanley-Brown data you accept his maps. The only remedy I see is to make a new survey with the best means the Government has at hand. To do anything else is simply to produce maps which have no greater value than those now in use. The survey of the rookeries must be made by a skilled topographer, using the best means that can be supplied.

The Treasury Department, most interested in having correct maps, has fortunately at hand in one of its bureaus the best means possible in the world of making such a survey. I refer to the United States Coast and Geodetic Survey. This bureau has two items in the appropriations, under either of which the work I think can be done. The one, "Alaskan explorations," and the other "For objects not named that may be deemed urgent."

It will take a competent assistant with an aid and five men equipped with the best instruments at least one full year to make the rookery surveys on a scale of 1:2,500. A party leaving by the earliest steamer in spring and wintering on the islands might finish to return by the following summer. Generally the breeding seals lie from the base of the cliffs to a line reached by the spray of the heaviest seas, to the high-water mark in fact, on a cliff or series of shelves projecting from the base of the cliffs, and when a breach or gorge through the cliffs forms a valley the rookeries extend partly up the valley. This shelf is narrow in places, wide in others, and still in other locations it merges into the valleys. In some places the harems are three or more deep, in others two, tapering to one, and then broken. In the valleys the gorges may be six or seven or more harems deep. To map this shelf or shelves with all the ramifications into valleys and gorges and represent it so that it is intelligently expressed to the nonexpert requires topography of the highest order.

The rookery surveys to have exact value must be made during the season when the seals are not occupying them. The rookery must be occupied by the topographer. During the breeding season bases can be measured and the work carried on to the edge of the rookeries. In my opinion it is not necessary to measure the base for these rookeries. I believe that all the rookeries on the south side of St. Paul from Polovina to Zapadni can be connected with one good base.

I would again repeat the necessity of locating permanent marks for reference points on a rookery for the purpose of accurately sketching the areas occupied by breeding seals. These marks must be plainly visible, numbered or lettered, and in considerable numbers. Without such reference points the most elaborate survey will fail to meet the wants of the future fur-seal investigator.

In closing this portion of my report I beg to say that it is my opinion, based on twenty years' experience in surveying, that no party, however well equipped they may be, can go to the Pribilof Islands during the summer season and either correct the topography of the rookeries on existing maps or make new surveys of the rookery areas that will fulfill the existing requirements.

XIV.—PRACTICAL EXPERIMENTS IN THE BRANDING AND HERDING OF THE SEALS.

By David Starr Jordan and George Archibald Clark.

In his report for 1895 Mr. F. W. True made certain suggestions as to ways and means of remedying the condition of the fur-seal herd. One of these was to brand the seals either with a property mark on the flipper or with such a mark on the back as would destroy the value of the skin. Another plan was to drive the seals back from the rookeries in August and confine them in the salt lagoon and certain fresh-water lakes, where they could be held during the sealing season.

With these suggestions in mind, in the autumn of 1896 the present commission undertook to test these plans and determine by actual experiment their feasibility. These experiments we may consider somewhat in detail.

THE BRANDING OF THE SEALS.

The commission was fortunate in having as a special assistant Col. Joseph Murray, whose former residence as a Treasury agent on the islands made him familiar with the handling of the seals and whose experience in the branding of cattle enabled him to understand the practical workings of the plan of branding. He was from the outset an enthusiastic advocate of branding and had unbounded faith in its success. To his judgment and supervision therefore the experiments of the commission in this direction were intrusted.

At the outset it was decided that a mere property mark would not answer the immediate needs of the situation and would be of doubtful value. Accordingly, the experiments were directed toward so marking the skins as to destroy their value, knowing that a mark accomplishing this result would prove quite as effective as a property mark. Naturally the branding was limited to the females. Here again it became at once apparent that the older animals could not be handled with safety on account of their viciousness and the difficulty in controlling them. The work therefore finally resolved itself into the branding of the female pups.

It was found possible in the month of September to drive up the pups and handle them just as the older seals are handled in the killing season. The smaller size of the pups made it possible to catch and hold them without danger or difficulty. With this work the Aleuts found themselves at once familiar. For twenty years prior to 1890 it had been customary for them to drive up from 10,000 to 15,000 pups from certain rookeries and sort out the sexes to secure the 5,000 males to be killed for winter food. This process was identical with that necessary for branding, and at the outset laid at rest the question of the possibility of handling the pups.

The pups to be branded were driven back in herds from the rookeries to the flat grassy plains in the rear and at a convenient distance. Here the larger droves were broken up into smaller pods and herded separately. The Aleuts then examined the pups, and sorting out the males allowed them to go back to the rookeries, leaving only the females, which were then ready for branding.

As no thought had been given to this subject prior to our starting for the islands in the spring of 1896 no special preparation was made. It was therefore necessary for Colonel Murray to improvise a set of irons and other necessaries for carrying out the experiments. The brands were made of pieces of iron about 8 inches long by 1 inch wide and thick. These were welded to iron handles about 4 feet long. A small portable forge furnished the necessary heat. A home-made salve composed of ingredients designed to promote healing was also prepared for application to the wounds. This constituted the original apparatus for branding.

During the season of 1896 377 pups and 11 adult cows in all were branded. Of these, 124 pups on Lukanin rookery were marked on the back with the following brand: ⧧. Two young cows on this same rookery were branded with two marks asross the shoulders, thus . On Kitovi rookery 191 pups were branded thus , with a single mark across the shoulders. On North rookery of St. George 62 pups were branded thus, —; and 9 cows thus, .

The branding of the cows was attended with great difficulty. It was necessary to lasso them by means of a loop affixed to the end of a pole, by which they could be pinned to the ground. The experiments clearly enough showed that any general branding of the adult females would be impossible.

With the pups the matter was comparatively simple. The little animals could be easily held down by placing one hand on the neck and holding the hind flippers with the other. While held in this position the red-hot iron was applied to their backs, burning through the fur the width of the iron. With the edge of the iron a deeper burn into the skin was made, which was destined to produce a scar. It was expected that the fur would replace itself on the bare space on either side of the scar, thus affording protection to the pup by the overlapping of the fur. As a matter of fact, however, while this replacement of the fur did, as a rule, take place, it was more or less imperfect, and left the skin marred throughout the entire extent of the burning.

The mere mechanical features of the work of branding, involving the handling of the pups and the application of the irons, was entirely successful from the start. It only remained to be seen what effect the operation would have on the pups themselves. With a view to determining this the pups were closely watched during the months of September and October, 1896.

For a week but little change could be seen in their condition. The wound showed only the dull scar of the burning. In some cases suppuration set in at the angles made by the crossing of the brands on the pups branded first on Lukanin. The skin curled slightly at the corners in these cases, and made apparent the inadvisability of putting on a brand so that two scars crossed each other.

After a week or ten days the wounds appeared raw and apparently inflamed. The cause of this was not at once apparent, but later on, when opportunity was afforded for closely examining the skin of a branded pup which had been drowned, it was found that, instead of being raw and sensitive, the salt water had merely washed out the scab, leaving the healing skin in a pinkish condition resembling the color of corned beef.

During this time the pups appeared very uncomfortable when out of the water, as the skin tended to dry and crack and doubtless the movements of the animals caused them pain. On going again into the water the wounds were softened up and washed out. With each return from the sea they became narrower until healing was finally completed in about three weeks to a month after the branding. The pups then appeared in their usual spirits and seemed not to have suffered any inconvenience by their experiences.

While the wounds were still sore the pups manifested little disposition to play. They resented the curious attention which their companions sometimes gave to their backs. Occasionally a mother would smell the back of her branded pup, which called forth its vigorous protest. As a rule, however, as characteristic of the wounds of the fur seals in general, neither the animals themselves nor their companions paid any attention to the wounds from branding.

That no adverse change in the habits of the seals resulted from the branding is clear from the fact that no alteration was seen in the relations of the pups and their mothers. They were treated exactly as if nothing had happened. The relations of the pups among themselves remain unaffected. Five out of nine of the adult cows were found in 1897 on the breeding grounds with their pups. One of the cows was found in a harem on Lukanin rookery, in practically the same spot from which she was driven at the time of her branding in 1896.

Only four of the branded pups were positively known to have died, and the rookeries of Kitovi and Lukanin were closely inspected on various occasions with a view to finding them, if present. One of these was killed to furnish a specimen skin. Another was found in good condition at high-water mark on Lukanin beach, plainly drowned. A third was killed while almost dead from starvation. The cause of death in the case of the fourth could not be determined, because the animal was long dead when found and decomposition was far advanced. At the time of the count of dead pups in October, 18 of the branded pups and 2 of the branded cows on St. George were seen all in perfect condition and the brands showed distinctly. Throughout this month an inspection of Lukanin and Kitovi rookery on any day showed from 50 to 100 of the branded pups, which was a large percentage considering the difficulties of an inspection.

On our way to the islands in the season of 1897 we obtained, through the kindness of Mr. Gray, the agent of the Alaska Commercial Company at Unalaska, the skin of a branded pup which had been taken late in November by the natives at Akun Island. This skin showed the fur of the pup in a more advanced stage than the one taken on the islands in October. The brand was perfectly healed except for a slight break in the skin at the crossing of the brands. The skin was tanned with a view to determining the effect of branding on the prepared pelt. This demonstrated more clearly than ever the true effect of the branding. When the blubber was removed and the skin was worked over, the part which had been affected by the brand in places fell out, leaving a long slit in the skin.

This fact adds emphasis to the statement made in 1896 by Mr. J. D. Williams, of Brooklyn, N. Y., a dyer and dresser of seal skins, that "if a brand were to be applied to the back of the seal even so imperfectly as to leave no permanent scar or trace in the raw skin, in the process of curing the fur would doubtless come out, and the very fact that any class of skins were liable to this defect would cast doubt on the whole lot and depreciate their value."

We thus find that branding is not only a feasible operation, but that it is entirely effective. Without injury to the animal itself or interference with its habits and relations, its skin can be so marked as to destroy its value for commercial purposes. Pelagic skins are now of much less value than are the island skins. Two or three cross brands at intervals through the most valuable part of the skin must reduce still lower its value and leave the business of taking these skins at sea unprofitable.

We may note here that there is no truth whatever in the assertion so strenuously urged by Mr. Henry W. Elliott, that the fur of the branded seal will replace itself without scar. This contention is based on analogy to the way the wounds of the seals from cuts or bites heal. The difference between the result of a bite and of the application of a hot iron is too evident to need comment. The one destroys the hair cells; the other does not. It is probable that most of the minor wounds of the seals heal perfectly and without a scar; but it is not true that all do, as the welts in the skin, due to imperfect healing, which causes seals to be rejected on the killing fields, abundantly show.

But the proof necessary to break down this contention was found in the case of the adult cows branded in 1896 which were present in the season of 1897. Five of these were seen and the marks were clear and distinct, leaving no doubt as to their destructive effect on the fur. That this would be the result was a foregone conclusion. The process of branding domestic animals has been in vogue long enough to show that a scar thus made in the skin of an animal remains permanently. There is no reason why we should suppose a special exception in favor of the seal. There is none.

It is necessary, also, to refute an equally absurd report that the branding had the effect of driving the seals away from the Pribilof Islands across to the other side of the Pacific, it being reported that during the season of 1897 branded skins had been taken off the Japan coast.

We may say that an inspection by Captain Hooper of the catch of the schooner *St. Lawrence*, the vessel said to have taken the skins, in Unalaska, failed to discover any branded skins, and the master made affidavit that he not only did not take any skins of this sort on the Japanese coast, but he had not even heard of any being taken there.

This of course is merely negative evidence. The fact that five out of nine cows branded in 1896 were seen present in 1897 is sufficient proof that they were not driven away by the process of branding. That four should have been overlooked among the thousands of seals on the rookeries is not strange. If any class of the seals were likely to be affected by the branding it would be the adults. It is absurd to suppose for a moment that the pups of 3 months old would remember what had occurred, or, in case they did, that a mere temporary experience should weigh against such an unerring and thoroughly fixed instinct as the homing instinct of the seal.

During the season of 1897 the work of branding was largely extended. Colonel Murray branded on St. Paul Island in all 5,371 pups and 118 adult cows. Mr. James Judge, Treasury agent in charge of St. George Island, branded 1,880 pups on the rookeries of that island. The details of the work of branding for the season of 1897 will be found in the reports of Agents Murray and Judge, appended herewith (Appendix I, II).

As a result of the experiments of 1896 it was suggested that an electrical cautery might be used instead of the red-hot iron as an instrument of branding. With this end in view experiments were conducted by Mr. Elmer E. Farmer in the laboratory of electrical engineering in Stanford University. The necessary apparatus was constructed and taken to the islands. In the report of Mr. Farmer, also appended herewith (Appendix I), will be found a detailed account of the matter.

The apparatus for electrical branding was not landed at the islands before our departure. As a result we did not have an opportunity to test it's working in person. The actual conditions were so different from the experimental conditions that the apparatus proved in some respects inadequate. Its use was therefore confined to experiments. The actual work of branding was done by Colonel Murray by means of the simpler and already tested irons.

It will be seen from Mr. Farmer's account of the experiments with the electrical cautery that the practicability of this principle with improved and perfected apparatus is proved. This answers our present purpose. If branding as a business becomes necessary it will be a comparatively simple matter to develop the principle of electrical branding and make it work. The advantages of the white-hot cautery wire over the clumsy red-hot iron are too obvious to need comment.

It is to be hoped that branding as a means of protecting the fur-seal herd will not be necessary. It must be said, however, that the plan is entirely feasible. The task involves some labor and expense, but no insurmountable obstacle. As Colonel Murray puts it: "With an assistant and a duplicate set of forges and men, 5,000 pups a day could be easily branded, or in twenty working days 100,000 pups." This is about double the number of female pups on the islands at present, so the work could be done in ten days; or one brander with the force of men now on the islands could do the work in twenty days, and the period in which branding can be done will admit of fully this time. To brand all these female pups for five years in succession would settle the fate of pelagic sealing.

HERDING.

No attempt was made in the experiments in herding to carry out Mr. True's idea of driving back and holding all classes of animals. Whether this could be done in any event seems to us extremely doubtful. It ought not to be tried, we think, because it is probable that such a course would result in the death of most of the pups and the complete demoralization of rookery life.

On the contrary, we accepted the plan of herding as forming merely a complement to the plan of branding. The latter plan was designed to protect the female portion of the herd. Herding can in a similar manner protect the young males. At the close of the killing season in July, if such of the bachelors as are left can be herded up during the month of August, or even longer, they can be kept out of the way of the pelagic sealer.

During the season of 1896 the practicability of this plan was tested by driving up and retaining in the salt lagoon on St. Paul Island about 3,000 bachelors and half bulls under guard of a force of natives. No difficulty seemed to be encountered, and so during the season of 1897 fencing was taken up to St. Paul Island and the salt lagoon was inclosed. This lagoon, covering as it does upward of 300 acres of space and having a direct connection with the sea, is admirably adapted for the purpose. It is, moreover, conveniently located for all the rookeries on the southern end of the island. For the two remaining breeding areas—Polovina and Northeast Point—fresh-water lakes are available, several in the vicinity of the former and one of considerable size—Webster Lake—near the latter.

The fencing, unfortunately, was not delivered at the islands until late in August, and so the only use which could be made of the inclosure for the present season was in further testing its utility. Seals were confined in the inclosure during the first week of September, and it was found entirely feasible to so retain them. Of the details of this experiment an account will be found in the daily journal of the commission for September, 1897, and also in Colonel Murray's brief report appended herewith (Appendix II).

The proper time in which to utilize this inclosure is in the early part of August. The younger bachelors come to the islands late in July, and in the last few days of this month the bachelors should be gathered up and held in the lagoon or elsewhere as long as it is possible to hold them. Whether they could be retained longer than the month of August would remain to be seen. But judging from the length of time which it takes the fur-seal pup of three months old to starve, they would not suffer for want of food within a month.

It is to be hoped that neither branding nor herding the seals may be necessary in the future as a means for the protection of the fur seals; but in case such measures are necessary, we desire to call attention to the fact that both plans are entirely feasible, and that, systematically carried out, they furnish a means of doing away with pelagic sealing, or at least so seriously crippling it as to make its abandonment certain. With its mark of ownership and reservation thus stamped upon its herd of breeding females, the United States should then set about a determination of its rights of redress against the slaughter of such animals, wherever killed.

In conclusion we may call attention to the fact that both of these experiments have an important place in the proper management of the fur-seal herd, aside from their bearing on the fur-seal question. As the young yearlings and 2-year-old males swarm over the hauling grounds late in July, they crowd the drives and become a nuisance and obstruction on the killing fields. From the beginning of the season, moreover, the half bulls and idle bulls, of which many get into the drives, are a menace to those conducting the killing. These seals, rejected from the killing, should be turned into the salt lagoon instead of being allowed to go back to their hauling grounds to reappear in the very next drive. They should be held for a week at least, or until a second drive has been made, and then released, their place in the lagoon being filled by the new lot of rejected seals. The unnecessary driving which marks the close of the season will be in a large measure diminished, and the work of handling the seals on the killing grounds will be made much simpler and easier. Furthermore, it will not be devoid of interest to study the actions of the seals themselves under confinement, opportunity to do which will be thus afforded.

In the matter of branding, also, we may note it is of the utmost importance to the Government to know just what proportion of breeding males are necessary for its herd. This fact once known, it then becomes equally important to see that the proper number of young males are reserved for the replenishment of the breeding stock. Under present conditions the matter of securing this reserve is left more or less to chance. There is no evidence that the 3-year-old which is allowed to escape from one drive will not be taken in the next.

It is more than probable that the reserves are at present sufficiently supplied from those hauling grounds which, through inaccessibility or from other cause, it is difficult to reach. But this still leaves the matter to chance. In the future management of the herd it ought to be possible to reach and utilize these hauling grounds. With the full product of the herd under control, it should be the business of those having it in charge to choose out, brand, and so reserve for all time those males which are to be set apart as breeders. Whether this branding should be done when the males are pups or at the age of 1 year or at the age of 3 are matters of detail which must be worked out in practical experience. What we wish to point out now is the fact that branding can be and should be thus employed to make certain that the proper reserve of males is left.

APPENDIX I.

REPORT ON THE ELECTRICAL EXPERIMENTS IN THE BRANDING OF THE FUR-SEAL PUPS—SEASON OF 1897.

By Elmer E. Farmer, *Assistant to the Commission.*

The earliest experiments in electrical branding, made in the laboratory at Stanford University, were carried on under serious difficulties, resulting from a lack of suitable apparatus and machinery as well as of suitable fur on which to operate. Having neither low-voltage dynamo nor suitable rheostat, it was necessary to use the incandescent-light circuit, on account of the high voltage of which approximately 11,000 watts were used instead of the necessary 300. This excessive voltage caused trouble in the loaded dynamo and reacted on the experiments by changing factors which were supposed to remain constant.

The only available fur of a living animal approaching that of the seal which we could obtain for use in the early experiments was cat's fur. On this our results were very satisfactory. Searing the outer surface of the skin of the cat, without burning underneath, was found sufficient to destroy the hair cells. This could be accomplished with one stroke in about ten seconds, a mark 1 inch wide and about 5 inches long being made. When we came to deal with the actual fur of the seal we found it so different that these early experiments gave us no real idea of what was wanted.

As a result of the preliminary tests, under your authorization I set about the preparation of more suitable apparatus.

THE APPARATUS.

The apparatus provided for the work in electrical branding consisted of a direct-current dynamo, compound wound, and weighing 85 pounds. The dynamo was connected to a half-horse power gasoline engine weighing 160 pounds. The gas was ignited by a battery and coil.

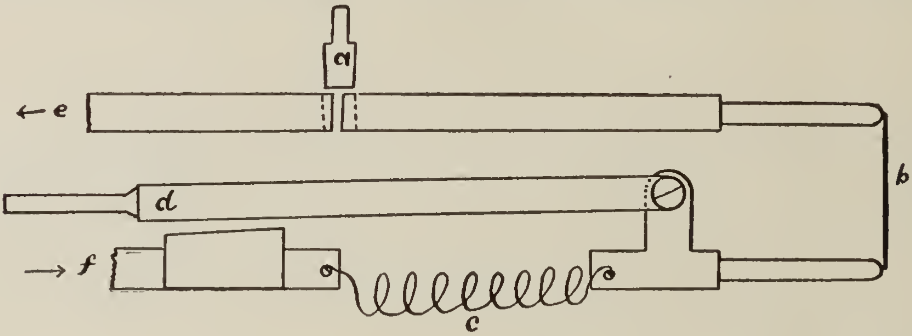
Platinum was chosen as a cautery wire, on account of the high temperature of its melting point and its comparative nonoxidizability. The size of wire used was No. 18 B. & S., which seemed large enough to insure the required strength at white heat and yet small enough to require only an economical amount of power, with a minimum expenditure for replacement in case of fusing.

The hand rheostat to which the cautery wire was attached had, in its final form, simply a coil of iron wire short-circuited by a heavy lever arm and plug "cut out" inserted in series with the wire.

The connections were as represented in the figure: *a*, plug cut out; *b*, cautery wire; *c*, iron wire resistance; *d*, lever arm; *e* and *f*, terminals to be connected to the dynamo.

After the dynamo of low voltage was completed, a run of five hours was made with the current at its full value, to test the plant. The test also showed that the current could be controlled by the rheostat, and was large enough to keep the cautery wire white hot during the burning.

Our practical work with the apparatus shows that improvement can be made on the present handle, in the method of holding the cautery wire, and also in the form of the lever for the control of the current. The least weight possible was put into the plant, as it was supposed to be necessary to carry it by hand from place to place. This made parts of the apparatus too light. For permanent work a heavier plant



mounted on wheels would be better suited to the conditions. There are few of the rookeries which can not be reached with a team.

THE FIRST TESTS.

The first tests were made on dead pup skins soon after the apparatus reached the island, and were a failure. The engine furnished an insufficient amount of power to burn with any degree of ease through the seal fur, which is several times denser and much finer than that of the cat.

The power generated in the earliest tests was less than that previously obtained in the trial run. This was due to the following causes: A bent shaft on the engine, caused by rough handling in transport; slipping of the belt; dampness in the coils of the dynamo, allowing a leakage of the magnetizing current; and an inferior quality of gasoline which had been supplied.

Before the time arrived for work in active branding, these faults were corrected and an improvement made in the commutation of the current, but there was still insufficient power to do the branding rapidly. Two hand gears were then mounted on the base between the engine and dynamo. They were belted to the vacant fly wheel and a wooden pulley mounted on the same shaft. With this arrangement more power was generated than could be used.

Under these conditions the apparatus proved satisfactory. Dead pups were branded with a uniformly smooth brand 1½ inches wide at a single stroke.

THE TESTS OF LIVING PUPS.

When the apparatus was thus made ready, 12 live pups were brought up in a wagon from Kitovi rookery.

The conditions in dealing with the living animal were found to be entirely different from those in connection with the dead. It took some time to learn how to handle the cautery over the loose and yielding skin of the living pup. As a result it was found necessary to make two strokes instead of one. On the whole, therefore, the branding of the first 8 live pups was much less satisfactory than the branding of the dead ones. On the last 4, however, better results were obtained. Experience gave confidence in handling the cautery, and the brands were satisfactory in all respects as regards length, breadth, intensity, and uniformity. They were acceptable to Colonel Murray. The only unsatisfactory element was that of time. It required fully thirty minutes from the beginning to the end to brand the 12 pups.

The time was greatly lengthened, however, by several delays due to accidents. A belt was thrown from one of the hand pulleys, and one of the improvised stands was completely overturned by the loosening of a screw in the soft redwood base. The plug "cut out" had been soldered up, to do away with a small loss of power, and it therefore became necessary to stop the entire plant each time a cautery wire fused. This occurred four times in the branding of the first 8 pups but not at all in the branding of the last 4. The unknown factor of how long a cautery wire would last under constant use could only be tested by actual continuous trial. These and all other questions we had no opportunity to properly test, as, the Commission having left the island, we were not allowed by the Treasury agent in charge to experiment further on living pups neither at this time nor at any time later.

CONCLUSION.

While this test was wholly inadequate to show the full possibilities of branding by the cautery wire, its action in the case of the last 4 pups indicated that the principle of the cautery was a success. With the apparatus improved and perfected the work can undoubtedly be greatly accelerated. Barring accidents, it is my belief that after a little practice 4 pups a minute could be branded with the cautery wire, as running at the close of our test. With the perfection of the apparatus, aided by experience and practice, this number could undoubtedly be increased. It was possible with the irons to average five a minute, and in that case it was necessary to burn through the entire fur, whereas with the cautery wire only a short length of fur at the surface of the skin had to be burned.

COMPARATIVE RESULTS.

We were allowed for a short time at the first day's branding to observe the method of branding with the irons. It was in the whole very satisfactory. In the matter of speed and simplicity the process is all that could be desired. A round iron would be better than the rectangular one used by Colonel Murray. We made one of these and he used it for a time.

The principal objection, which is in no sense fatal, to the present method of branding by the hot irons lies in the smallness of the animal and the weight of the iron. It is difficult to control the depth of the burning and the long handle (nearly 4 feet) removes the work too far from the eye to make it possible to see clearly what is being done. It would be better to use a small iron with a short handle, which would bring it under the direct control of the muscle and sight of the operator. The heavy irons now used are adapted more to the branding of cattle than to the branding of a small animal like the fur-seal pup.

The advantages of the electrical cautery are that it brings the work closely under the control of the operator; it requires no weight or pressure; it does not necessitate the burning down through the thick, oily fur. The wire cuts through the fur at the surface of the skin like a razor. The platinum being kept at a uniform and much higher temperature, the scar can be made more quickly and practically without pain.

APPENDIX II.

EXPERIMENTS IN BRANDING AND HERDING SEALS ON ST. PAUL, 1897.

By Joseph Murray.

In accordance with instructions from Dr. David S. Jordan, under date of August 8, I submit the following brief report on the results of the experiments in herding and branding the seals:

HERDING IN THE LAGOON.

The fence about the lagoon was completed in due time by the young men assistants left for this purpose and to help in the branding. On September 1 the seals were driven from the hauling grounds of Reef, Kitovi, Lukanin, Tolstoi, and Middle Hill and kept within the inclosure under close watch until September 7, when the fence was opened and they were allowed to return to the sea and to their respective hauling grounds, which they did by degrees during the following week, many of the animals showing no particular haste in abandoning the inclosure.

At first the seals gave evidence of feeling the restraint put upon them. They patrolled the inside of the fence until they established a beaten path. A few climbed over and others found holes under the fence through which they crawled. After a day or two, however, the novelty wore off and no further attention was paid to the fence. The closest observation during the time of their captivity failed to discover anything in their actions or movements that indicated uneasiness or suffering of any sort.

The experiment of holding the seals in the lagoon by means of a fence may therefore be considered entirely successful. I never doubted its practicability, and the test has removed all possible doubt. I strongly favor the fencing of every important body of water on the islands, which can be conveniently used for the purpose, and the holding in them of the young seals for a month or six weeks in the sealing season.

BRANDING.

The branding was begun on September 7, at Lukanin rookery. About 350 pups were driven up, assorted, and branded during the forenoon, an effort being made to make the natives familiar with their work rather than to accomplish large results. The natives entered into the spirit of the work, and soon became skillful and effective in its various operations.

On the 8th, getting an earlier start and having two forges running, we branded 1,017 pups. During the forenoon of the 9th 600 pups were branded on Kitovi, and in the afternoon 900 on the Reef.

Heavy rains interfered with the work until the 14th, when 804 additional pups were branded on the Reef. On the 15th work was again interrupted by the rain, but on the 16th a third branding of 600 pups and 100 cows was made on the Reef.

On the 17th we crossed over to Zapadni in boats and branded 600 pups and 8 cows. The following day 500 pups and 10 cows were branded on Tolstoi rookery.

In all we branded 118 cows and 5,371 pups. I used two forges, with two men to attend each, keeping six irons hot. One man carried the irons to and from the forges. With nine active young men to handle the pups, I found it possible to brand 300 an hour without special exertion.

With an assistant, and a duplicate set of forges and men, 5,000 pups a day could easily be branded, or in twenty working days 100,000 pups, which is nearly double the number of female pups at present on the islands. So far as the labor is concerned, the branding of all the female pups each year is entirely possible. It is simply a matter of time and men.

BRANDING DOES NOT INJURE THE ANIMALS.

It is evident that the branding does not injure the animals. The adult cows branded last year were seen in good condition and with their pups on the rookeries this year. The pups branded last year were also to be seen in numbers hale and hearty on the hauling grounds and rookeries. The salt water helps rather than hinders the healing of the wound. Neither pups nor adult cows are driven from the islands by the operation of branding.

The most difficult part of the work is the driving of the pups and the sorting of the sexes. This requires men and careful supervision, but this is all. The pups stand the handling well. Of the number handled this season, which must have exceeded 10,000, only one pup was killed.

The appearance of the branded cows, as well as of the yearlings, shows clearly the effectiveness of the brand to depreciate the value of the skins. Each brand mark stands out bare and clean, not a trace of fur having come to replace that which was burned.

CONCLUSION.

I am well satisfied that in the plan of herding the bachelors and branding the female seals has been struck the keynote of the whole situation. Carried to their logical conclusion, these methods will forever settle the vexed question of pelagic sealing.

The following is a detailed list of the brandings, together with the different marks used, which will doubtless be of value to future observers:

Statement of seal branding on St. Paul Island for the season of 1897.

1897.	Rookery.	Cows.	Brand.	Pups.	Brand.	Total.
Sept. 7	Lukanin			350		350
8	Lukanin and Kitovi			1,017		1,017
9	Kitovi			600		600
9	Reef			900		900
14	do			804		804
16	do	100		600		700
17	Zapadni	8		600		608
18	Tolstoi	10		500		510
	Total	118		5,371		5,489

APPENDIX III.

BRANDING ON ST. GEORGE.

Mr. James Judge.

In pursuance of instructions received from Dr. David S. Jordan, commissioner in charge of fur-seal investigations, I submit the following statement regarding the work of branding female fur-seal pups on the island of St. George for the season of 1897.

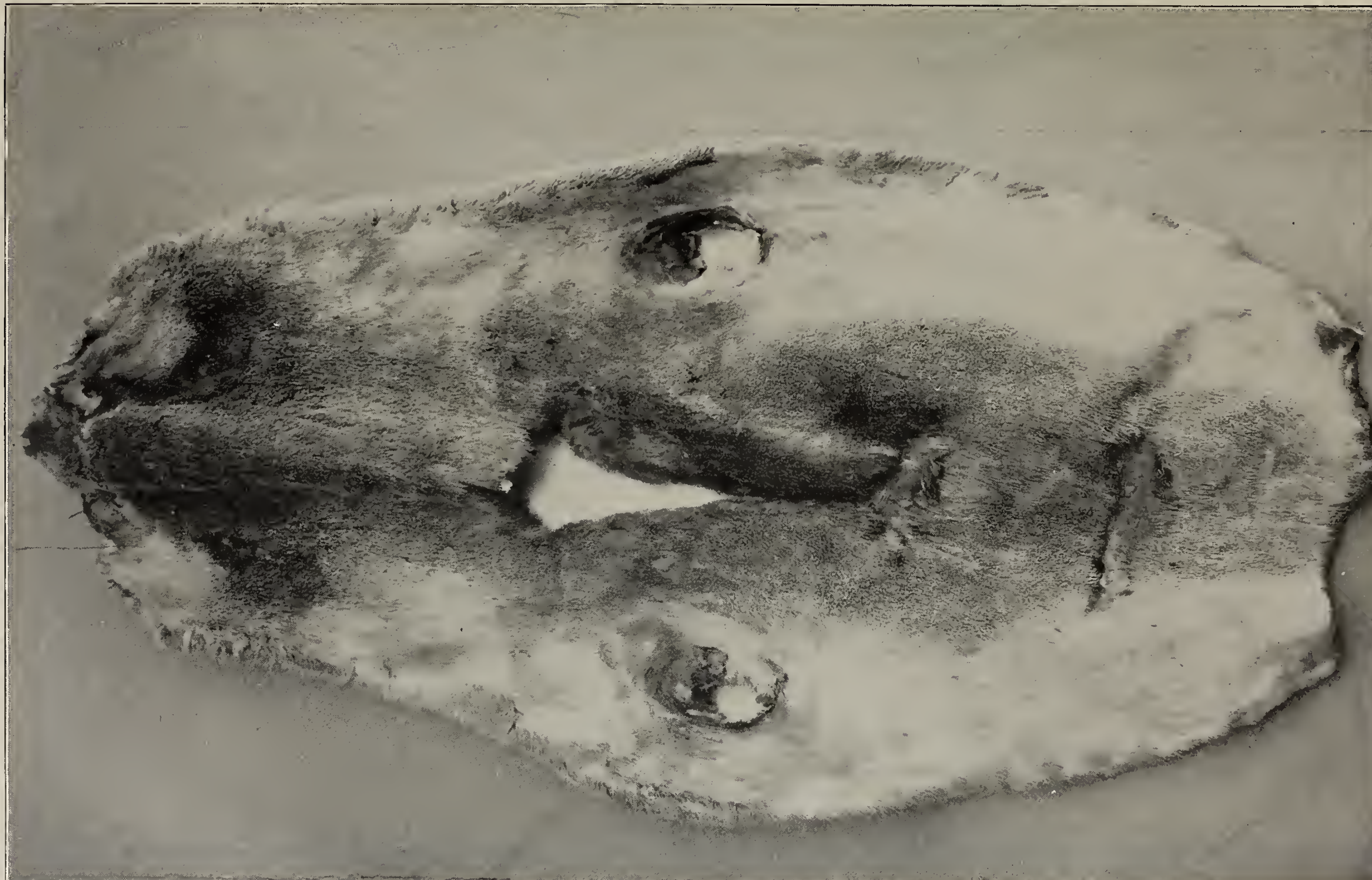
Date.	Rookery.	Pups branded.
Sept. 17	North	416
18	do	27
21	Staraya Artel	404
22	Zapadni	677
23	East	235
23	Little East	121
	Total	1,880

The pups on North and Staraya Artel rookeries were branded across the back with this mark, ; those on East, Little East, and Zapadni rookeries with this, . The marks extended well down on the sides of the pups, giving the brands a circular appearance.

In the drive on East rookery four sea lion pups were included among the fur-seal pups and were branded, one with three and the others with two marks each, similar to those put on the fur-seal pups. These may be of interest to future observers.

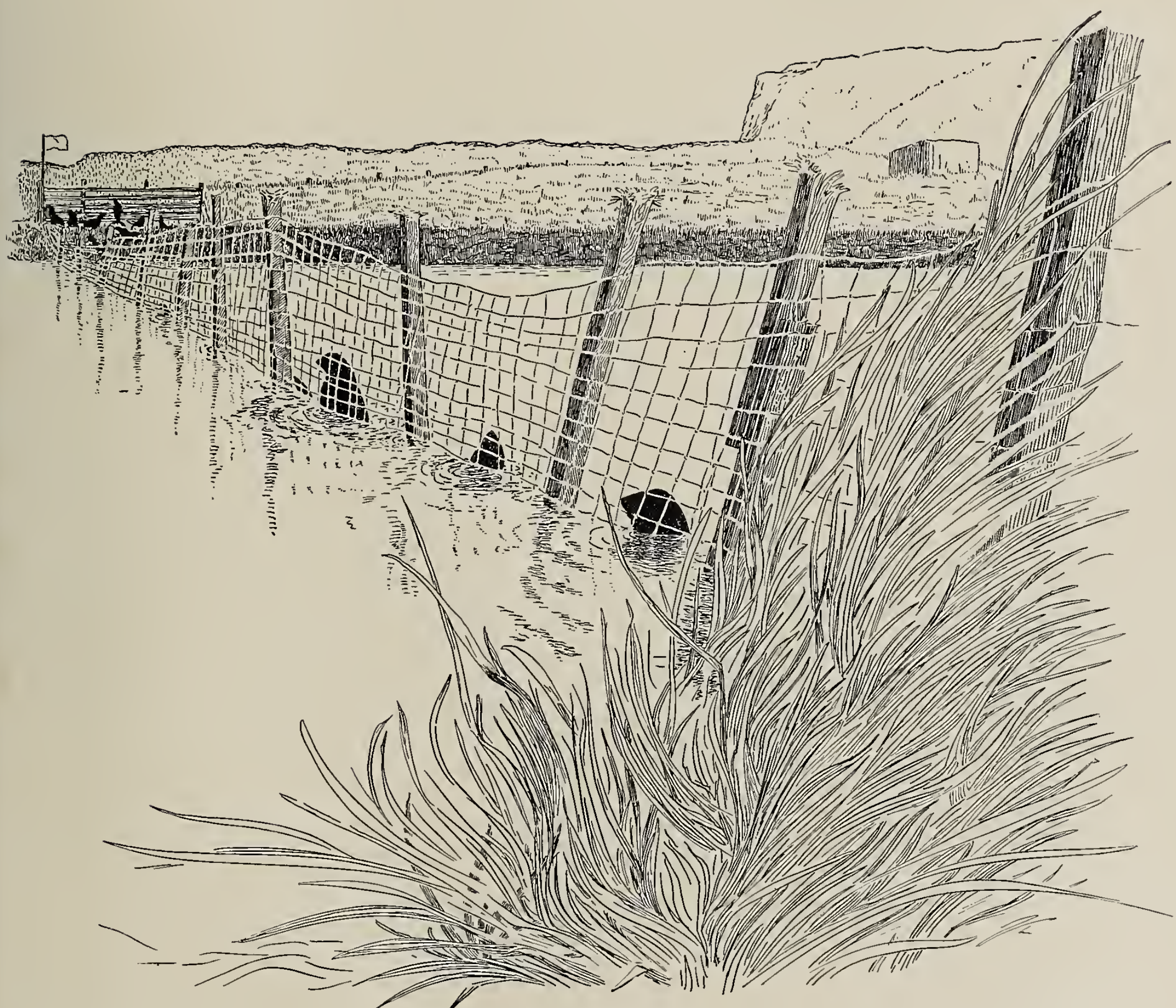
BRANDING SEALS ON LUKANIN ROOKERY.

From a photograph by Dr. Otto Voss.



A BRANDED SEAL SKIN.

This skin was taken from a female seal killed in the harbor at Akun, Aleutian Islands, in November, 1896, and turned over to the commission by Mr. A. Gray, of Unalaska. In the process of tanning a portion of the skin burned by the iron has fallen out, showing the effectiveness of branding as a means of depreciating the value of pelagic skins.



HERDED SEALS IN THE SALT LAGOON.

Drawn from nature by Bristow Adams.

XV.—THE BLUE FOX OF THE PRIBILOF ISLANDS.

By David Starr Jordan and George Archibald Clark.

One of the important resources of the Pribilof Islands is the so-called Arctic fox or blue fox *Vulpes lagopus*, which is widely distributed along the coasts of Alaska and on the islands of Bering Sea. It is associated with the fur seals both on the Pribilof and on the Commander islands, and in these places it has received a certain degree of protection. The blue fox and the white fox are identical as species, both being found in the same litter, the white fox being simply an albinistic form of the other, its inner fur showing always some blueness or grayness.

Of the general distribution of this animal Ivan Petroff in his report of 1883 gives the following account:[1]

Of the Arctic fox we find in Alaska two varieties—one white and the other a bluish gray, commonly called "blue fox" by the traders. The white fox is found along the coast of continental Alaska from the mouth of the Kuskokwim northward to Point Barrow and the eastern boundary. Its fur is of a snowy white, especially in the young, and both soft and long; but, owing to the lack of durability, it does not command a high price in the market.

The animal is very numerous northward of Norton Sound, and not at all shy. Natives and travelers alike report instances of the fearlessness with which these foxes enter their camps, and even dwellings, in search of food or out of mere curiosity. A large portion of the skins secured by Eskimo and other natives are used by themselves for trimming their garments, and the remainder falls chiefly into the hands of whalers and whisky smugglers, so that it is impossible to obtain accurate figures as to the annual catch. They may be called omnivorous, and they refuse nothing that will fill their stomachs. I observed one sleek and apparently well-fed specimen which devoured nearly the whole of a large salmon and afterwards worried down, with considerable difficulty, a thick leather strap with a heavy buckle attached to it. In the depth of winter the natives find it unsafe to leave any article of clothing, dog harness, or boat material within their reach.

The blue fox exists now on several of the Aleutian Islands, where it was found by the first discoverers in 1741. The animal is also found on the Pribilof Islands, and here, where it has been possible to protect the species against intermixture with other and inferior foxes, the skins are of the finest quality, commanding a high price in the market. Traders report the existence of the blue fox to a limited extent in the vicinity of Oogashik, on the Aliaska Peninsula, and also on the Lower Kuskokwim; and it occurs also on the delta between the mouths of the Yukon and Kuskokwim. Captain Hooper, of the Revenue Marine, who commanded the U. S. S. *Corwin* during two successive cruises in the Arctic, reports that he saw blue foxes at Cape Espenberg, Elephant Point, Hotham Inlet, Point Hope, Point Belcher, and Point Barrow. The same gentleman also states that he "found the blue fox much more plentiful on the Siberian than on the American coast, and that all the blue foxes in the far north are so inferior to those on the islands of Bering Sea as to suggest the possibility of their being a different species." Even on the Arctic coast Captain Hooper saw blue foxes, taken at the same time and place, differing very much in the color and quality of the fur. On the Pribilof Islands from 1,000 to 1,500 of the best quality of blue-fox skins are annually [1883] shipped, and several hundred of a little inferior quality from Attoo and Atkha islands, but it is impossible to ascertain the quantity obtained along the Arctic coast by whalers and illicit traders.

[1] Seal and Salmon Fisheries and General Resources of Alaska, 1897, Vol. IV, pp. 255–256.

In our investigations of the past two seasons we found these little animals objects of much interest. They live in the crevices and interspaces of the castle-like masses of angular bowlders that crown the various headlands of the islands. These headlands are also the home of the myriads of sea birds which frequent the islands.

In our visits to certain rookeries of St. Paul the peculiar rasping cry of these little animals as they caught sight of us soon became a familar sound. After a few visits to the Reef on St. Paul, a pair of these foxes regularly followed us about over the parade ground, dogging our footsteps and at times snapping at our heels. The animals are protected from molestation and annoyance in the summer; as a result of this immunity they grow overbold and impudent.

The natives are allowed to take the foxes only in traps during a short period in midwinter when the fur is in the best condition. From our limited opportunities for studying the animals it would seem that they breed in pairs, bearing several young at a birth, and that the time of bringing forth the young is in June or July. On the 29th of June two of the little foxes, which appeared to be about a week old, were seen playing about the mouth of a fox burrow at Northeast Point. They were so tame that they could be handled like kittens.

Of the past history of these animals we have but little data beyond the account of Ivan Petroff, just quoted. As to the importance of the herd of blue foxes on the Pribilof Islands, we may gain some knowledge from the statistics of the furs purchased by the Russian-American Company during the period from 1842 to 1860; also given in Petroff's report. From this we may take the following summary:

Arctic foxes purchased by the Russian-American Company from the Pribilof Islands, 1842–1860.

Date.	St. Paul.	St. George.	Date.	St. Paul.	St. George.
1842	505	1,491	1853	641	1,238
1843	515	1,377	1854	624	1,291
1844	394	1,343	1855	....	1,123
1845	365	1,366	1856	514	1,145
1846	528	1,418	1857	1,417	1,198
1847	515	1,354	1858	558	1,555
1848	461	1,298	1859	619	1,296
1849	519	1,069	1860	625	911
1850	519	1,073			
1851	517	1,263			
1852	645	1,477	Total........ 34,767		

For the period between the transfer of the fur-seal islands in 1867 to the United States and the year 1880, Petroff gives a total of 27,731 foxes as taken from Alaskan sources, doubtless including others in addition to those taken from the Pribilof Islands. He remarks that these returns are incomplete and "necessarily below the real figures."

In recent years the catch of blue foxes has diminished. In so far as we have been able to get the returns, it is as follows:

Blue foxes taken on the Pribilof Islands, 1890–1896.[1]

Season.	St. Paul.	St. George.	Season.	St. Paul.	St. George.
1890-91...	505	793	1894-95...	nil.	nil.
1891-92...	nil.	nil.	1895-96...	467	[2]33
1892-93...	438	875	1896-97...	176	497
1893-94...	nil.	nil.	Total............ 3,784		

[1] These figures were furnished by the North American Commercial Company.

[2] The taking of foxes on St. George in this season was stopped by the Treasury agent.

When we contrast these recent catches with those of the earlier period covered by the statistics of Petroff, we find that there has been a marked falling off in the product of the herd. It is not necessary to look for the probable cause. While the foxes are protected at other seasons of the year, during the period of trapping their only safety lies in the limitations of the trapper's ingenuity and in their skill to elude him. With an extended period of hunting, especially at the time when food is scarce, doubtless the whole herd could be wiped out in a single season.

The precarious condition of the herd, or at least the importance of taking better care of it, has evidently been recognized by the Department, as the following quotation from Chief Agent Crowley's report for 1893 will show:[1]

> I have ordered that the catch of blue foxes be limited to the month of December, 1893, and that the price fixed for the skins taken be $5 apiece. The cause for limiting the time to one month for trapping was, in my judgment, necessary for the preservation of the foxes. It is suggested in my instructions in connection with the blue-fox trapping that if a trap could be contrived in such a way as to prevent injury to the fox, and all females so caught turned loose, such a course would tend to increase the supply of these valuable animals. Such a method would certainly be an advantage if it were possible to carry it into effect; but at least two obstacles will be in the way of making this method a success. First, to invent a trap sufficiently large to hold a fox without doing him some bodily injury, and devising a plan to induce the wary fox into it; second, to take chances on the native trapper, who has probably tramped across the island from five to seven times a week through cold and snow knee deep, having convictions of honesty and courage enough, when he comes to his trap and finds the only fox he has caught that week to be a female, to turn it loose. I advised, however, that this sort of a box trap be tried as an experiment. To avoid the wholesale slaughter of foxes, the better plan would be to adopt the rule of only trapping foxes every alternate winter until they have increased sufficiently to warrant a more frequent limited catch.

Here the attempt has been made to exempt the females from slaughter. Doubtless in accordance with these same instructions, Mr. James Judge, agent in charge of St. George Island, in the season of 1896–97 put the idea of a box trap into practical execution. By salting away meat in the killing season and freshening it in the winter to feed the foxes, he attracted them to certain centers where his traps were located, and the females caught were released.

It may be noted that these efforts to better the condition of the foxes are based upon a mistaken analogy. It is attempted to treat the blue fox as though it were identical in habits with the fur seals. The female of the fur seals is exempt from slaughter on the islands, and this principle is applied to the fox. The latter is not, however, polygamous, and therefore the saving up of females without making provision for a like supply of males would be folly, unless it should have in time the effect of developing in these animals a polygamous habit.

We do not know the breeding habits of the blue foxes sufficiently well to say just what should be done for their protection. From our casual observation it would seem that they breed in pairs and bring forth several young at a time—two at least, possibly more. With these fundamental facts in mind, any system of preserving females only is inadequate. The aim should be to leave a definite number of breeding pairs to survive. When the number of pups born at a birth is exactly known, from a given stock of breeders, it will be possible to know the approximate product. The problem would then resolve itself into the discovery of practical methods for insuring the reservation of an ample breeding stock and making provision for its growth.

How this can be accomplished we are not prepared to say. The box-trap method

[1] Seal and Salmon Fisheries and General Resources of Alaska, 1897, Vol. I, p. 411.

of capture, in some modified form, might attain the desired end. A certain definite number of animals in pairs from the first foxes caught might be set apart as breeders, which, being marked in some way, could be released if again caught. It may be that a time limit, cut short enough to make it impossible to catch all the foxes, is the only feasible one. The necessary protection to a breeding herd might be afforded by exempting certain tracts of the island from the operations of the trappers. But we offer these merely as suggestions.

It has further been attempted to provide artificial means for feeding the foxes. A successful beginning in this regard was made on St. George Island during the season of 1896 by Mr. James Judge, who salted away in silos the superfluous seal carcasses on the killing field, freshening the meat in the winter time and giving it out to the animals. It was understood during the past season that the lessees would make experiments on St. Paul Island in the same direction with artificial food of some sort.

Here again intention, while good, has clearly outrun adequate knowledge on the subject. The question naturally arises whether it is necessary to thus provide food for the foxes. We may note that during the nineteen years of which we have the record given by Petroff the number of foxes taken averaged three and one-half times as great as for the past seven years. We are not aware that any effort was made to feed the foxes then, or that they did not have food enough. The decline in the fur-seal herd has probably had nothing to do with the matter. The presence of the bones and feathers of sea birds about the fox dens, and the broken egg shells along the fox trails in summer when the killing grounds are covered with seal meat, clearly shows that the chief diet of the foxes is not seal meat. In the autumn of 1896 the foxes were known to have eaten dead pups on St. George, but a similar phenomenon was not witnessed on St. Paul.

It appears from the early records that St. George has always furnished the greater proportion of foxes, although always the smaller proportion of seals. As the sea birds are far more numerous on St. George than on St. Paul, it would seem that their flesh and eggs rather than seal meat is the regular diet of the fox while they are to be had. The fox-runs on the islands all point toward some cliff or place frequented by the sea birds.

Whatever may be said of these attempts to better the condition of the fox herd, it must be borne in mind that they clearly recognize the two important factors of the problem. Some plan must be adopted whereby a definite breeding herd is insured and if possible enlarged. As this grows, artificial means of increasing the food supply must be devised after the natural limit has been reached. The criticism we have to offer is that an attempt has been made to apply methods and means of protection without definite knowledge as to the facts and needs of the herd. To a monogamous animal, wholly confined to the land and bearing several young at a birth, has been applied the regulation which was designed to serve an amphibious animal, polygamous in its habits and bearing but a single young at birth. The attempt to feed the animals by artificial means has been undertaken without definitely knowing whether or not such a course was necessary.

What we wish to emphasize in this connection is the fact that a thorough study of the natural history and breeding habits of the blue fox should precede any final plan for its protection. With full knowledge of the problem to be dealt with, means for solving it can be intelligently devised and effectively carried out.

It has not been our purpose to give an exhaustive treatment either of the history or habits of the blue fox, but to point out the necessity and desirability of a serious and systematic study of the subject. As we have seen from the table of annual catches of foxes, for nineteen of the years of Russian control the average number of skins was 1,800 a year. This number, at the rate which the lessees now pay the natives for fox skins, would yield a sum of $9,000 annually, which is no insignificant matter to the Government in providing for the natives. It is to be supposed also that with proper management and care the output of the herd might be made still greater than it has ever been in the past.

We have had occasion to recommend that the fur-seal herd be placed in charge of a trained and capable naturalist, in order that its needs and possibilities may become the object of systematic study and care. The problems connected with the blue-fox herd demand equally such attention and furnish an additional field for study.

XVI—MAMMALS OF THE PRIBILOF ISLANDS.

By Frederick W. True.

The species of terrestrial mammals of the Pribilof Islands are so few in number that they can scarcely be said to constitute a fauna. We find only a shrew, a lemming, and a fox. The first two are closely allied to species on the American mainland, and the fox is supposed to be a late introduction. The islands are composed almost exclusively of volcanic materials, but certain fossil remains have been found on St. Paul which are believed by some to indicate that their origin was not entirely volcanic. However that may be, if the present mammals were derived from a preexisting fauna we might properly expect them to differ more than they do from the mainland forms. That they are very closely related would seem to indicate that they are late arrivals from the mainland. The fox, as already stated, is believed to be certainly such, and the same is probably true of the lemming and shrew.

It is a singular fact, however, that the lemming is confined to St. George Island and the shrew to St. Paul.

The pinniped carnivora—the fur seal, sea lion, and walrus (now extirpated)—are not peculiar to the islands, and no cetacean is known to frequent their shores exclusively.

PRIBILOF SHREW.

Sorex pribilofensis Merriam.

Sorex pribilofensis, Merriam, North American Fauna, 10, December 31, 1895, p. 87.

This beautiful little shrew is readily recognizable by its peculiar coloration, being grayish sienna brown on the back and abruptly whitish on the sides and belly. The white of the sides is tinged with buff, while that of the under surface is purer.[1] The chin, throat, and feet are white and the tail is bicolored, brown above and white below.

Dr. Merriam gives the following average dimensions of five individuals: Total length, 4.13 inches (105^{mm}); tail vertebræ, 1.50 inches (34.5^{mm}); hind foot, 0.52 inch (13.2^{mm}).[2]

The Pribilof shrew, so far as known, occurs only on St. Paul Island. Mr. William Palmer reported in 1890 that the natives considered it very abundant on the

[1] There is another American shrew, *Sorex richardsoni*, which is sharply tricolored, but this is a species with the under parts dusky and washed into chestnut.

[2] Mr. William Palmer's measurements of seven adults give 3.7 inches as the average total length.

north shore. He obtained no less than sixteen specimens, including both adults and young. Dr. Merriam also obtained specimens in 1891. Mr. Prentiss and myself put out traps for it many times, in 1895, but either for want of proper bait or for some other reason did not capture any. By impressing the native boys into our service, however, we obtained specimens. These were caught at the East Landing salt house near the village of St. Paul.

I found two dead shrews on the low ground at the west end of village hill, and later one was picked up alive on one of the hills north of the village during a seal drive from Lukanin hauling ground. The natives report that they are often seen in the water, and their tracks are to be found on the muddy shores of the village pond.

The shrew feeds on the seal carcasses and such insects as are obtainable. One seen by Mr. Palmer in 1890 was feeding on whale blubber.

The young are noticeably duller in color than the adults, and the color of back merges much more gradually into that of the belly. The feet and tail are more hairy, and the hairs at the end of the tail form a long pencil.

A male taken June 22, 1890, is molting. Two males taken August 13, 1895, are also in this condition, though it seems somewhat early for them to take on the winter coat, if such it is. A female taken August 14, 1895, also shows traces of the molt.

In the skeleton the vertebræ formula is as follows: c. 7. d. 13. l. 6. s. 5. ca. 14=45.

PRIBILOF LEMMING.

Lemmus nigripes (True).

Myodes nigripes, True, Proc. U. S. Nat. Mus., 17, No. 999. Advance sheet April 26, 1894.

The occurrence of a lemming mouse on St. George was reported by Elliott in 1875[1] and also 1882[2] from notes made between 1872 and 1876. He identified it with the Asiatic species, *Lemmus obensis*. Later, Mr. Charles H. Townsend collected two specimens for the National Museum, and finding it apparently distinct from any described species, I gave a diagnosis of it in 1894, under the name of *L. nigripes*.

The following is a repetition of the original diagnosis:

LEMMUS NIGRIPES (True).

Upper surfaces nearly uniform cinnamon-gray, without bands or spots. Sides, including the lower part of the cheeks and neck, clear tawny brown. Under surfaces paler tawny, which tint is gradually merged into the stronger color of the sides. Nose black. Fore feet black above, tawny below. Hind feet black both above and below. Tail bicolored, black above, pale tawny below.

Dimensions (from dry skin; type).—Head and body 130 mm; tail vertebrae, 13 mm; hind foot (without claw), 17.5 mm.

Type.—No. 59152, U.S.N.M., male, St. George Island, Alaska. Collected by Charles H. Townsend, August 18, 189(?).

The only specimens of this lemming I have seen are from St. George, and Elliott in 1875 states that it was restricted to that island. Dr. Merriam also, in his enumeration of the mammals of the Pribilofs, cites it as a species found "only on St. George."[3] Mr. Palmer's manuscript record of 1890, however, contains the note "none seen on St. Paul, though a few have been introduced." In 1895 I saw at Northeast Point, St.

[1] Report upon the Condition of Affairs in Alaska, 1875, p. 72.

[2] Monogr. Seal Islands of Alaska, Special Bulletin U. S. Fish Com. 176, 1882, p. 125.

[3] See Abstract in Science, new series, I, p. 698, June 21, 1895.

Paul, what appeared to be the droppings of this mouse, but as the circumstances permitted only a hasty inspection of them, I may have been mistaken. It may be stated positively that no specimens of the lemming are known from St. Paul, and if the animal occurs there at all the fact remains to be demonstrated.

Mr. Elliott wrote as follows in 1875:

> Aside from seal life on the Pribilof Islands, there are no indigenous mammalia, with the exception of blue and white foxes and the lemming (*Myodes obensis*),[1] which latter is restricted, singularly enough, to the island of St. George, where it is exceedingly abundant. Its burrows and paths under and among the grassy hummocks and mossy flats literally checker every square rod of land there covered with this vegetation; and although St. Paul Island lies but 29 miles to the northwest, not a single one of these active curious little animals is found there.[2]

Mr. Palmer reported that though formerly abundant, they had become scarce in 1890. My own observation in 1895 led me to the same conclusion as regards the north side. In the lichen-covered fields between the village and Staraya Artel their runways were enormously abundant, but they were very largely deserted. Mr. Prentiss labored faithfully during a sojourn of ten days on the island to obtain a series of specimens, but only secured four. He reported, however, that on the south side of the island, in the vicinity of Zapadni rookery there were numerous fresh runways, and at one point he saw two lemmings running through them.

In 1896 and 1897 the scarcity of lemmings was very noticeable, but one specimen being seen and none taken. This scarcity is attributable to the foxes, which are abundant and devour the lemmings whenever possible.

The condition of knowledge regarding the American lemmings of the present genus is not at all satisfactory. Richardson described two species from Arctic British America, under the names of *helvolus*[3] and *trimucronatus*.[4] Middendorf considered them both identical with *M. obensis* Brandt, in which opinion he was followed by Coues.[5]

From the scanty material at command, it would appear that the American lemmings are certainly distinct from the Asiatic *obensis*, and that there are two species besides the Pribilof form. Whether Richardson's two species are really distinct from each other, and whether either are represented in the National Museum collection can not be definitely determined at present. A form from the Arctic coast and from the mouth of the Porcupine River, which appears to represent *trimucronatus*, is close to the Pribilof species, differing only, so far as can be determined, by its smaller size and brownish rather than black feet. The island form may thus prove to be at most only a subspecies of one of the mainland species.[6]

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[1] The shrew was not then known to exist there.

[2] Report, 1875, pp. 72, 73.

[3] Fauna Boreali Amer. I, 1829, p. 128.

[4] Parry's Second Voyage, Appendix, 1825, p. 309; l. c., p. 130.

[5] Coues and Allen, N. A. Rodentia, 1877, p. 240.

[6] Wagner also described an American species under the name of *Myodes albogularis*. (See Schreber's Säugeth., Suppl., 3, 1843, p. 602.)

HOUSE MOUSE.

Mus musculus Linnaeus.

The house mouse is extremely abundant about the village of St. Paul and has been noted by various observers also on St. George, though I did not observe it there myself. As soon as the natives on St. Paul learned that I wanted specimens they brought them in abundance, but not always in a condition to be preserved. The mouse is a great pest in the houses. A colony of them invaded our laboratory, which was established in one of the houses built for the use of the natives, and before we were aware of it took up headquarters, with disastrous results, in a box of birds which Mr. Prentiss had taken great pains to collect.

I am not aware that any record has been made of the date of introduction of the mouse into the islands. Veniaminof in 1840 includes mice among the animals of the islands, and presumably has reference to the present species. According to his account it was introduced into the Aleutian Islands by the Russians. Mr. Elliott includes it among the species observed by him between 1872 and 1876, but as it was then common in the villages it must have arrived at a considerable earlier date. In his report on Alaska, published in 1875, Mr. Elliott, referring to the Pribilof Islands, remarks: "The islands are as yet free from rats, but mice have been brought long ago in ships' cargoes and are a great pest in the winter."[1]

I saw nothing of rats while on the islands in 1895, but observe that Mr. Palmer has noted that they arrive occasionally in ships, but do not breed. Veniaminof states that the rat was introduced into Unalaska in 1828 by the ship *Finland* and increased rapidly.

ARCTIC FOX (WHITE FOX AND BLUE FOX).

Vulpes lagopus (Linnaeus).

Next to the fur seal and the sea lion the fox is the most interesting mammal of the Pribilof Islands. One is not long on the islands before making his acquaintance, and his maneuvers are a continual source of interest. Now he will be seen trotting along in the distance, turning neither to the right hand nor the left, and again he will spring up almost from under one's feet, giving utterance to his high-pitched and querulous bark. There is something uncanny in the dogged persistence with which he follows one's footsteps, falling back and barking if one faces about and drawing near again the instant one proceeds. I took pains on one occasion, when a fox had been following me for some distance, to ascertain whether these little footpads could be readily frightened away. I commenced by throwing large stones in the direction of the animal, thinking to alarm it, but it merely drew aside to let the missiles pass, and continued to bark at intervals, as before. Finally I aimed some rather smaller stones directly at the fox, one of which struck it forcibly on the forehead. The fox merely drew back a little and barked defiance, so I desisted, fearing that I might kill the animal, which I had no wish to do. As I proceeded the fox drew near again and followed me to the boundary of his domain, for each fox, like his neighbor the bull seal, seemed to have a definite territory which he regards as his own and upon which he resented intrusion.

[1] Report upon the Condition of Affairs in Alaska, 1875, p. 73.

On the hillside to the west of the Lagoon and over toward Lukanin I frequently heard the harsh bark of the fox proceeding from among the piles of rock, and here and there the little brown head of a cub would appear at the mouth of a burrow. All about these burrows were scattered fragments of sea birds' bones, of skulls and limbs of fur-seal pups, and other similar relics of repasts. Once I observed a fox trotting along toward its burrow with a fresh fur-seal placenta in its mouth, and foxes may be frequently seen on the outskirts of the rookeries hunting for placentas.

During the summer all these articles, as well as birds' eggs, are eaten by the foxes, but in winter they lead a somewhat precarious existence and subsist largely on sea urchins (*Strongylocentrotus drobachiensis*), which they obtain at low water. During the fall of 1896 the foxes devoured all the seal pups which had perished of starvation caused by pelagic sealing.

The fields all over the islands are traversed by fox trails, and many lead up and down across the face of the precipitous cliffs that bound the islands at different points.

All the foxes I saw on St. Paul were of the brown or so-called "blue" variety. Of the whole number of about 300 taken on that island in any one year not more than a dozen are white. Mr. Palmer reported in 1890 that of 800 or 1,000 taken on St. George annually not more than 30 or 35 were white.

The fox is slow in changing the winter coat and presents a ragged appearance throughout June, though retaining some patches here and there of the long winter fur. The tail remains unchanged after the molt is completed on the body, and by its faded color and the density of the fur presents a curious appearance.

The largest blue fox obtained by Mr. Palmer in 1890 had a total length of 37½ inches. This was a female. Two adult males measured 36 inches and 34½ inches, respectively.

Mr. J. B. Crowley, special agent of the Treasury, reported in 1895 as follows:

> The past winter [1894-95] was an exceptionally long and severe one at the seal islands. There was more snow fall than usual and the ice remained attached to the shores much later than common. The result was that food for blue foxes became very scarce and many of them starved to death. Special Agent Ziebach on St. George Island bought food in such quantities as he could procure and fed to the foxes that came to the village in search of food, and in this manner averted the death of many that would have otherwise perished. No foxes were trapped on the islands during the past winter.[1]

Veniaminof in 1840 commented as follows upon the foxes on the Pribilof Islands:

> Blue foxes are confined to the Pribilof Islands, on St. George especially, where they annually kill about 1,500. It is said that when these islands were first discovered there was naught but blue foxes there of most excellent quality; but a few winters afterwards came white foxes, which breed very rapidly, and in a great measure spoiled the fur; that now the fur which once was called blue is called smoky.[2]

Of late years some effort has been made to attract the foxes to the village by placing out food for them, and the white ones have been shot.

In 1896 and 1897 Mr. Judge, the Treasury agent, had the bodies of seals salted in order to feed the foxes during the winter, and in 1897, owing to the scarcity of seals on St. George, it was necessary to bring bodies from St. Paul.

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[1] Senate Doc. 137, Pt. I, Fifty-fourth Congress, first session, 1896, pp. 31, 32.

[2] Condition of Affairs in Alaska, p. 258.

FUR SEAL.

Callotaria ursina (Linnaeus).

As the natural history of the fur seal forms the basis of discussion in this whole report, and is furthermore spread over the pages of numberless other reports bearing on the fur-seal question, I shall refrain from any attempt to summarize it here. No one who has seen the great seal herds will hesitate to reckon them among the chief wonders of the world, and there is no naturalist who would not think himself well repaid for a journey half around the earth by the sight of them, were it but for a few days. Nowhere else, I presume, is an equal body of large wild animals to be found which can be observed at close range in their natural surroundings from day to day and week to week without danger to the observer or fear in the observed.

STELLER'S SEA LION.

Eumetopias stelleri (Lesson).

I had but a few opportunities of observing the sea lion at close range while on the Pribilof Islands in 1895, and can add little, therefore, to Mr. Elliott's elaborate description of its natural history, published in 1882.[1]

The great northern sea lion is an animal more grotesque and fully as interesting as the fur seal, but its reduced numbers at the present day and the general inaccessibility of its stations render detailed observation of the species more difficult.

On St. Paul the main station is at Northeast Point, and on St. George at Tolstoi Point and the East rookery. In 1895 a few resorted to Gorbatch Bay, Kitovi rookery, and other points on St. Paul Island, lying on the rocks at the water's edge. They appeared to be females. They were very conspicuous among the black basaltic rocks and the dark fur seals on account of their light color, which on sunny days appeared white by contrast.

At the East rookery, St. George Island, the old bulls and harems mingled at the water's edge with the fur seals, but neither gave the slightest heed to the other, the bull sea lions dozing contentedly on the beach, while the fur seals passed to and fro, seeking the water or returning to the rookery. Many of the bull sea lions at this point take up their stations near the shore in the shallow water, which covers them to the shoulders. Viewed from the neighboring heights, they presented the appearance of so many casks half covered by the waves.

I surprised the group at Northeast Point, St. Paul Island, at quite near quarters, and succeeded in photographing them with a snap-shot camera, but the females quickly scented danger and plunged into the waves with a great splash, followed by the bulls.

The movements of the bulls on land are awkward and labored to an extreme degree. Their great weight, though easily sustained in the water, oppresses them when on land and renders them almost helpless. Mr. Elliott affirms that they can be driven but 2 miles in twenty-four hours.

Fifty large males were killed in June, 1890, by the natives, and the skins of six of the largest were measured by Mr. Palmer, with the following results, the measure-

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[1] U. S. Fish Com. Special Bull. 176, 1882, A Monograph of the Seal Islands of Alaska, pp. 84–92.

ments being from the tip of the nose to the root of the tail: No. 1, 10 feet 7 inches; No. 2, 10 feet; No. 3, 10 feet; No. 4, 10 feet 3 inches; No. 5, 10 feet 2 inches; No. 6, 9 feet 10 inches.

Mr. Palmer obtained a male on Walrus Island June 13, 1890, which measured 11 feet 1 inch in total length. Regarding this bull, Mr. Palmer furnishes the following note:

While on Walrus Island on June 13 I noticed that several small rocks about 40 yards from the main island were literally covered with sea lions. One old bull occupied the center, six or seven smaller ones, probably females, surrounded him, and some twenty-five of all sizes occupied every other available space. Upon my trying to creep within gunshot, the smaller sea lions rapidly plunged into the water, followed by the others, until, as I neared the water, none but the old bull remained. He slowly raised himself and looked around, and while doing so received two shots in the neck, which hastened his movements, but before he could leave the rock a lucky shot from my rifle through the base of the brain stretched him lifeless.

The skins of the sea lion are still employed, to a limited extent, for covering the large bidaras or skin boats. The frames of these boats are made of wood, formerly lashed, but now mainly nailed and bolted together, and over these the skin covering is tightly stretched. See Pl. XXXI. The skin is oiled and is carefully removed at the end of the season. Bidaras are used by the North American Commercial Company for transferring the seal skins from the warehouses to the steamer, and for general lightering purposes. They are not so heavy as a wooden boat, and have also this advantage, that if they strike a rock, as not infrequently happens, the bidara gives to the blow and receives no injury, when a wooden boat would be caused to leak.

THE HARBOR SEAL.

Phoca largha Pallas (?).

The hair seal found about the islands has generally been regarded as the common *Phoca vitulina*, but in a recent communication before the Biological Society of Washington, Dr. Merriam has shown that it differs in some respects from that species, and is probably to be identified with the *P. largha* of Pallas. According to Dr. Merriam's statements, though extremely like *P. vitulina* and presenting, in like manner, two color phases, it is larger and exhibits certain peculiarities, of which the most salient relate to the form of the teeth and the premaxillary bones. In *P. vitulina* the lower premolar and molar have usually four cusps each, but in the Pribilof seal three. Again, in *P. vitulina* the upper extremities of the premaxillae merely touch the sides of the nasals, while in the Pribilof seal they run along the sides of those bones for a considerable distance.

Solitary representatives of this seal were seen by myself on the rocks in Gorbatch Bay, St. Paul, in 1895, and at other points, and they were more numerous on the rocks of Southwest Bay, but their headquarters is on the north shore. Three young ones were brought to the village.

RIBBON SEAL.

Histriophoca fasciata (Zimm.).

A young female of this species was taken by one of the sealers 84 miles west of St. Paul in August, 1896, so that it may be regarded as a probable occasional visitant to the Pribilofs.

BOWHEAD WHALE.

Balæna mysticetus Linnaeus.

Bones of the bowhead are numerous about the islands, particularly at Northeast Point. I made the following measurements of a right mandible on the beach north of Lukanunon:

	Ft.	In.
Total length (straight)	18	8
Length along outer curve	20	4
Greatest depth of the proximal end	2	0
Depth at the middle of length	1	3
Depth 1 foot from distal end	1	½

Diameter of incisive foramen, 7 by 5 inches.

The left mandible, presumably of the same individual, lay near by, but was much weathered.

In the right mandible the internal groove started from the lower margin of the incisive foramen as a shallow trough, about 1 inch broad, and curved down toward the lower margin of the jaw, becoming a narrow line inclosing a narrow channel fully 1 inch deep. It ran along close to the lower margin for three-fourths the length of the jaw and then forked, and, becoming more and more shallow, was finally lost. The coronoid process was represented only by a faint swelling of the margin.

The bones on the beaches are from dead whales which wash up from time to time in winter.

One stranded on St. George in 1889, and about 1,500 pounds of whalebone, according to Mr. Palmer, were obtained from it by the natives, who received $1 a pound from the company. Another came ashore the same year near East Landing, on St. Paul. The mass of cervical vertebræ and a number of ribs were still there in 1895. I also found a portion of a skull imbedded in Zoltoi Sands, which may have been of the same individual.

LARGE FINBACK WHALE.

Balænoptera velifera (Cope).

The hind part of a skull of a large finback, which may be this species, was found by Mr. Prentiss and myself on the shore of the lagoon in 1895. The greatest breadth across the temporals was 6.35 feet. The height of the occipital from the upper margin of the foramen magnum to the nasals was 3.15 feet.

I saw nothing of these whales about the Pribilof Islands in the summer of 1895, but when returning homeward observed them in large numbers on September 3 along the south coast of Kadiak. Mr. Palmer remarked in 1890: "Not common about the islands in summer, but a number were seen after leaving St. George for the south on August 11. A dead one was stripped of its 'bone' on St. Paul last winter."

DAVIDSON'S LESSER RORQUAL.

Balænoptera davidsoni Scammon.

The bones of a small finback belonging without doubt to this species[1] were found at Rocky Point, St. Paul. There were 27 in all—the seventh cervical, 11 dorsals, and 15 lumbars and caudals.

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[1] If distinct from the *B. acuto-rostrata* of the Atlantic, which Van Beneden denied.

KILLER WHALE.

Orca gladiator (?)

The skull of a killer was brought from St. Paul Island in 1895 by Mr Charles H. Townsend, obtained from a specimen which came ashore to the south of Hutchinsons Hill. Many nominal species of killers have been established, but it has not yet been demonstrated whether there are really several or only one.

I saw two killers on one occasion quite close inshore at St. Paul in 1895. In 1890 Mr. Palmer wrote: "A few seen about the islands in May and early in summer. They return in August. We saw quite a number on August 12 between St. George and Unalaska."

Most of the natives have seen killers chasing sea lions, and have seen both sea lions and killers strand on the rocky shore. The majority of the killers seen had a large whitish blotch on each side of the back, immediately behind the dorsal. In no case was this blotch pure white, though the center and upper part of it was always lighter than the sides. The tip of the dorsal in no case turned over.

HARBOR PORPOISE.

Phocœna communis Lesson.

A few bones of a small porpoise, apparently of this species, were picked up at St. Paul June 3, 1890, and two small schools were seen on the harbor at Unalaska May 20 and 21, the same year. A specimen of this species was obtained by Mr. Charles H. Townsend at Captains Harbor, Unalaska, August 17, 1895.

The range of several other cetaceans, as given by Scammon, would include the Pribilof Islands. These are the California gray whale, *Rhachianectes glaucus*, the humpback, *Megaptera versabilis*, the right whale, *Balæna sieboldii* (?), and the right whale porpoise, *Tursio borealis*. As regards the humpback, Scammon remarks: "The last seen of them in high latitudes by whalemen is on their return from the Arctic Ocean, when they are found in the vicinity of St. Paul Island, Bering Sea, in the month of October, and these are usually very large."[1] Elliott also cites the Humpback as occurring about the Pribilof Islands, but says there are "a few only."[2]

SPECIES EXTERMINATED.

Sea Otter.—Sea otters occurred in great numbers on the Pribilof Islands at the time of their discovery, but were soon extirpated. Elliott states that they were all gone in eight or nine years. I note, however, that Veniaminoff reported them as "scarce generally in 1811, and in the next thirty years extinct."

In the report of Treasury Agent McIntyre in 1875 an account is given of the appearance of the schooner *Cygnet* off St. George in September, 1874, and the captain is reported as claiming "that he was looking for a kelp patch to the west of the island, where he expected to find otter in abundance."[3] How much reliance can be placed on such an intimation is uncertain.

[1] Marine Mammalia, 1874, p. 68.

[2] Monograph of the Seal Islands, 1882, p. 125.

[3] Seal fisheries of Alaska, House Doc. No. 83, Forty-fourth Congress, first session, 1876, p. 124.

Nothing was seen of sea otters in 1890 by Mr. Palmer. In 1892 Mr. Townsend picked up a skull from the beach at St. Paul, and this is now in the National Museum. There is also another skull in the Museum from the Pribilofs, without definite record. In 1896 Mr. Lucas learned that a sea otter had been found on the beach near Rocky Point, St. Paul, in the spring of that year.

Walrus.—Walrus formerly occurred on the Pribilof Islands, and in large numbers at first, if we may believe the Russian agent, Sarytschew (quoted by Elliott and Allen), who stated that they "formerly resorted in summer in large numbers to St. Paul and St. George islands, where 28,000 pounds of their teeth were obtained in a single year."[1] He reports, however, that they were all gone from these islands in 1805.

Veniaminof in 1840 includes "a few walrus" among the animals belonging to the Pribilof Islands. These were presumably on Walrus Island, where they still occurred as late as 1890. In that year Mr. William Palmer went to Walrus Island in the hope of getting specimens for the National Museum. He saw eight then, but obtained none, and they were reported all killed the following season.

During my sojourn on St. Paul in 1895 I noted that the bones were very abundant, especially at Northeast Point, and in 1890 Mr. Palmer found the natives digging in the low sand bluff near Webster House, as opportunity occurred, for the sake of the tusks, which they sold to the company for about 20 cents per pound. I dug about there a good deal myself in 1895, but found no skulls with tusks.

I saw a pair of tusks, however, in the possession of Dr. Voss, which were obtained there, and a few others were procured in 1897.

Red Fox and Polar Bear.—These animals are said to be occasionally brought to the islands on the ice in winter. I saw nothing of the red fox in 1895, and Mr. Palmer reported in 1890 that not more than six or seven had been taken in twenty years.

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[1] Allen, J. A., North American Pinnipeds, 1880, p. 176.

XVII.—THE AVIFAUNA OF THE PRIBILOF ISLANDS.

By William Palmer.

CHECK LIST OF THE SPECIES.

1. Phalacrocorax urile.
2. Merganser americanus.
3. Harelda hyemalis.
4. Histrionicus histrionicus.
5. Eniconetta stelleri.
6. Somateria v-nigra.
7. Nettion carolinense.
8. Anas penelope.
9. Anas boschas.
10. Anser albifrons gambeli.
11. Branta canadensis minima.
12. Philacte canagica.
13. Olor columbianus.
14. Diomedea albatrus.
15. Fulmarus glacialis rodgersii.
16. Oceanodroma furcata.
17. Gavia adamsii.
18. Gavia arctica.
19. Colymbus holbœllii.
20. Lunda cirrhata.
21. Fratercula corniculata.
22. Cyclorrhynchus psittaculus.
23. Simorhynchus cristatellus.
24. Simorhynchus pusillus.
25. Synthliboramphus antiquus.
26. Cepphus columba.
27. Uria troile californica.
28. Uria lomvia arra.
29. Stercorarius pomarinus.
30. Stercorarius parasiticus.
31. Stercorarius longicaudus.
32. Larus schistisagus.
33. Larus glaucescens.
34. Larus barrovianus.
35. Pagophila alba.
36. Rissa tridactyla pollicaris.
37. Rissa brevirostris.
38. Xema sabinii.
39. Sterna paradisæa.
40. Grus canadensis.
41. Crymophilus fulicarius.
42. Phalaropus lobatus.
43. Tringa ptilocnemis.
44. Triuga maculata.
45. Tringa damacensis.
46. Ereunetes pusillus.
47. Limosa lapponica baueri.
48. Totanus flavipes.
49. Heteractitis incanus.
50. Numenius hudsonicus.
51. Numenius borealis.
52. Charadrius dominicus fulvus.
53. Ægialitis semipalmata.
54. Arenaria interpres.
55. Haliæetus leucocephalus alascensis.
56. Falco rusticolus gyrfalco.
57. Falco peregrinus anatum.
58. Asio accipitrinus.
59. Nyctea nyctea.
60. Cuculus canorus telephonus.
61. Merula migratoria.
62. Anthus pensilvanicus.
63. Anorthura alascensis.
64. Hirundo erythrogastra unalaschkensis.
65. Ammodramus sandwichensis.
66. Calcarius lapponicus alascensis.
67. Passerina townsendi.
68. Acanthis linaria.
69. Leucosticte griseonucha.

INTRODUCTION.

This list has been prepared partly from my own experience and collections on the islands from May 27 to August 11, 1890, and partly from the published results of the visits of Mr. Henry W. Elliott in 1872–73 and 1876; also from such other matter as I have been able to glean from the literature, the collections in the United States National Museum, and from the naturalists who have visited the group in recent years. I have attempted to give a full measure of credit in all cases, with reference to the actual specimens when any are known to exist. Nearly all of these I have seen. The chapters on Migration and Distribution seem pertinent to an understanding of the avifauna of these islands and are offered as suggestive for future work in the region.

As to the systematic arrangement, I must confess my responsibility. I have begun the list with what appears to me the lowest and most generalized type—the cormorant. Not only upon general physiological grounds, but upon the purely morphological one of the nature and development of the feathers have I considered this group the lowest of the birds given in the list. At the other extreme, the higher and more specialized, I have placed the Fringillidæ. Several reasons might be advanced for this, but the following may suffice here: As in botanical science the Spermatophyta are, geologically and chronologically speaking, the higher and most recent, so in birds the seed eaters and their allies are necessarily, in point of time, the most recent, and as a group more highly specialized. In an evolutional sense they have kept pace with the general development of the higher botanical groups, even specializing to a very high degree in their food-getting habits. If the vegetation of the world had never advanced beyond a pteridophytan stage, it is difficult to imagine the development of the Conirostres; nevertheless the insectivorous birds would have been prominent. The arrangement in such a small list of the intermediate groups is not so satisfactory. The value of the purely nonfunctional and almost nonadaptive characters of the neossoptiles [1] and mesoptiles,[1] when they are better known and have been comparatively studied, may afford a clearer insight into the relationships of genetic groups as well as of the lowest members of the various orders. The taxonomic values of the neossoptiles may be indicated as follows: In *Phalacrocorax* they are almost entirely dissociated externally with the mesoptiles. The rachis is short and weak, and the rami connect with it in an uneven manner. In the *Anatidæ* the rachis is strong and long, and the connection with it of the rami is regular. These neossoptiles are carried for a time on the tips of the new growing mesoptiles, either on the flight feathers by a strong connection with the enlarged tip of the rachis of the mesoptile, or on the body feathers on the united tips of the rami and weakened rachis. In all the other groups the neossoptiles divide, have no rachis, and are carried singly on the tips of the rami of the growing mesoptile. In the higher groups this division into single parts is usually prevented by a band formed of a persistent portion of the sheath. Correlated with the above are other conditions, such as the condition at hatching, the duration of growth or nongrowth either of these feather structures or of the basal portion of the neossoptile, the period and time of further changes, etc.

There is no consistent practice concerning the use of the comma between the specific part of a name and the name of the authority or citer. I have used the comma only to indicate the fact that the author following is the user and not the authority or original describer.

To Mr. Robert Ridgway and Dr. C. W. Richmond, curator and assistant curator of the Department of Birds of the National Museum, my thanks are due for many courtesies in connection with examining the specimens and literature. To Mr. F. A.

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[1] Page 424.

Lucas I am under deep obligation for many favors. To Mr. Henry W. Elliott I am especially indebted for much assistance, specimens and notes, when on the islands, together with kind attentions during exceptionally unfortunate circumstances, as well as for his published notes.

Necessarily this list is incomplete, as the winter-occurring birds have been little noted. Under each species will be found a synonymy as far as it relates to the islands and with the addition of the names from several general works, such as the Bird Catalogues of the British Museum, the American Ornithological Union's Check List of 1895, Coues' Key of 1890, and Ridgway's Manual of 1896.

THE TOPOGRAPHY OF THE ISLANDS, ORNITHOLOGICALLY CONSIDERED.

I have simply confined myself to an account of the topography as it influences the summer distribution of the birds.

The Pribilof group consists of four small islands, St. Paul, Otter, and Walrus Island constituting a subgroup, St. George another. The subgroups differ markedly in appearance and size, and though evidently of the same volcanic origin, being simply rocky uplifts through which volcanoes have broken, and with a more or less special surface deposit of lava and volcanic cinders, may be of somewhat different age; and certain circumstances of life distribution would seem to warrant the opinion that they have never since they were uplifted been united.

St. Paul.—This is the largest and most important. It is 13 miles long from Northeast Point to the Reef and about 9 miles wide. The area given by Elliott, who first surveyed the group, is 33 square miles. The character of the surface is rolling, with many rounded hills of volcanic cinders and a few with rugged, weathered summits. Usually a crater or two is found at or about the centers of these hills and are often filled with snow or water. About these elevations, which do not exceed 600 feet, birds are very scarce. Much of the flat surface consists of huge masses of rocks, which were once uplifted and broken and are now almost completely covered with a dense carpet of flowering plants, mosses, and lichens, mixed in indescribable confusion. In some places it is possible to descend between these rocks for 8 or 10 feet and even to lunch on the coarse, granular ice snow to be found there. The cinder débris from the hills has covered a great extent of these rocks, and inland along the shores the drifting sands from the beaches have also had a large share in producing a flatness which enables one to journey almost entirely around the island with some comfort, even much of it being accessible to teams. On the slopes and lower grassy places the Lapland longspur is abundant; about the tundra and small rocky cliffs and gorges the Pribilof snowflake is to be found, while practically all over the tundra the Pribilof sandpiper makes its summer home. Between the slopes at many places are ponds of water of varying sizes, while along the entire eastern side numerous ponds or lakes occur at intervals, many caused by the throwing up by the sea of sand barriers, while others seem due to steam eruptions from the now extinct volcanic forces. About these ponds waders and waterfowl generally are found, sometimes in great numbers. The oldsquaw duck makes her nest in their vicinity and leads her young to take their first lessons in swimming on their surface. A few mallards and northern phalaropes also nest in their neighborhood. At intervals all around the shores bold headlands jut into the sea and are connected by magnificent, curved stretches of fine, compact sandy beaches, back of which is an extensive area of dry, loose sand, with patches of grasses, sedges, and wild peas, together with pieces of driftwood and occasional bones of cetaceans. Occupying the land side of the more extensive of these sandy areas are many, mostly grass-grown, sand dunes, some in process of demolition by the winds, and all increasing or decreasing in size and shape as its varying velocity or direction compels. The headlands, always rocky, generally have cliffs from 2 or 3 to 60 feet in height, the bases of which are constantly washed by the ever-present surf. The bold and exceedingly broken faces of these cliffs furnish innumerable crevices and shelves in and on which various species of waterfowl breed and roost in great numbers. These cliffs are generally capped by cinder deposits. In other places, where the rocky shores are flat for some distance, numerous huge rounded bowlders have been pushed up by ice pressure until they are mostly above high tide. Under these the choochkie (and a few of other species) lays its solitary egg and is always to be found in compact little flocks perched on their summits. At the southern end of the island, but opening on the west side, is an extensive flat, sandy area—the only one of the kind on the group—in which the tide ebbs and flows, and which is known as the Lagoon. On its beaches during the summer the Pribilof sandpiper flocks in numbers, gulls and ducks are always to be found, and later the migrating swarms rest and feed in and about its waters.

Otter Island.—This is a small copy of its relative, St. Paul, from which it is distant about 6 miles south-southwest. It is rather more than a mile in length and about half a mile in width. Three sides fronting to the sea consist of bold, rocky cliffs ranging to some 300 feet in height. On the north side, toward St. Paul, is a small rocky beach, back of which is a small pond. From this pond the ground slopes upward to the crest of the cliffs. Here occurs most of the species found breeding on St. Paul, and, besides, a colony of fulmars, which are only to be found elsewhere, on St. George. Mr. C. H. Townsend, in June, 1895, collected here many specimens of fourteen species, breeding and migratory, including an addition to the American avifauna, *Tringa damacensis.*

Walrus Island.—Seven miles eastward of Northeast Point, on St. Paul, lies an exceedingly rugged huge rock on which in summer innumerable individuals of comparatively few species of birds breed and roost. The central portion is an irregular plateau some 40 feet above sea level. (Pl. XXXVIII, fig. 1.) Its edges either end in bold cliffs or slope in a series of shelves to the shore line. On the lower and more extensive of these shelves are numerous rounded and much-crowded huge bowlders (Pl. XXXVIII, fig. 4), while almost entirely around the island low shelves of rock extend irregularly for some distance seaward, and which are always covered at high and but slightly uncovered at low water. The only vegetation are some clumps of grass and a few other plants on the central higher portion. The area is about 5 acres, the length about a quarter of a mile, the greatest width less than 80 yards. The various species occupy definite portions, and practically all available space is utilized by the breeding birds. Under the bowlders the horned puffin and paroquet auk breed in numbers, and on the cliffs of the southern end both species of kittiwakes nest in colonies. Upon the central portion of the plateau, at its southern end, several hundred nests of the glaucous-winged gull are to be seen, and a few of the larger Point Barrow gull. These nests are built but a few feet apart, are large, and their surroundings are invariably clean, in great contrast to the nesting sites of other species. From the edge of the bluffs and extending all over the available space from the shore line to the gull nests are to be found the large, strongly marked, and often gaudily colored eggs of the murres, *Uria lomvia arra*, and *U. troile californica.* (Pls. XXXVIII, XXXIX.) They keep apart. In 1890 the first named occupied the western side, while the other, the slender-billed and paler-colored bird, swarmed on the western side. An idea of their numbers is shown in the following extract from Elliott: "On the occasion of one visit, and my first one there, July 5, 1872, six men loaded a bidara at Walrus Islet, capable of carrying 4 tons exclusive of our crew, down to the water's edge with eggs in less than three working hours." Thousands and thousands of these birds breed here close together, almost touching each other, constantly quarreling, even fighting; coming and going; while overhead the large gulls and more delicate kittiwakes are hovering on quivering wing or protecting the vicinity of their nests from the crowding swarms of the murres. At intervals entirely around the island are solitary or small colonies of nests of the red-faced cormorant built in niches on the larger shelves. (Pl. XXXVIII, figs. 3, 4.) As the cormorant comes early, it is able to select and maintain its position, but the murres crowd closely about its home.

St. George.—Unlike St. Paul, this island has an exceedingly bold, rocky shore line with no sand beaches, and but three small places worthy the name of a beach. "The island itself is a trifle over 10 miles in extreme length, east and west, and about $4\frac{1}{4}$ miles in greatest width, north and south. * * * There are several small reservoirs of fresh water—I can scarcely call them lakes—on this island; pools, rather, that the wet sphagnum seems to always keep full, and from which drinking water in abundance is everywhere found. At Garden Cove a small stream, the only one on the Pribilof group, empties into the sea. St. George has an area of about 27 square miles."—(*Elliott.*) Standing on the deck of the steamer anchored off the village of St. George and facing the shore, one sees on his right the eastern end of a great cliff which extends around the western end of the island, with an elevation of from 75 to 900 feet for some 14 miles. The sea washes its base for its entire length, but the force of the waves is considerably broken by a multitude of huge, rounded bowlders, the débris of former parts of the cliffs. The base of the cliff is basaltic, hard and durable, but above the rock is less compact and is fractured into innumerable crevices and holes; and generally a rough stratification is noticeable—the shelves—which are parallel to the surface of the water. These crevices and shelves afford innumerable nesting sites for myriads of birds, which crowd every available space, are constantly coming and going, quarreling and shifting, screaming, and even dying. Back from the cliff toward the village is an immense area of rolling, sloping ground thickly studded with huge masses of rock which lie in every possible position, and under which, deep down in their recesses, myriads of the least auklet breed. Some twelve species only make these places their summer home, but the numbers of individuals of several of these may well challenge the admiration of the world. During early morning and late evening their numbers are incalculable. For hours they swarm about the cliffs, the adjacent land and sea, in indescribable numbers and confusion. Similar conditions prevail almost entirely around the island. Inland the surface is rolling, with valleys and hills deeper and higher than on St. Paul, but of the same general aspect. The same species as on that island occur on these uplands, but another, the smallest bird of the group, is found about the cliffs, the little Aleutian wren, which is not found on any of the other islands. On the south side of St. George large colonies of the fulmar breed, which, outside of a few on Otter Island, is its only summer home on the group. In all else the avifauna agrees practically with that of St. Paul.

THE ORNITHOLOGICAL HISTORY OF THE ISLANDS.

I have had little opportunity for looking up ancient references to the birds. They are but meager and fragmentary. Coinde in 1860 made a list of but nine species that were collected by an officer of the Russian navy, Mr. Warneek, in 1852. The jealous care exercised by the Russians for the preservation of the seals prevented any outsiders from studying the avifauna, so that it was not until the islands passed under the control of this Government, and Mr. Elliott made his investigations, that any great effort was made to study the bird life. Dr. W. H. Dall had indeed in 1868 spent a short time at the islands and, together with the officers of his surveying vessel, had collected some specimens, one of which was described as new by Prof. S. F. Baird, but the first systematic investigation was made by Mr. Henry W. Elliott. The result of this gentleman's work was a list of 40 species, based on copious notes and numerous specimens which were named and elaborated by Dr. Elliott Coues in Mr. Elliott's report for 1873, and which was reprinted in 1875. Mr. Elliott made another more extensive elaboration in his monograph of the seal islands in 1882. Besides the above, various other Government expeditions which have visited the waters of Bering Sea for different reasons during the past sixteen years have generally touched at the seal islands and given several naturalists opportunities for collecting and noting the bird life. Thus, Mr. L. M. Turner in 1878, Dr. T. H. Bean in 1880, Mr. E. W. Nelson in 1881, Lieut. J. E. Lutz in 1884, Mr. C. H. Townsend in 1885 to 1896, myself in 1890, Messrs. F. W. True and D. W. Prentiss, jr., in 1895, Mr. F. A. Lucas in 1896–97 have spent from a day or two to several months on the islands. The results I have brought together in the following list. Besides, several employees of the sealing companies and several Treasury agents have collected and preserved some specimens, though few of them have been noted in publications or are available for study. The specimens collected by the naturalists of the various Government expeditions were deposited in the collection of the National Museum, of which they are now a part. The following list is based on them; but of many of the species a better series would have been more acceptable. Of many but a single specimen is available, while of many more only the observations of the collectors have been the means of incorporating the species in the list. Mr. Elliott translated for his 1873 report the following bird note from Bishop Veniaminof's work, Zapieska ob Octrovah Oonahlashkenskaho Otdayla, 1840:

> Birds: The guillemots (or *arries*); gulls; puffins; crested, horned, and white-breasted auks; snow finches; geese (two kinds); a few kinds of *Tringa;* sea ducks, black and gray. Most of these birds come here to lay, and with them *jägers*, hawks, owls, and "*chikees*" (big *Larus glaucus*), and the albatross is frequently to be seen around the beaches.

Mr. Elliott has enumerated 41 species in his various lists, 3 were added by Mr. Townsend in 1885, 3 others were collected by Messrs. True and Prentiss in 1895, Mr. Lucas added another in 1897, and I am responsible for 21 others, thus bringing the total to 69.

EXAMINATION OF STOMACHS.

I preserved a number of stomachs of many of the species, which were turned over to the Division of Biological Survey of the Department of Agriculture. Dr. C. H. Merriam, the chief of that division, has kindly permitted Mr. Sylvester D. Judd, one of his assistants, to examine them for this paper, and the results are given under the species with Mr. Judd's initials attached. A few were examined by myself on the islands, in which cases my own initials follow. Mr. Judd speaks as follows of his examination:

The birds, principally sparrows and shore birds, collected by Mr. W. Palmer on the Pribilof Islands during the summer of 1890, had lived for the most part upon insects, although mollusks, seeds, and berries had occasionally been resorted to. The food of these birds is very different from that of birds along the eastern coast of the United States in that it consists in its greater part of flies. Some beetles were eaten, but not to nearly such an extent as would have been commonly expected. Little pieces of red and black porous lava were found among the mineral matter contained in the stomachs, plainly indicating the volcanic origin of the collecting ground. Of the 32 stomachs examined, 6 were Pacific godwits; one of these contained hundreds of specimens of an exceedingly rare beetle.

The chilly damp nights are doubtless responsible for much of the fly food.

VALID SPECIES WHICH HAVE BEEN DESCRIBED AS NEW FROM THE GROUP TYPES IN THE UNITED STATES NATIONAL MUSEUM COLLECTION.

TROGLODYTES ALASCENSIS Baird. Trans. Chic. Ac. Sci. i, 1869, 315, pl. 30, fig. 3. Type, No. 54447 im. ♂, U.S.N.M. Coll. August 17, 1868, St. George Island, W. H. Dall. A species confined to the Aleutians, and to St. George.

TRINGA PTILOCNEMIS Coues. In Elliott's Report, Seal Islands, Alaska, 1873; Reprint, 1875, 182. Type, No. 64249 ad. [♂] ♀ ?, U. S. N. M. Coll. July 22, 1873, St. George Island, H. W. Elliott. A species confined in summer to the Pribilofs, and to St. Matthew's Island.

PASSERINA TOWNSENDI (Ridgway)., Manual of N. Am. Birds, 1887, 403. Type, No. 106695 ad. ♂; U.S.N.M. Coll. June 8, 1885, Otter Island, C. H. Townsend. A species confined to the Pribilof, Aleutian, and Commander islands.

CALCARIUS LAPPONICUS ALASCENSIS Ridgway. Auk, 1898, 320. Type, No. 118904 ad. ♂ U.S.N.M. Coll. June 5, 1890, St. Paul Island, William Palmer. Resident in Alaska and intergrading to the eastward with *lapponicus*.

SPECIES DESCRIBED AS NEW, BUT WHICH HAVE PROVED SYNONYMS.

LARUS WARNECKI Coinde, Rev. et Mag. Zool. 1860, 401, = *Rissa brevirostris* (Bruch).

TRINGA GRACILIS Harting, Proc. Zool. Soc. Lond. 1874, 243, pl. XL. = *Tringa ptilocnemis* Coues, 1873.

SPECIES WHICH HAVE BEEN ADDED TO THE NORTH AMERICAN AVIFAUNA FROM THE ISLANDS; SPECIMENS IN THE NATIONAL MUSEUM COLLECTION.

Anas penelope Linn. by H. W. Elliott, No. 62525 ad. ♂ U.S.N.M. May 27, 1872, St. Paul Island (Dr. Coues, in Elliott's Rpt., Seal Islands, 1873; Reprint, 1875, 191). Since taken many times throughout North America.

Charadrius dominicus fulvus (Gmel.), by H. W. Elliott, No. 64273 ad. ♀ U.S.N.M., May 1, 1873, St. Paul Island (Dr. Coues in Elliott's Rpt. Seal Islands, 1873; Reprint, 1875, 179). Since found to breed abundantly on the Bering Sea and Arctic coasts of Alaska. Since ascertained to have been taken by the Russian officer Warneck in 1842 and confused by Coinde with *C. pluvialis*.

Tringa damacensis (Horsf.), by C. H. Townsend, No. 106809 ad. ♀, U.S.N.M. June 8, 1885, Otter Island (Ridgway, Auk, III, 1886, 275). As yet unique from North America.

Cuculus canorus telephonus (Heine), by William Palmer, No. 118864 ad. ♂ U.S.N.M. Coll. July 4, 1890, St. Paul Island. (Palmer, Auk. XI, 1894, 325). As yet unique from North America.

Species of which but one specimen, presumably, is known from the group (17 species).

Colymbus holbœllii	Taken by Elliott, 1873.
Gavia adamsii	Taken by native, 1885.
arctica	Taken by Elliott, 1873.
Stercorarius parasiticus	Taken by Elliott, 1872.
longicaudus	Taken by Elliott, 1872.

Species of which but one specimen, presumably, is known from the group (17 species)—Continued.

Pagophila alba	Taken by True and Prentiss, 1895.
Larus barrovianus	Taken by Palmer, 1890.
Anas penelope	Taken by Elliott, 1872.
Branta canadensis minima	Taken by Elliott, 1872.
Tringa damacensis	Taken by Townsend, 1885.
Ereunetes pusillus	Taken by Palmer, 1890.
Numenius borealis	Taken by Elliott, 1872.
Ægialitis semipalmata	Taken by True and Prentiss, 1895.
Falco rusticolus gyrfalco	Taken by Elliott, 1873.
peregrinus anatum	Taken by Palmer, 1889–90.
Cuculus canorus telephonus	Taken by Palmer, 1890.
Anthus pensilvanicus	Taken by Dall, 1868.

Species of which only two specimens are, presumably, known from the group (5 species).

Stercorarius pomarinus	Taken by Elliott, 1872, Lavender, 1890.
Diomedea albatrus	Taken by Adams, 1874, Palmer, 1890.
Oceanodroma furcata	Taken by True and Prentiss, 1895, Thompson, 1897.
Eniconetta stelleri	Taken by Palmer, 1890.
Tringa maculata	Taken by Palmer, 1890.

Species of which no specimen, presumably, is in collections from the islands (18 species).

Synthliboramphus antiquus	Mentioned by Dall.
Cepphus columba	Seen by Nelson, Palmer.
?Larus schistisagus	Seen by Palmer.
Sterna paradisæa	Seen by Webster, Lucas.
Merganser americana	Seen by Lockhart, Nelson.
Anas boschas	Seen by Elliott, Palmer.
Nettion carolinense	Seen by Palmer.
Somateria v-nigra	Seen by natives.
Anser albifrons gambeli	Seen by Palmer.
Philacte canagica	Seen by Elliott and others.
Olor columbianus	Seen by residents.
Totanus flavipes	Seen by Palmer.
Numenius hudsonicus	Seen by Lucas.
Haliæetus leucocephalus alascensis	Seen by natives.
Asio accipitrinus	Seen by Palmer, Elliott.
Acanthis linaria	Shot by Elliott.
Ammodramus sandwichensis	Seen by Palmer.
Hirundo erythrogastra unalaschkensis	Seen by Palmer.
Merula migratoria	Seen by Elliott.

Species known to breed (20).

Lunda cirrhata	Common.
Fratercula corniculata	Common.
Cyclorrhynchus psittaculus	Common.
Simorhynchus cristatellus	Common.
pusillus	Common.
Uria troile californica	Common.
lomvia arra	Common.
Rissa tridactyla pollicaris	Common.
brevirostris	Common.
Larus barrovianus	Few.
Larus glaucescens	Common.
Fulmarus glacialis rodgersii	Common.
Phalacrocorax urile	Common.
Harelda hyemalis	Common.
Phalaropus lobatus	Few.
Tringa ptilocnemis	Common.
Leucosticte griseonucha	Common.
Passerina townsendi	Common.
Calcarius lapponicus alascensis	Common.
Troglodytes alascensis	Common.

Species which probably breed (9).

Cepphus columba.	Eniconetta stelleri?
Larus schistisagus.	Crymophilus fulicarius?
Xema sabinii?	Asio accipitrinus.
Anas boschas.	Nyctea nyctea?
Histrionicus histrionicus.	

Of regular occurrence as migrants, evidently an incomplete list.

Nettion carolinense	Uncommon.	Limosa lapponica baueri	Common.
Somateria v-nigra	Common.	Heteractitis incanus	Common.
Branta canadensis minima	Few.	Numenius borealis	Few.
Crymophilus fulicarius	Common.	Charadrius dominicus fulvus	Fairly common.
Phalaropus lobatus	Common.	Arenaria interpres	Common.

THE GEOGRAPHICAL DISTRIBUTION OF PRIBILOF BIRDS.

The Holarctic region comprises all of the Northern hemisphere except the southern portions. It is divisable into the following subregions: Palæarctic, Europe and Northern Asia; Aleutican, North Pacific and adjacent shores; Nearctic, North America.

American (Nearctic) forms occurring on the islands (18 species).

Colymbus holboellii	Migrant.	Totanus flavipes	Once.
Merganser americanus	Migrant.	Numenius hudsonicus	Once.
Nettion carolinense	Migrant.	borealis	Migrant.
Anser albifrons gambeli	Migrant.	Aegialitis semipalmata	Once.
Branta canadensis minima	Migrant.	Falco peregrinus anatum	Migrant.
Olor columbianus	Migrant.	rusticolus gyrfalco	Few, migrant.
Grus canadensis	Rare, accidental.	Hirundo erythrogastra	Twice, accidental.
Tringa maculata	Twice.	Anthus pensilvanicus	Once, migrant.
Ereunetes pusillus	Once.	Merula migratoria	Once, accidental.

Asiatic (Palaearctic) forms, none breeding.[1]

Anas penelope	Few, accidental.	Charadrius dominicus fulvus	Migrant.
Tringa damacensis	Once, migrant.	Arenaria interpres	Migrant.
Limosa lapponica baueri	Migrant.	Cuculus canorus telephonus	Once, accidental.

Pacific (Aleutican) forms (29 species, 18 breeding).

Gavia adamsii	Migrant.	Diomedea albatrus	Migrant.
Lunda cirrhata	Breeds.	Fulmarus glacialis rodgersii	Breeds.
Fratercula corniculata	Breeds.	Oceanodroma furcata	Breeds?
Cyclorrhynchus psittaculus	Breeds.	Phalacrocorax urile	Breeds.
Simorhynchus cristatellus	Breeds.	Somateria v-nigra	Winter.
pusillus	Breeds.	Philacte canagica	Migrant.
Synthliboramphus antiquus	Doubtful.	Tringa ptilocnemis	Breeds.
Cepphus columba	Breeds?	Heteractitis incanus	Migrant.
Uria troile californica	Breeds.	Haliæetus leucocephalus alascensis	Accidental.
lomvia arra	Breeds.	Leucosticte griseonucha	Breeds.
Rissa tridactyla pollicaris	Breeds.	Passerina townsendi	Breeds.
brevirostris	Breeds.	Ammodramus sandwichensis	Accidental.
Larus barrovianus	Breeds.	Calcarius lapponicus alascensis	Breeds.
glaucescens	Breeds.	Troglodytes alascensis	Breeds.
schistisagus	Doubtful.		

[1] It is of course understood that these birds are found here at about the most eastern portion of their range, while of the 18 American forms they here occur at about the most western part of their habitat.

Circumpolar (Holarctic) forms (13 species, 2 breeding).

Gavia arctica	Once.	Harelda hyemalis	Breeds.
Stercorarius pomarinus	Migrant.	Eniconetta stelleri	Migrant.
parasiticus	Migrant.	Crymophilus fulicarius	Migrant.
longicaudus	Migrant.	Phalaropus lobatus	Breeds sparingly.
Pagophila alba	Once.	Nyctea nyctea	Migrant.
Sterna paradisaea	Migrant.	Acanthis linaria	Migrant.
Xema sabinii	Migrant.		

Of doubtful category.

Anas boschas subsp	Probably *Palaearctic.*
Histrionicus histrionicus	Probably *Aleutican.*
Asio accipitrinus subsp	Probably *Aleutican* or *Nearctic.*

The birds represented by the above three names have not been critically compared. When this is done the Pribilof birds may be placed as indicated above.

Exclusively American species form but an insignificant feature of the avifauna. This is accounted for, in part, by the small area of the islands and consequent lack of land birds, but principally because of the preponderating abundance of exclusively Northern Pacific forms; in fact, the islands are located in the midst of a quite different subregion, the *Aleutican.* More than half of the American or *Nearctic* forms are casuals or accidental visitors. On the other hand, Asiatic forms have a much less influence in numbers of species, but regarding individuals it is greater. Of the 6 species, 3 are noted for one specimen each, the other 3 being more or less numerous, far more so than any American form. The circumpolar species need little comment. The 29 Pacific forms, however, are entitled to some consideration. Of them, 16 may be said to have close relatives on the Atlantic side of North America, but the remaining 13 are utterly distinct, even 8 of them generically. If we add to these the various members of the subfamily *Phalerinae*, which occur abundantly throughout the Aleutian Islands, and several forms which as yet are unknown from the Pribilofs, we are confronted with the fact that a very large number of Bering Sea birds have no close natural affinity with Atlantic forms. Of the family *Alcidae* there are known from the coasts of North America 25 species and subspecies, of which only 9 occur on the Atlantic side. But a single species (*Cepphus mandtii*) occurs on both sides. Of the 12 genera in which these forms are placed, 3—*Alca*, *Plautus*, and *Alle*—are exclusively Atlantic. Three others—*Fratercula*, *Uria*, and *Cepphus*—have their species about equally divided on each side. The remaining 6, belonging to the subfamily *Phalerinae*, are exclusively Pacific. Besides these we have *Lunda*, *Diomedea*, *Philacte*, *Heteractitis*, *Aphriza*, and *Leucosticte*, to say little of such forms as *Rissa brevirostris*, *Oceanodroma furcata*, *Sterna aleutica*, and others, which have no representatives on the Atlantic side. Most of the species and subspecies of the genera *Fratercula*, *Uria*, and *Cepphus* breed in the far north and are little differentiated from each other. These birds could readily have made their way from ocean to ocean during some extraordinarily warm summer in the remote past, and having been unable to return have remained and perpetuated their kind with consequent variations. It would seem correct to consider that the ancestral stocks of these genera were Pacific.

Many eastern American species summer in western Alaska, even to the shores of Bering and the Arctic seas. Certain Siberian forms also summer in the same region. On the American side there is now continuous land connection, but it may not always have been so. On the Asiatic side we have no present continuous land connection, but evidently it has been otherwise, for these Siberian species could hardly have learned their way into Alaska over the present bleak and forbidding route. The facts thus require that when the Asiatic or Siberian forms first reached what is now Alaska they did so over continuous or narrowly separated land areas. The American forms only extended their range as the rising or clearing land became available for their needs. The Siberian species have simply continued their migration over the slowly disappearing land.

The practical restriction of the family *Alcidae* to the Pacific, and the actual restriction of so many genera and species, would seem to require that when, previous to the glacial periods, ice existed in but small quantities about the North Polar region what is now Bering Straits was tightly closed to the members of this family in the Pacific. If it were not so, it is perhaps impossible to account for the restriction of these birds to the North Pacific, and also for the reason that such Atlantic forms as *Plautus*, *Alca*, and *Alle* failed to diffuse themselves throughout circumpolar areas during preglacial times.

Of the 29 Pacific forms, 16 have close relatives on the Atlantic side, but they belong to genera of wide distribution, and, excepting a few land genera, *Passerina*, *Calcarius*, *Ammodramus*, *Troglodytes*, are water birds of extensive northern habitat and generic circumpolar distribution, like *Rissa*, *Larus*, etc. These last all have extremely well-developed powers of flight. It would seem that where related forms inhabit both sides, the Pacific birds are the larger, with longer and larger bills. Of the various species of the subfamily *Phalerinae* nearly all occupy generic or subgeneric divisions by themselves and are consequently distinctly differentiated, few genera containing more than one species and none subspecies.

The above facts would indicate that the Atlantic members of the *Alcidae* have been derived from Pacific ancestors during several warm periods of the past, *Alle*, *Plautus*, and *Alca* having been much the earliest.[1] Thus, besides the present and past ice, there would seem to have existed a barrier to transpolar mixing and dispersal of Atlantic and Pacific forms.

That this ancient Bering Straits land barrier prevented Pacific types from spreading east and west into the Atlantic, and vice versa, seems extremely probable, and that this same barrier may have had considerable to do with the causation of the Glacial epochs seems evident, considering the general topography of the region surrounding the Arctic Basin. The result now of damming up the waters flowing south through the Straits, the influence of which is felt and seen by every traveler in Bering Sea, and even when hundreds of miles south of the Aleutians, would be disastrous in its effects on the present climate of Asia, and especially to North America, and most certainly so to the present distribution of northern forms of life. The North Pacific Basin is a vast amphitheater. The volcanic activities which dot its circumference—the grandest in the whole world, yet now in its last throes—have consumed considerable material that has most evidently been derived from a seaward direction. Destruction and submergence has necessarily followed, and deep water is now found where most probably low, extensive, and volcanic island areas were

[1] I consider *Alle* misplaced with the other genera. It is more closely allied with the lower *Alcidae*, the neossoptiles being structurally distinct from those of the *Alcinae*.

formerly numerous. The present rugged and precipitous coast line of the Pribilofs and other islands of Bering Sea are certainly indicative of their former much greater extent. Also the low coast line and the shallow seas of the western coasts of Alaska point to the same previous condition.

The relationships and zoogeographical distribution of the avifauna of the region under consideration have often been variously determined by naturalists. Sometimes considered as *Nearctic*, then as often *Palaearctic*, we now find them settled by Professor Newton as *Alaskan*, a province of his *Holarctic*.[1] On Dr. Merriam's provisional maps of the principal life areas of North America, Alaska is divided between his *Arctic* and *Boreal*, the last being distinguished as a region and described as circumpolar.[2] I doubt if either of these names can be properly applied to primary life divisions, for *Palaearctic* types must have been in existence long before glacial times, which alone has produced Arctic and most of the present boreal conditions. Besides, the avifauna of northern North America is not greatly different from, and has most evidently been derived from, that of Eurasia. As well-known authorities completely differ as to the values of the elements of the avifauna of Alaska, their relations may be discussed here briefly as an effort toward determining the status of the birds of the Pribilof Islands.

We have first a very large number of forms, common transients of eastern North America, which are summer residents of Alaska, and which reach that region by way of the Mississippi and Missouri watersheds. From western North America also quite a number of forms reach and enter Alaska as far as Kadiak Island and the Aliaska Peninsula, though a few penetrate farther, even to Point Barrow. Certain forms cross over from Siberia and also summer in Alaska. Others again, summering in Alaska and Siberia, winter on the islands of the middle and southern Pacific. So much for the true migrants. Resident forms may also be divided into four groups which are to be correlated with the same directions. We have resident forms in northern Alaska whose nearest relatives are found eastward in British America. Others are resident about Sitka and the Aliaska Peninsula and adjacent islands whose nearest relatives are directly southward. The Siberian influence also has stamped itself in such a way that we find resident Alaskan forms whose nearest relatives are in Asia. And, last, there is another group, resident about the shores of Bering Sea and on the islands, and but rarely found elsewhere. The first mentioned in each of these two divisions belong to the *Nearctic* subregion. Those of the second belong to another division of the *Nearctic*, the *Sitkan*. The third group is essentially *Palaearctic*, and therefore *Siberian*, and the fourth *Aleutican*.

Mixed as these bird elements certainly are, especially during the summer season, we can, perhaps, readily unravel the causes which have produced such a conglomeration. In preglacial times, when Arctic ice and its effects were absent, the continent of North America was undoubtedly inhabited by species the great majority of which were most evidently of *Neotropical* derivation. The archipelagic character of the northern parts of North America and the land continuity of its southern portion assisted in preventing any predominating influence from the Eurasian (*Palaearctic*) continent. But with the gradual cooling incidental to preglacial conditions the *Neotropical* influence gave way gradually to the hardier and nearer elements of *Palaearctic*

[1] Dict. Birds, 1893, 331.

[2] N. A. Fauna, No. 3, 1890, p. 24.

life. This became greatly intensified when the glacial influence reached a maximum. Those *Palaearctic* types which under the former mild, cooling conditions had effected a foothold on the American continent were then forced southward and readily displaced the previous *Neotropical* stock. This must have been a comparatively easy task, for the cooling climatic conditions were in their favor. Thus a number of forms of various genera and families of *Palaearctic* types were cut off from the parent body and subsequently became differentiated into what should be considered as a branch or subregion of the *Triarctic* (or *Holarctic*) region—the *Nearctic* subregion. The retreat of the ice permitted not only the reoccupation of the more northern portion of the continent by these now fixed *Nearctic* forms, but also a northern extension of the remains of the more northern *Neotropical* forms. These movements, the result of the retreat of the ice sheet, plus the altering topographical conditions resulting and in connection therewith, or following, have effected the present mixed condition of the Alaskan avifauna and of North America generally. The northwestern trend of the western outline of the ice sheet and the lacustrine conditions thereby induced as the glacial influence diminished, plus the influence of the Missouri and Yukon drainage systems, assisted in the extension, even to the mouths of the Yukon, of the common migratory forms of the Mississippi Valley. The same result evidently occurred on the Pacific watershed, but modified by the western trend of the Rocky Mountains and the barrier of the Mount St. Elias region. The probably extensive island condition then of Bering Sea, and perhaps of the North Pacific, assisted in permitting the return of Asiatic forms to again reside in summer in Alaska. The extreme cold of the glacial periods and the volcanic activities of the North Pacific region have undoubtedly effected the extermination of some prior forms and the dispersal of others. The habits of the sea species, especially the *Alcidae*, have favored their preservation.

The common migrating forms of *Limosa* and *Charadrius* have a peculiar status, which may be mentioned here as illustrating one phase of Alaskan bird life. The first is closely related to the European *L. lapponica*, but is paler and larger and does not occur in North America except in western Alaska. The second is closely related to the American *C. dominicus*, though smaller, but also occurs on the Pacific coast of Asia as a migrant. Both occur in their greatest abundance in winter on the islands of the Pacific and rarely if ever on the mainlands except in summer in Alaska and Siberia, and both are good subspecies. The winter distribution of the *Limosa* is more southerly than the other. Of *Arenaria*, another extensive Pacific islands' migrant, rarely found on the northern mainland in winter, I have treated fully under that genus.

It would appear then that we should be right in considering that the *Palaearctic* ancestors of our present Alaskan avifauna were originally breeding residents on the island land areas immediately about the North Pole and became diffused as that region became covered with ice. As this refrigeration began at a center—whether that center was at the Pole or elsewhere is immaterial—it would have caused, more markedly than before, the individuals of each species to migrate southward over ocean island routes when that suited their needs and over land routes when that was more to their taste. This separation of the main body of breeding birds and their segregation into several noncommunicating parts began early in the first glacial period and continued and increased as time went on. Then there occurred, naturally, variations in the scattered noncommunicating members of each species because of their different environments. That differentiation increased in time, but varied in amount in the different groups for various reasons. Some of these divisions now constitute good species, while others are only considered worthy of ranking as subspecies, while of still others opinions differ as to the sufficiency of causes for separation as species or subspecies or even for separation at all. This explains the differences between such forms as *Somateria mollissima* and *dresseri*, and *S. v-nigra*, *Arenaria interpres* and *A. morinella*, and *Larus glaucus* and *L. barrovianus*. This differentiation is correlated by the time which has elapsed since the separation began and the differing environment, but the species or subspecies also vary in amount of difference by the effects of another factor, the degree of communication possible during the early or intermittent stages of the separation. The generally so-called circumpolar species are really not circumpolar except generically, the amount of our ignorance being more than sufficient to fill up the measure of our knowledge of what constitutes a usually so-called circumpolar species. A good example is the case of the turnstone.

Thus it would appear probable that western Alaska and the Bering Sea islands are the remnants of former land areas originally connected with or narrowly separated from the *Palaearctic* continent, the differences now observable as to resident faunal and floral life being due to greater or less volcanic action and greater or less glacial influence in affecting and isolating that life. And the same is true of North America as a whole. It is now essentially *Nearctic*, with a very strong double intrusion, pre and post glacial (of *Palaearctic* derivation), from the northeast and northwest, consequent on glacial and volcanic action, destruction, and dispersion. Where these opposite types meet the modifying influences of the varied environments have effected results tending to bridge over the gaps, thus producing transitional forms. Thus the retreat of the ice permitted the reextension northward of *Nearctic* types, but contact with boreal influences differentiated these frontier forms, so that we now find them generically and specifically distinct from their nearest relatives. In less degree have the southern outliers of northern forms differentiated.

It would consequently seem from this discussion that from the elements of the Bering Sea avifauna and vicinity are deducible several zoogeographical provinces and subprovinces, and that the whole constitutes a division of the *Holarctic* region. Professor Newton's term *Alaskan* can be retained for the region north and east of the Aliaska Peninsula. This peninsula, with the islands adjacent on the south and the mainland to British Columbia, may retain Mr. Nelson's name of *Sitkan*. It is properly a true transitional subprovince of the *Nearctic*. The Aleutian Islands, the islands of Bering Sea, and much, perhaps all, of the mainland coasts of Alaska and northeastern Asia to the Arctic Sea constitute a single subregion to which the name *Aleutican* is more properly applicable.

These views are necessarily somewhat suggestive and void of details, but seem pertinent to a consideration of the avifauna of the Pribilof Islands. Unfortunately, little is known concerning the exact distribution of many of the forms, and the collections that have been made in the region are so widely scattered that it is impossible to bring them together for comparison.

DISTRIBUTION OF THE FAMILY ALCIDAE IN NORTH AMERICA.

Pacific.	Atlantic.
Fraterculinae.	*Fraterculinae.*
1. Lunda cirrhata.	1. Fratercula arctica.
2. Fratercula corniculata.	2. glacialis.
Phalerinae	*Phalerinae.*
3. Cerorhinca monocerata.	
4. Ptychoramphus aleuticus.	3. Cepphus grylle.
5. Cyclorrhynchus psittaculus.	
6. Simorhynchus cristatallus.	
7. (Phaleris) pygmaeus.	
8. (Ciceronia) pusillus.	
9. Synthliboramphus antiquus.	
10. Brachyramphus marmoratus.	
11. kittlitzii.	
12. hypoleucus.	
13. craveri.	
14. Cepphus columba.	
Alcinae.	*Alcinae.*
15. Uria troile californica.	4. Uria troile.
16. lomvia ana.	5. lomvia.
	6. Alca torda.
	7. Plautus impennis.
Allinae.	*Allinae.*
	8. Alle alle.

COMMON TO BOTH SIDES.

Phalerinae.	*Phalerinae.*
17. Cepphus mandtii.	9. Cepphus mandtii.

I have prepared the above table for the purpose of illustrating the great difference between the two sides of North America as represented in this order.[1] But one form is found on both sides, and this a high northern species which can readily in a very mild season pass from one side to the other. The *Alcinae* are distinct, but have hardly been separated for any great length of time. The characters of the others indicate, however, that when the present boreal climate was milder a barrier existed to prevent dispersion.

THE MIGRATION OF PRIBILOF BIRDS.

I can do little more than hint at the facts, phases, and factors that are concerned in the bird migration of this portion of Bering Sea. For the true migrants (not summer breeders) the course is undoubtedly north and south through the islands, practically all the individuals going to breed on the islands north of the Pribilof group and on the adjacent Alaskan and Siberian coasts, below and also beyond the Straits. As to the course taken by the migratory flocks on their way south after reaching the

[1] All Atlantic species are given, but there are a number of additional Pacific forms confined to the Asiatic side. The British Museum catalogue, vol. XXVI, gives a total of 26 species for this order, of which 18 are Pacific, 5 are Atlantic, and 3 are common to both.

Aleutians there is little direct evidence. That which is available indicates three routes—one southward toward the Californian coast,[1] a second toward the Hawaiian Islands, and a third along the Aleutian chain, thence toward the Asiatic coast and islands. I am unaware of any positive movement from the Aleutian Islands eastward along the coast to California southward. When over 800 miles south of Unalaska a Savanna sparrow (*A. sandwichensis*) boarded the vessel, staid with us all night, and I saw it depart the next morning in an east of north direction which would take it to its summer home. Mr. Nelson records that when he approached the Aleutian Islands in the spring of 1877 several turnstones were seen ten or twelve hours' steaming from the islands. They were headed north. Mr. Elliott also tells us that when 700 miles off the Straits of Fuca he saw many individuals of the same species heading northwest for the Aleutian Islands. In May, 1890, soon after passing the halfway point between San Francisco and Unalaska we began to see phalaropes (*C. fulicarius*) and for some hundreds of miles they were common. Their course was northward. Nelson tells us "While the *Corwin* was midway between the Aleutian Islands and San Francisco, in October, 1881, a small party of birds, undoubtedly of this species [*C. dominicus fulvus*], was seen passing high overhead, coming from the direction of the Aleutian Islands and passing directly toward the Hawaiian group." He adds, "This is certainly a remarkable flight for birds of this character to undertake, and its accomplishment indicates great powers of flight as well as great endurance."

Dr. Thomas H. Streets, in Bulletin No. 7, United States National Museum, page 17, tells us, in speaking of the same species—the Asiatic golden plover: "In regard to the habits of these birds we were informed by residents of the island [Oahu, Hawaiian Islands] that they make their first annual appearance about September. When they arrive they are very poor and weak, having evidently been on a lengthy voyage and been deprived of food for a long time. During their stay through the winter they become very fat. About March or April they begin to prepare for their departure. They can be seen during the day, at this time, taking long or short flights out at sea and returning again to the islands. This exercise is undoubtedly for the purpose of strengthening themselves for the final effort, their muscles during the winter's life of luxury and ease having become flabby and feeble. We have met them at sea a long distance from any land very much exhausted, and have known them to take refuge aboard the ship, where if not molested they would remain until we reached land." As this plover is unknown from the American continent in winter, breeding only in summer in America on the Bering Sea side of Alaska, we are compelled to the conclusion that it traverses twice a year the 2,000 miles or more of ocean between the Aleutian and Hawaiian islands.[2] The species breeding in Alaska and occurring in winter on the Fanning and Hawaiian groups are the tattler (*H. incanus*), the turnstone (*A. interpres*), the sanderling (*C. arenaria*), the Asiatic golden plover (*C. d. fulvus*), the bristle-thighed curlew (*N. femoralis*)—taken several times in Alaska, the pintail (*D. acuta*), the shoveler (*S. clypeata*), and perhaps many others. We are thus

[1] This is probably wrong and should be added to the second. The barn swallow breeds at Unalaska and far northward, and evidently reaches there through California. It and the robin are but accidental on the Pribilofs.

[2] In the extracts from the diary of Henry Palmer (Rothschild, Avifauna Laysan, 1893, Vol. I, p. xiv, occurs the following: "A kolea (Golden Plover, *Charadrius fulvus*) flew also round the ship and considerably astonished me by sitting on the water several times to rest." This occurred just previous to August 18.

justified in the belief that migration does take place across these extensive wastes of waters. The barred-tailed godwit (*Limosa lapponica baueri*)[1] is another example of a Pacific migrant. They pass through the Aleutian Islands in spring in small flocks, reach St. Michaels before the end of May, and breed along that coast of Bering Sea. They return in the fall, pass through the Pribilofs and the Aleutians, and winter on the islands of Polynesia and Southeastern Asia, Australia, and New Zealand. They are absent from North America during our winter, there being but one record—in Lower California.[2] Their course is probably through the Aleutian chain, on many islands of which they have been taken, thence to the Japanese coast, and southward. Other species of Asiatic wintering birds occur, breeding in Alaska; also individuals of eastern American species have been taken with them on the islands of Bering Sea, thus pointing conclusively to a migration route over the western Pacific Ocean. Another group of migration movements from the Alaskan breeding grounds is shown in such species as the Pribilof sandpiper (*T. ptilocnemis*), and the emperor goose (*P. canagica*) and many other species. These winter on the shores of the southern islands of the Aleutian chain and along the Aliaska coast southward.

The fact that many species of Alaskan birds boldly launch themselves into the wide expanse of ocean between their summer and winter habitats naturally leads us to expect that at sometime in the remote geological past their ancestors had a more happy course over contiguous land areas which have since been submerged. No other solution seems possible, and many probabilities point to such a conclusion in spite of the fact now of considerable deep water intervening. Birds have no inclination to explore unknown regions lying at such great distances apart. Their movements must necessarily have begun gradually over contiguous or narrowly separated areas which have been widened during the operation of geologic changes. The Pribilof group is some 250 miles from the nearest Alaskan coast; they are nearly 200 miles north of the Aleutian chain. They are 200 miles south of the next island to the northward, St. Matthew. The Commander Islands lie 750 miles westward. The islands of the Aleutian chain are generally visible from each other in clear weather, but gaps of 40 to 60 miles are frequent. Attu, the most eastern of the chain, is about 180 miles from the nearest of the Commander Islands and about 500 from the nearest coast of Asia, Cape Shipunski in Kamchatka. California is some 2,000 miles southeastward of Unalaska, and Sitka is about the same distance almost directly eastward. The Hawaiian Islands are also 2,000 miles directly southward from Unalaska, without intervening land. Bird migration between the the Pribilofs and the Aleutians and between the Aleutians and Asia, Polynesia, and the Hawaiian group undoubtedly occurs with many species and in enormous numbers.

It has often been asserted that migrating birds take advantage of geographical objects, as mountains, valleys, rivers, etc., in directing their course during their long journeys from their summer to their winter habitat. However plausible this may be as applied to land-migrating birds it fails completely upon consideration as a factor of the movements of the Pacific birds noted above. I am not even sure that it is a necessary factor even to land-migrating birds, but however that may be it most certainly can not be considered when one is endeavoring to account for causes that enable these birds to continue in a direct line; for instance, from the Aleutian to the

[1] =*Limosa novæ-zealandica.*

[2] La Paz, No. 86418, U.S.N.M., 1882, L. Belding (in spring, head).

Hawaiian islands. Migrating birds evidently have a power of keeping a straight course for very long distances, a sense of direction, as it were, which enables or allows them to fly at certain periods for a certain time, the starting and arriving places being positive factors as well as the distance between, thus insuring an arrival—winds and other influences permitting—within a certain time near some objective point, the exact location of which can be ascertained by the ordinary powers of observation. As we in ourselves combine in a marvelous degree certain attributes or powers, purely educational ones, unknown to, or only in an embryonic stage in our ancestors, so birds, migrating first from necessity over short distances, have during the lapse of countless ages, as necessity enforced, developed a sense of direction which is practically unknown among mammals and is consequently difficult to be imagined and understood by ourselves. This accounts for the great loss when migratory species, like the Pacific salmon and the European migratory quail, are transplanted to localities geographically opposite that to which their ancestors had for ages been accustomed to.

It must not be understood that I am wedded to the idea that land connection must have been straight and continuous between the Aleutian and Hawaiian groups. It would seem more probable that these ancient connective land areas existed between these points, but fronting on the American and Asiatic continents, respectively. The descendants of our ancient migrating birds possibly have simply gradually straightened out the originally somewhat perhaps crooked course. In other words, the lines of migration to-day are somewhat different from the ancient lines because of the tendency of natural selection to weed out gradually those individuals or groups of individuals not adapting themselves to the altering physical conditions and availing themselves of the direct, less dangerous, and shortest route between the starting and objective points. Our knowledge of Pacific migration is still in its infancy, and this brief chapter may suggest further investigation.

Synopsis of Pribilof birds.

Swimmers	39
Waders	15
Birds of prey	5
Perchers	10
Total species	69
Total families	21
Total genera	56

THE BIRDS OF THE PRIBILOF ISLANDS.

Order STEGANOPODES. Totipalmate Swimmers.

Family PHALACROCORACIDAE. Cormorants.

But one species of this family, the only one of the order, is found on the islands. But there would seem to be no reason why one or more of the various species of cormorants found in Bering Sea should not wander occasionally within our limits.

1. **Phalacrocorax urile** (Gmel.). Red-faced Cormorant. "Oreel."

Carbo pelagicus, COINDE, Rev. et Mag. Zool. 1860, 401.

Graculus bicristatus, DALL and BANNISTER, Trans. Chic. Ac. Sci., 1869, 302, Pl. XXXIII.—DALL, Proc. Cal. Ac. Sci., 1874, 275.—COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 192.—ELLIOTT, Mon. Seal Ids., 1882, 130.

Phalacrocorax bicristatus, COUES, Key, 1890, 728.—GRANT, Cat. B. Br. Mus., 1898, 358.

Phalacrocorax urile, NELSON, Bds. Alaska, 1887, 65.—A. O. U. Ch. List, 1895, 45.—RIDGWAY, Man., 1886, 80.

Fairly abundant and one of the few summer birds which winter. But few breed on St. Paul, the chief nesting places being on Walrus, Otter, and St. George islands. They are far less abundant now than formerly. When one is in a boat some distance from land and cormorants are about, several will usually alter their course to circle about and inspect at close quarters.

"As this bird is found during the whole winter, in spite of severe weather, perched on the sheltered bluffs, the natives regard it with a species of affection, for it furnishes the only supply that they can draw upon for fresh meat, soups, and stews, always wanted by the sick; and were the shags sought after throughout the year, as they are during the short spell of intensely bitter weather that occurs in severe winters, driving the other waterfowl away, they would certainly be speedily exterminated. They are seldom shot, however, when anything else can be obtained."—(*Elliott.*)

A somewhat critical comparison of the feather conditions of my specimens of various ages has led me to doubt the correctness of the position usually assigned the birds of this order in our lists. Consequently, I have examined all the specimens accessible to me, not only of this order, but of most of the families of North American birds. Part of the results are embodied in the present paper.

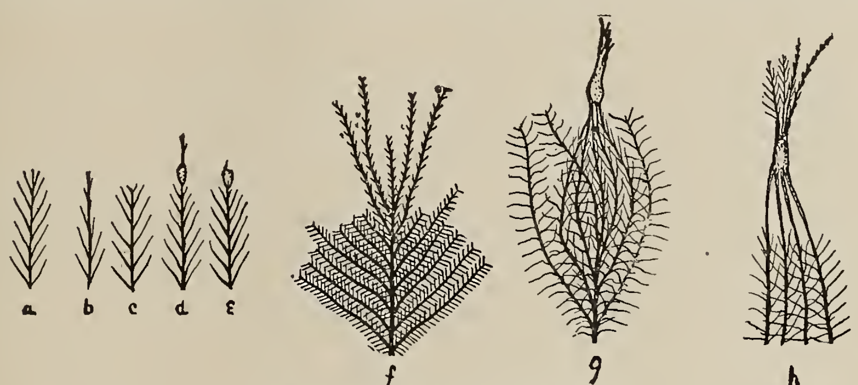
In winter specimens in adult plumage the necks are profusely decorated with long, white, club-shaped filoplumaceous feathers. Most of these drop out before summer, but a few are persistent and can be found on the necks, usually just below the head and sometimes on the breast (fig. 6, Pl. XL). One of my immature (brown yearling) specimens also has quite a number on the neck (fig. 7), and some of these have one to several rami scattered irregularly down the rachis (fig. 8). Also on my two young collected on August 7 (about two months old), the necks have a great number of these long, white filoplumes projecting beyond the down (fig. 9). These average about 12 millimeters in length, and are also to be found sparingly all over the body, especially on the thighs. I am at a loss to interpret these feather structures. They are evidently degenerate and homologous with those so abundant about the bases of the larger feathers of eagles, etc., but in this instance they precede the true feather growth. The feathers of the white thigh patches of the fully adult generally begin to loosen by June, so that few specimens are perfect in that respect among those taken on June 13. On August 7, good-sized young were found hiding among the rocks, and two were collected, Nos. 118726, 118727, ♀ ♀ ; one of these, 28 inches long, is still in the downy stage on the body, but the wings and scapulars are well feathered, and some new feathers are showing down the breast. Others are to be seen all over the body upon parting the down. The tail is well grown. The down is darkest, sooty seal brown, toward the tail, gradually changing to drab gray toward and on the head. The other specimen is older and has lost the down on the body and partly up the neck, where it has been replaced by the shorter and much-paler new growth of down. This change takes place all over the body, the long, brown, first down giving way to the new true feathers after they have grown for a time, and a new, short, whitish down, which evidently is permanent until the next year's molt.

A very small nestling (No. 62533, St. Paul, July 2, 1872, H. W. Elliott) is scantily clothed with dark-brown down, it being especially abundant on the thighs and scanty elsewhere. Most of the down is still bound with the remains of the sheaths, but on the thighs it is dry and fluffy. On one of the thighs and on the neck downward all over the underbody are single white downs scattered about somewhat evenly. On the other thigh there is but one. A few white downs can be seen on my two larger specimens when the long dark down is parted, but there are very few.

The absence of down attached to the tips of the new feather growth of the cormorant and which is so conspicuous in many species, especially in the higher birds, led me to examine these specimens closely. The sequence of feather growth on the body of the cormorant is as follows. The bird is hatched nude. In a few days down appears on the feather tracts of the dorsal surface, the growth gradually spreading until the whole body is covered with the down, the head being the last to be completed. This down increases in length as the bird grows, reaching a length on the back of about 24 millimeters. When this down has reached its full length and abundance, our young bird is about one-third grown. Then the new plumage contour feathers appear, as I have described. As these new feathers increase in length this first down loosens and drops out and another downy growth follows. Thus in the young cormorant, before it has become fully feathered, there have developed two distinct downs, structurally similar, but differing in color and length, and functionally, if such a word can be applied here, dissimilar. These two down growths are common to many other birds, especially the hawks, but there the first is attached to the tips of the first plumage feathers as they grow out, whereas in the Steganopodes the opposite is the case. Hence I have formed the opinion that the first down growth of the cormorant is homologous with the first down growth of other groups. An examination and comparison of many specimens of young birds of this order reveals similar conditions to those of the cormorant. Hence the conclusion is inevitable that in this order we have early plumage conditions quite different to those that obtain in all the other groups.

On the lower portion of the legs of my larger young specimen there are quite a number of feathers nearly full grown, which in their appearance differ greatly from those on the body. Their distal outline, instead of being clean cut, have the rami considerably lengthened and fluffy. At first glance this would seem to be similar to the down attached to the first feathers of other birds, but under the microscope it is seen that the rami tips are simply lengthened, they having longer radii than usual. They are really partially semiplumaceous feathers. But attached to the tips of one or two of the rami on nearly every one of these feathers is a slight swelling with a continuation of the rami at its apex. These ends are variously broken and imperfect, but there can be no question but that they are a relic of the first down growth, and hence are identical with those described under *Tringa ptilocnemis*, but of course greatly degenerate. Also on the early upper tail coverts the tips carry a rudiment of the down growth.

In the higher groups, according to the position of the birds in the avian scale and the flight and nidification characteristics, the suppression of the first downs on the



TIPS OF FEATHERS OF YOUNG CORMORANT.

a, b, c, d, e, from lower portion of leg, showing variously worn rami tips, *d* and *e* with rudiments of down attached; *f*, tip of a secondary, the upper portion being the degenerate down; *g*, tip of an upper tail covert, with rudimentary down attached; *h*, tip of a tertial with a more perfect though rudimentary down. All greatly enlarged.

tips of the flight feathers is either complete or partially so. In the birds of this order there is a slight difference according to the family, but as a rule the down is persistent on a small portion of the growing flight feather. In the cormorant it is much less so than in the other examples of the order that I have seen. On some secondaries and tertiaries of the larger of my young specimens there are attached to the tips a prolongation of the rachis, having longer rami but shorter radii than those immediately below. A very similar though more perfect structure is found in some other birds of other orders, where there can be no question as to their downy nature and position. Unquestionably this irregular, imperfect, and short-lived growth is the remnant of the downs of the flight feathers. They rarely exceed 3 or 4 millimeters in length. In *Sula* they are much larger and more persistent, and differ but little in the other families.

Unlike most water birds, the cormorant is hatched nude and its eggs are very small, considering the bulk of the parents. Soon after hatching the down appears, short at first but increasing in length as the bird grows. As it reaches full size the first true feathers, the wintering plumage, appears, and as it covers the body the down loosens and drops out. A microscopical examination of this down reveals a true bunch of down rami but all united at their proximal ends in a somewhat uneven manner, so that their combined mass at that point is homogeneous and can not be separated, when fully grown, into rami parts. Figs. 10 and 11 show the structure of these downs. We have thus a peculiar case quite unlike any other North American bird except the members of this order in that the first body downs are not pushed out by and attached to the tips of the new feathers.

The presence of a well-defined persistent rachis or calamus, the unequal and irregular dividing of the bases of the down rami and their nonattachment, externally, to the tips of the new feathers, their slow growth, and the long period of use of the first true feathers, suggests that we have to do with feather conditions much more primitive and degenerate than in water birds generally, and quite different to those to be considered later. No structure or rami bases can be seen in the rachis when full grown, though as it is growing the bundles of rami fibers are distinctly to be seen even to the growing end, as shown in fig. 12. Further explanation will be found with the plate.

Consideration and comparison of these feather structures and the environing influences of the habitat of the species has led me to the conclusion that the cormorants, with the other members of the order, occupy a much lower position on the avian scale than the other species of this list. The very small egg, the nudity at birth, the growth and character of the first and second feathering are morphological characters, which, taken together, are so strikingly different from our other water birds as to be explained only on the ground of the birds being less advanced, and therefore more generalized. The principal use of feathers is as a protection to the cuticle, especially to prevent the rapid loss of body heat; therefore the great differences noticeable between the feathers of land and water birds—such, for instance, as the long, narrow, fluffy, less rigid and less oily feathers of the former as compared with the short, broad, and more compact, greater curved, and more oily feathers of the latter are adaptive and their use highly mechanical. It thus follows that differences of method and sequence of growth of the feathers of water birds, when the mechanical stress due to similarity of use varies but slightly, or not at all, are of value on purely morphological grounds, and suggestive of the path of their evolution. The specialization of any group is due to the constant efforts of such to adapt themselves to minute changes of environment during millions of years, the pathway being selected by the tastes of a more or less numerous body of individuals, separate bodies diverging in different directions and gradually becoming more different, thus forming other species and genera. But the slight need of further physiological specialization of the feather growth, after having once attained a high plane, is shown by the sufficiency of their development in securing an end necessary for the direct preservation of the species—the prevention of the rapid loss of body heat and protection of the cuticle. Further changes (color and shape) must necessarily result from the action of psychological or psychodynamical influences. According to this view the cormorant has remained at, or probably degenerated to, a lower point on the avian scale than any of the other forms of this list. And this seems true also of the other members of the same order, although all of them have variously differentiated in the direction of greater specialization, but not in all respects to the same extent as other water birds.[1] The fact that different species have accomplished similar comparable results in mature plumage, by roads so strikingly different, argues, I think, an evolutional suggestion of the chronological changes which have taken place. Our knowledge of the relationships of extant to extinct forms is obviously crude and inexact, because of the great lack of precise data and the deficiencies of the known and guessed at geological record; and on the other hand one is apt to be misled by not properly discriminating between the purely morphological characters and those that are partly or entirely and strikingly adaptive, either on physiological or psychological lines.

I am fully aware that in thus placing this species at the foot of my ornithological ladder I am doing violence to current opinions; yet considering its life history, its evident generalized low structure, and lack of advanced specialization, I can not consider it as anything but lower in the avian scale than the other species of water birds to follow.

The nest of the red-faced cormorant is large, 16 to 18 inches in diameter, and is placed in the center of a niche or shelf of the rocks. It is composed almost entirely of sea ferns with a few quill feathers of the large gulls inserted in the sides, perhaps for ornament or recognition. The nests are very filthy; insects, especially maggots, swarm beneath them, and evidently they are used for many seasons, with repairs. They breed early. Elliott took two eggs, well incubated, on June 1, 1872, and I secured young, some a week old, on Walrus Island, on June 13, together with eggs more or less advanced in incubation. Some nests contained two, others three, and a few four eggs. Usually the birds leave the nest upon our approaching, but in one case by moving slowly I succeeded in capturing a female by the neck with my hand.

"From the nest of a cormorant I removed two full-grown birds, to all appearances the parents of the brood of chicks, and I afterwards observed two other adult birds feeding the chicks and taking a parent's care of them."—*Lutz.*

The eggs of this species are very small for the size of the birds. The general color is a light, pale blue, over which is deposited, thinly and thickly, a layer of white, chalky lime, which is roughened by contact with the nesting material. Usually the blue can be seen through this white layer, but often it is thick and can be picked off and scraped from the bluish surface of the egg. That the white surface layer is soft when the egg is deposited is shown especially by No. 16741, which has several small pieces of grassy matter imbedded in the surface, besides numerous impressions of others. The eggs are filthy, as a rule, when in the nest, and when advanced in incubation are apt to be stained yellowish, even when well washed and cleaned.

The largest and smallest eggs were collected by Mr. Elliott in the summer of 1872, and measure 2.60 by 1.45, 2.26 by 1.57. A set of three taken by myself on June 13, 1890, on Walrus Island, measure 2.50 by 1.55, 2.41 by 1.52, 2.36 by 1.54. A single egg taken at the same time is 2.40 by 1.40. I saw several sets of four.

The following are the weights of seven specimens collected June 13, 1890: Adult

[1] Thus in *Sula* downs are prominently attached to the tips of the flight feathers and their coverts, and in one species at least to the scapulars. Otherwise they are as in *Phalacrocorax*. The explanation is perhaps simple, the higher food-getting habits of *Sula* having produced and fixed a corresponding advancement of feather structure on the parts mentioned, owing to their habitual use. The low grade of the members of this order has permitted a degeneration of the connective portion of the first two feather structures on those parts less concerned in the powers of flight, and which, in *Phalacrocorax,* has extended to nearly all the feathers.

males, $5\frac{1}{2}$ and $5\frac{5}{8}$ pounds; adult females, $4\frac{1}{4}$ and $3\frac{5}{8}$ pounds; immature (brown) males, $4\frac{3}{4}$, $5\frac{3}{8}$, and $5\frac{3}{4}$ pounds.

Order ANSERES. Lamellirostral Swimmers.

Family ANATIDAE. Ducks, Geese, and Swans.

Eleven are here noted as occurring on the islands; others are undoubtedly to be found during migrations and in winter. Three species traced, two commonly and the other in small numbers. Of one of these, the Harlequin duck, it would seem that the nest and eggs have not been seen on the islands, though the young apparently have been taken.[1]

2. Merganser americanus (Cass.). American Merganser.

Mergus americanus, Dall, Proc. Cal. Ac. Sci., 1873, 30.
M[*ergus*] *merganser*, Coues, Key, 1890, 716.
Merganser americanus, Salvadori, Cat. B. Br. Mus., XXVII, 1895, 477.—A. O. U. Ch. List, 1895, 47.—Ridgway, Man. 1896, 89.

Of undoubted occurrence during migrations and in winter, but the only knowledge I have is from Dr. Dall's reference as above, which simply notes its occurrence in winter.

3. Harelda hyemalis (Linn.). Old-Squaw, "*Saafka.*"

Harelda glacialis, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 191; Key, 1890, 706.—Elliott, Mon. Seal Ids., 1882, 130.—Salvadori, Cat. B. Br. Mus., XXVII, 1895, 389.
Clangula hyemalis, A. O. U. Ch. List, 1895, 55.—Ridgway, Man. 1896, 106.
Harelda hyemalis, A. O. U. Com., Auk, 1897, 125.

A common species. Breeds near the freshwater ponds. "The *Saafka* is a very lively bird, particularly in the spring, when, with the breaking up of the ice, it flies into the open reaches of water and raises its peculiar, sonorous, and reiterated cry of *ah–naah–naáh–yah*, which rings cheerfully upon the ear after the silence and desolate dearth of an ice-bound winter"—(*Elliott*). They can be found on all the ponds, and it is common to see a male resting quietly on the surface at no great distance from its sitting mate. When disturbed and made to fly, the loud cries of the male sounded very like *ow–ow–ów–owerrr*. Between the foxes and the natives, who, upon finding a nest, generally suck the eggs, it is a wonder that the species is so common. Before or about the time that the young are hatched and brought to the ponds by their mothers, the males have forsaken their usual haunts on the ponds and have left for the open sea. This occurs early in August. The nests are placed almost anywhere on the flat ground near the ponds, on a little rise, usually. On June 12 I found a nest and nine fresh eggs about 40 feet from the village pond on St. Paul. It was placed on a little hillock on the killing ground. When flushed, about 10 feet off, the bird flew directly to its mate in the pond. Leaving the eggs, I returned soon, to find that she had been back, had covered them completely with down and dry, short grass, and returned to the pond. June 17, before 8 a. m., I found a nest, merely a few pieces of short grass stems, and containing one egg. Each morning thereafter at the same time I found another egg and more nest material, including from the second morning an addition

[1] This is a very distinct order. It should probably rank higher, but to place it elsewhere would do violence to the sequence following. The feather structure and growth (especially of the neossoptiles) are quite different and distinct from all our other orders.

of black down, which was always placed on and around the eggs, not beneath, and which was evidently from the bird's own breast. On June 10 several males were to be seen still in the winter plumage, and one remained for a considerable time after with the head feathers unchanged. A female, June 21, had not changed at all. No. 118728, ♂, June 7. Tip and base of bill black, center bright salmon, blending in front, but joining black in front of nostrils by a sharp curved line. Salmon color continued across lower jaw, with the tip blackish. Feet pearly white, webs darkish, also joints, as well as between scales; iris yellow gray. No. 118726, ♀, June 7. Bill very dark olive, base behind nostrils blotchy greenish; feet similar to ♂; iris light hazel. Downy young: Bill dark brown, center of tip of upper mandible horny reddish, reaching back on the sides somewhat; iris dark brown; feet glossy greenish gray, joints darker; webs at sides of toes light olive, reaching partly over toes between the joints.

4. Histrionicus histrionicus (Linn.). Harlequin Duck.

Histrionicus torquatus, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 199.—Elliott, Mon. Seal Ids., 1882, 130.

H[istrionicus] minutus, Coues, Key, 1890, 707.

Cosmonetta histrionica, Salvadori, Cat. B. Br. Mus., XXVII, 1895, 395.

Histrionicus histrionicus, Nelson, Bds. Alaska, 1887, 74.—Townsend, Cruise *Corwin*, 1887, 99.—A. O. U. Ch. List, 1895, 55.—Ridgway, Man. 1896, 107.

An abundant species about the rocky islets and shores, usually in quite large flocks. "It is the most gregarious of all the duck tribe known to these islands: flocks of a hundred closely bunched together may be found at every turn by the traveler on the coast; nor is it particularly wild or shy, for every morning at St. George * * * I could have a shot at fifty or a hundred of these birds. * * * It is a remarkably silent bird, and from it I never heard any cry whatever during the whole year; for it is about the island, unless the ice drives it away, throughout that entire period."—(*Elliott.*) On a little rock off shore, under Village Hill on St. Paul, I saw frequently fully 150 of this species. They came about 7 p. m. to roost during favorable weather. Seeing a person on the cliff, they fly off into the sea; but if one remains quiet they soon return, and, taking advantage of the crest of a wave, make a short flight to the rock. Among them, on June 12, I saw three male Steller's eiders and several females. In bad weather on the western side of the island they roosted at night on the rocks in the harbor, and often during the summer came into the harbor, and even flew up the lagoon. On July 10 I counted 63 in the harbor, of which only 3 were males in full plumage. I was told that some young were killed on St. George during the summer. The eggs, of which few are known, even these being of doubtful identification, are given by Mr. Ridgway in his manual as "buffy white or pale buffy, 2.30 by 1.62." Nos. 64297–64301, ♂ ♂ ♀ ♀ ♀, June–July, 1873, St. George, H. W. Elliott. No. 106839, ♂, June 14, 1885, Otter Island, C. H. Townsend.

5. Eniconetta stelleri Pall. Steller's Eider.

Somateria stelleri, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 192.—Elliott, Mon. Seal Ids., 1882, 130.

Somateria (*H.*) *stelleri*, Coues, Key, 1890, 709.

Heniconetta stelleri, Salvadori, Cat. B. Br. Mus., XXVII, 1895, 418.

Eniconetta stelleri, Nelson, Bds. Alaska, 1887, 75.—A. O. U. Ch. List, 1895, 56.—Ridgway, Man. 1896, 108.

From the Village Hill at St. Paul in May, 1872, Mr. Elliott shot two examples, and from the same point of view I saw several on June 10, 1890, in company with many

Harlequin ducks. He also mentions two others that were shot off East Point on St. George in 1872. In the harbor of St. Paul, off the wharf, on June 14, I saw four and shot three of them, all adult males. Later I saw others frequently, both males and females, in the harbor, sometimes on the lagoon beach of the killing ground, sometimes flying up the lagoon, and even with the old squaws. I could find no trace of their breeding, though they were often in pairs. No. 118744, ad. ♂, June 14, 1890, St. Paul, W. Palmer. Length, 17.55; extent, 28.75; wing, 8.57. Stomach and crop contents: Sand, small shellfish, and a great quantity of sea fleas. *W. P.*

6. Somateria v-nigra Gray. Pacific Eider.

Somateria v-nigrum, SALVADORI, Cat. B. Br. Mus., XXVII, 1895, 430.—COUES, Key, 1890, 712.
Somateria v-nigra, A. O. U. Ch. List, 1895, 57.—RIDGWAY, Man. 1896, 110.

Visits the islands in winter. Seldom seen near shore. Usually common outside of the ice.

7. Nettion carolinense Gmel. Green-winged Teal.

Nettion carolinensis, SALVADORI, Cat. B. Br. Mus., XXVII, 1895, 250.
Querquedula (N.) carolinensis, COUES, Key, 1890, 695.
Anas carolinensis, A. O. U. Ch. List, 1895, 50.—RIDGWAY, Man. 1896, 91.

We saw one in a pond near the village of St. George May 28, 1890, which was killed later the same summer. They are migratory and usually occur every year in small numbers, but are not known to breed.

8. Anas penelope Linn. European Widgeon.

Mareca penelope, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 191; Key, 1890, 694.—ELLIOTT, Mon. Seal Ids., 1882, 130.—SALVADORI, Cat. B. Br. Mus., XXVII, 1895, 227.
Anas penelope, A. O. U. Ch. List, 1895, 49.—RIDGWAY, Man. 1896, 96.

"It is an interesting fact that the widgeon which visits the Pribilof Islands is not *M. americana*, which would have been anticipated, but the true *M. penelope*, as Mr. Elliott's specimen attests."—(*Coues.*) "It is seldom seen, *never in pairs*, does not breed on the islands, and apparently the few individuals noted during two years' observations were windbound or astray."—(*Elliott.*) Mr. Elliott's specimen added this species to the American avifauna, but quite a number of others have been taken since in various places, especially among the Aleutians, where they probably breed. No. 62525, ad. ♂, May 27, 1872, St. Paul, H. W. Elliott.

9. Anas boschas Linn. Mallard.

Anas boschas, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 190; ELLIOTT, Mon. Seal Ids., 1882, 130; A. O. U. Ch. List, 1895, 48.—RIDGWAY, Man. 1896, 91.
A[nas] boscas, COUES, Key, 1890, 691.
Anas boscas, SALVADORI, Cat. B. Br. Mus., XXVII, 1895, 189.

A few undoubtedly breed about the Great Lake and the ponds at Polovina, on St. Paul, and sometimes visit the other lakes. I am not aware that the nest and eggs have been taken, but the birds are often seen, as I saw them frequently during the summer. They are more numerous during the migrations. No specimens.

10. Anser albifrons gambeli (Hartl.). American White-fronted Goose.

Anser gambeli, SALVADORI, Cat. B. Br. Mus., XXVII, 1895, 93
Anser albifrons gambeli, A. O. U. Ch. List, 1895, 61.—COUES, Key, 1890, 684.—RIDGWAY, Man. 1896, 116.

On June 11, 1890, on a little grassy islet in the village pond on St. Paul I saw two geese having no black on the heads or necks. Later I saw two others. They probably occur as migrants every year.

11. Branta canadensis minima Ridgw. Cackling Goose.

Branta canadensis, var. *leucopareia*, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 190.

Branta canadensis, Elliott, Mon. Seal Ids., 1882, 130.

B[*ranta*] *c*[*anadensis*] *leucoparia*, Coues, Key, 1892, 689.

Branta minima Ridgway, Proc. U. S. N. M., 1885, 22.—Salvadori, Cat. B. Br. Mus., XXVII, 1895, 116.

Branta canadensis minima Ridgway, Proc. U. S. N. M., 1885, 355.—Man., 1896, 117.—A. O. U. Ch. List, 1895, 63.

Does not breed, but seen every year, spring and fall. While walking to East Landing on June 25 a goose flew past me while on its way up the island. On June 28 a native saw twenty-nine in Kamminista Lake About the same time I saw two others come in out of the fog on the reef and pass on, flying very low, up the island. No. 62526, ad. ♂, May 14, 1872, St. Paul, H. W. Elliott.

12. Philacte canagica (Sevast.). Emperor Goose.

Philacte canagica, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 189; Key, 1890, 686.—Elliott, Mon. Seal Ids., 1882, 130.—Turner, Con. Nat. Hist. Alaska, 1886, 142.—Townsend, Cruise *Corwin*, 1887, 99.—A. O. U. Ch. List, 1895, 64.—Ridgway, Man. 1896, 118.—Salvadori, Cat. B. Br. Mus., XXVII, 1895, 109.

Stragglers occur almost every summer and as migrants. Elliott says they get "over here by mistake, I fancy, for the flock of which I witnessed the capture landed on St. Paul so exhausted that the natives ran the birds down in open chase over the grass." One was killed on St. George July 16, 1890, and others have been taken since. They occur nearly every year in varying numbers. "Three or four stragglers were also seen on St. Paul Island in September."—(*Townsend.*)

13. Olor columbianus (Ord). Whistling Swan.

Cygnus columbianus, Salvadori, Cat. B. Br. Mus., XXVII, 1895, 32.—Coues, Key, 1890, 686.

Olor columbianus, A. O. U. Ch. List, 1895, 65.—Ridgway, Man. 1896, 120.

They occur occasionally. Several were seen on St. George in the fall of 1889 and three rested on the shore at Halfway Point, on St. Paul, during the same autumn.

Order TUBINARES. Tube-nosed Swimmers.[1]

Family DIOMEDEIDAE. Albatrosses.

14. Diomedea albatrus Pall. Short-tailed Albatross.

Diomedea brachyura, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 194; Key, 1890, 775.—Elliott, Mon. Seal Ids., 1882, 131.

Diomedea albatrus, Salvin, Cat. B. Br. Mus., XXV, 1896, 427.—A. O. U. Ch. List, 1895, 28.—Ridgway, Man., 1896, 51.

While I was on St. Paul a brown immature bird was decoyed to a fishing boat by means of small pieces of fat and was killed with a stick by a native. Generally a few can be seen among the kelp and wash off the Reef point, but they are quite rare as compared with many years ago when whales and whalers were numerous, for, as Elliott says of one that he shot, "For as I first discussed the large bulk and spread of the albatross prior to shooting the natives clapped their hands and said, 'You should have been here twenty years ago, when instead of this solitary example you would have seen thousands.' They came with the whalers and disappeared as

[1] The first and second feather structures of the members of this order are not greatly different to those of the grebes and loons and the lower members of the auks, though evidently inferior.

they had done." On August 10, when leaving St. Paul, we saw five brown birds off the reef, but the adult white-bodied birds are occasionally seen. A specimen is recorded on the National Museum Catalogue as having been taken between St. George and Walrus Islands, No. 68346, ♀, U.S.N.M., August 12, 1873; No. 11872, im. ♂, U.S.N.M., August 4, 1890, St. Paul. W. P., was as follows: Upper bill entirely pale-rosy flesh color, with nail darker; lower bill much lighter, with the center of tip greenish; iris, dark brown. Feet, flesh color with a brownish tinge, darker toward tip of toes and altogether darker than bill. Testes, very minute. Length, 37.45; extent, 93.30; wing, 24.25. Stomach contents, the bait with which it had been decoyed, three small intestinal worms, and a few white feathers, *W. P.*

Family PROCELLARIIDAE. Fulmars and Petrels.

I am aware of but two members of this family which have been found on the islands. One is common and breeds; the other is rare, but may breed. Other species undoubtedly occur and will be taken.

15. Fulmaris glacialis rodgersi (Cass.). Rodger's Fulmar. "*Lupis.*"

Fulmarus rodgersii, Dall and Bann. Trans. Chic. Ac. Sci. 1869, 303, Pl. XXXIV, fig. 1.—Baird, *l. c.* 323, Pl. XXIV, fig. 1.—Salvin, Cat. B. Br. Mus., XXV, 1896, 427.—[Coues], Am. Nat., IV, 1870, 371.

Fulmarus glacialis, Elliott, Mon. Seal Ids., 1882, 131.

Fulmarus glacialis rodgersii, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 195.—Nelson, Bds. Alaska, 1887, 62.—Townsend, Cruise, *Corwin*, 1887, 99.—Coues, Key, 1890, 778.—A. O. U. Ch. List, 1895, 30.—Ridgway, Man., 1896, 58.

This gracefully flying bird is abundant off the south and east shores of St. George, and also on the cliffs of Otter Island. They breed at both these places, but not on either St. Paul or Walrus Island. A number of specimens in the National Museum collection were collected by Elliott and Townsend. They are all in the white phase. On August 11, 1890, when leaving St. George I saw a single dark-bodied bird evidently of this species. It "comes very early in the season and selects some rocky shelf secure from all enemies save man, where, making no nest whatever, but squatting on the rock itself, it lays a single large, white, oblong-oval egg and immediately commences the duty and labor of incubation. It is of all the waterfowl the most devoted to its charge, for it will not be scared from the egg by any demonstration that may be made in the way of throwing rocks or yelling, and it will even die as it sits rather than take flight, as I have frequently witnessed. The fulmar lays from the 1st to the 5th of June."—(*Elliott.*) The eggs are highly prized for food, but their collection is dangerous work. They evidently come early or remain near the islands all winter. "The chick comes out a perfect puffball of white down, gaining its first plumage in about six weeks. It is a dull gray, black at first, but by the end of the season it becomes like the parents in coloration, only much darker on the back and scapularies. They are the least edible of all the birds about the islands. Like others of the family they vomit up the putrid contents of their stomachs upon the slightest provocation."—(*Elliott.*) The eggs are white and are well pitted. One collected by Elliott on Otter Island in 1872 measures 2.95 by 1.88. Two others from St. George, June 10, 1873, Elliott, measure 2.80 by 1.78, 2.68 by 1.86. Nos. 62538, 62539, 62540, 62541, June 10, 1872, Otter Island. H. W. Elliott. No. 106859, ♀, June 14, 1885, Otter Island, C. H. Townsend. No. 63345, ♀, March 1, 1874. George R. Adams, Walrus Island.

16. **Oceanodroma furcata** (Gmel.). Forked-tailed Petrel.

Oceanodroma furcata, A. O. U. Ch. List, 1895, 36.—COUES, Key, 1890, 782.—SALVIN, Cat. B. Br. Mus. XXV, 1896, 357.—RIDGWAY, Man. 1896, 70.

A fresh specimen was picked up on a beach of St. Paul by Mr. F. W. True. It is found throughout the Aleutians, breeding on many of the islands and may often occur about the Pribilofs. Also, it is possible that they may breed about the interior of St. Paul, visiting, as is their habit, their burrows at night. Several suspicious places that I saw about Boga-slov may be thus explained. A second specimen was picked up near the head of the lagoon on St. Paul and preserved as a skeleton by Prof. d'Arcy Thompson about August 12, 1897, as I am informed by Mr. Lucas. No. 151464, ♀, July 12, 1895, St. Paul, F. W. True.

Order PYGOPODES. Diving Birds.

Family GAVIIDAE. Loons.

Loons are seldom seen, but may occur in numbers during the winter and migrations. Other species than those mentioned undoubtedly occur.

17. **Gavia adamsii** (Gray). Yellow-billed Loon.

C[olymbus] t[orquatus] adamsi, COUES, Key, 1890, 790.

Urinator adamsii, TOWNSEND, Cruise, *Corwin*, 1887, 98.—A. O. U. Ch. List, 1895, 4.—RIDGWAY, Man. 1896, 5.

Colymbus adamsii, GRANT, Cat. B. Br. Mus., 1898, 500.

One of this species was killed by a native in August, 1885, on St. Paul, as mentioned by Mr. Townsend in the cruise of the *Corwin*. The specimen was preserved for one of the Treasury agents, who informed me in 1890 that he still had it.

18. **Gavia arctica** (Linn.). Black-throated Loon.

Colymbus arcticus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 201; Key, 1890, 791.—ELLIOTT, Mon. Seal Ids. 1882, 133.

Urinator arcticus, NELSON, Bds. Alaska, 1887, 36.—A. O. U. Ch. List, 1895, 4.—RIDGWAY Man. 1896, 7.

Colymbus pacificus, GRANT, Cat. B. Br. Mus., 1898, 494.

Mr. Elliott, while surveying Zapadni on St. George in 1873, found a nearly dead individual which had been thrown ashore by the surf. It was an adult male and the natives who saw it agreed that it was very rare. While on the *Rush*, off the north shore of St. Paul on August 7, 1890, Mr. Elliott and myself saw a loon which may have been of this species. No. 64303, U.S.N.M. ad. ♂ June 22, 1873, St. George, H. W. Elliott.

Family PODICIPIDAE. Grebes.

Owing to obvious difficulties it is not possible to procure many of these birds about the islands. I saw none; they are seldom seen.

18. **Colymbus holboellii** (Reinh.). Holboell's Grebe.

Podiceps griscigena, COUES, in Elliott's Rpt. Affairs, Alaska, 1873; *Reprint*, 1875, 201.—ELLIOTT, Mon. Seal Ids. 1882, 133.

Podiceps griseigena holboellii, COUES, Key 1890, 749.

Colymbus holboellii, NELSON, Bds. Alaska, 1887, 35.—A. O. U. Ch. List, 1895, 1.—RIDGWAY, Man. 1896, 5.

Podicipes holboelli. GRANT, Cat. B. Br. Mus., 1898, 542.

Presumably uncommon during the fall and winter. Mr. Elliott obtained one on St. George; No. 64302, im. ○, U.S.N.M. Coll. June 22, 1873.

Family ALCIDAE. Auks, Murres, and Puffins.

The nine members of this family which occur well represent the diversities found in this group. They are exceedingly abundant and all breed on the islands, some of them in communities of numberless individuals. During the early morning and in the evening during the summer hundreds of thousands of several species may be seen from one point of observation on St. George at the huge cliff near the village on the north shore. Here is a sight of which perhaps the equal is not known. On Walrus Island their number is legion, practically the whole surface being covered in the evening and morning with the vast numbers of the breeding birds. They leave the islands at the close of the breeding season, when the young are able to take to the water, and are seldom seen during the winter, though a few linger until driven off by ice and snow. They return in immense numbers early in May. The eggs and bodies of all are utilized by the natives for food, but the murres especially are of great importance as well because of their abundance as for their size. Except the *Cepphus*, they all lay but one large egg.

20. Lunda cirrhata Pall. Tufted Puffin. "*Tawporkie.*"

Fratercula cirrhata, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 203.—Elliott, Mon. Seal Ids. 1882, 131.

Lunda cirrhata, Coinde, Rev. et Mag. Zool., 1860, 403.—Turner, Contr. Nat. Hist. Alaska, 1886, 117.—Townsend, Cruise, *Corwin*, 1887, 98.—Coues, Key, 1890, 804.—A. O. U. Ch. List, 1895, 5.—Ridgway, Man. 1896, 10.—Grant, Cat. B. Br. Mus., 1898, 612.

This odd and fantastic bird is common, and is usually seen perched in rows of four or five and more on the edges of the upper shelf of the precipitous bluffs. Here they breed in inaccessible recesses in the broken rocks, but in some places, and especially on Walrus Island, they nest among the bowlders that have been pushed up by the ice. In most cases, perhaps, the single large egg is laid on the bare rock, but I found a nest on Walrus Island on August 7 which contained a slightly incubated egg. This nest was placed between bowlders, was open to the sky, and was made of dry seaweeds and sea ferns. It was quite large, about 15 inches in diameter, scanty in material, and was practically bare in the center. No young were flying by August 10. The natives secure them by thrusting an arm between or under the bowlders and grasping a bird on the nest. They are killed by knocking them on the head or by biting on the base of the skull, the wings being then locked in a peculiar manner by twisting to prevent escape during their struggles. Elliott records that they come "up from the sea in the south to the cliffs of the island about the 10th of May, always in pairs, never coming singly to or going away from the Pribilofs in flocks." They do not seem to be as abundant as the following species. Most eggs show but very faint spotting; but one, nearly fresh, taken by Mr. Elliott on Otter Island July 4, 1890, has many very obscure irregular and a few fine dark spots, with a large, dark, irregular blotch near the small end. It measures 2.65 by 1.86. Another taken on St. Paul by Mr. Elliott is 3.00 by 1.95.

21. Fratercula corniculata (Naum.). Pacific Puffin. "*Epatka.*"

Fratercula corniculata, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 202.—Elliott, Mon. Seal Ids. 1882, 133.—Turner, Con. Nat. Hist. Alaska, 1886, 118.—Nelson, Bds. Alaska, 1887, 38.—Townsend, Cruise, *Corwin*, 1887, 98.—Coues, Key, 1890, 801.—A. O. U. Ch. List, 1895, 6.—Ridgway, Man. 1896, 11.—Grant, Cat. B. Br. Mus., 1898, 620.

More abundant than the above species and found in the same situations with them. They are fairly tame, and one can with care approach quite close without frightening them. Like all the other members of this family, they leave the cliffs in the morning and pass the day at sea, returning in the evening with food in their mouths and throats for the young, or possibly for the sitting mate. Thus during the day few are seen as compared with the thousands at other times, and on days of bright sunshine fewer still remain on the cliffs. They are very noisy when down among the rocks, but silent when in the open. Alarmed and compelled to fly off the rocks, they will frequently return and, flying parallel with the cliff, survey the intruder with a curious twist of the neck, which is made all the more comical by the peculiar waxy bill and oddly colored head. No. 118672 ad. ♀ U.S.N.M., August 2, 1890. St. Paul, W. Palmer. Callosity at corner of mouth, pale orange. Feet pale orange, webs darker; is evidently a female just off from sitting. Eggs white with obscure spotting wreathed around large end. Three specimens collected by Mr. Elliott on St. George July 4, 1873, are 2.78 by 1.80; 2.57 by 1.75; 2.77 by 1.75.

22. **Cyclorrhynchus psittaculus** (Pall.). Paroquet Auklet. "*Baillie-Brüshkie.*"

Phaleris aleuticus, COINDE, Rev. et Mag. Zool., 1860, 403.

Phaleris psittaculus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 204.—ELLIOTT, Mon. Seal Ids., 1882, 134.—GRANT, Cat. B. Br. Mus., 1898, 607.

Simorhynchus psittaculus, COUES, Key, 1890, 806.

Cyclorrhynchus psittaculus, NELSON, Bds. Alaska, 1887, 41.—TOWNSEND, Cruise, *Corwin*, 1887, 98.—A. O. U. Ch. List, 1895, 7.—RIDGWAY, Man. 1896, 12.—STEJNEGER, Cruise, *Corwin*, 1884, 125.

As mentioned by Elliott and others, the Whitebreast is almost a solitary bird. They never fly inland and rarely pass inside of the edges of the bluffs. While the greater number spend the day far out at sea, some can always be found dozing near the entrance to their burrows, and can then be easily approached. Their pure white breasts, red upturned beaks, and quaint, watchful movements as one is gradually drawing nearer make them very interesting objects. On Walrus Island they lay their solitary egg under the bowlders like the puffins and are often taken by the natives when they visit that rock. When they return from the sea in the evening to their young or mate, their mouths and throats are greatly distended with an enormous quantity of a small, almost colorless crustacean, which they obtain far out at sea. The burrows on St. Paul, as far as I saw, were excavated in the volcanic cinders overlying the rocky bluffs, so that the entrance was always at the edge of the cliff, with the rock as a floor. On St. George they are quite abundant in small flocks of four and five, and may often be seen perched on the loose rocks, surrounded by numbers of the least auklet. Taken on a bright day, the white iris of a wounded bird is so wide that the pupil is reduced to the size of a small pin's head, and this changes in size rapidly as the bird is placed in the dark or light.

White filoplumaceous feathers are to be found on the heads and necks of some specimens mixed in with the dark normal feathering. No. 151598, ♂, July 12, 1895, St. Paul, True, and Prentiss, has a few on the nape. Another ♂, August 2, 1890, W. Palmer, has many all over the head, especially on the throat. No. 62551, ♀, July 9, 1872, St. Paul, H. W. Elliott, is a peculiar one in this respect. There are several large ones on each side of the head, just above the eyes, and also a number clustered directly back of the eyes, with an intervening dark space. All these feathers are pure white, have a long, glossy white stem or shaft, are club shaped and pointed at the upper end and are longer than the adjoining ordinary dark feathers. Under the microscope these club-shaped ends are seen to be double, each branch having long rami on each side, the crossing and prolongation of which on the inner side producing the point. (See figs. 2–4*a*, Pl. XLI.) No. 62555, ♀, July 9, 1872, St. Paul, H. W. Elliott, has a white patch behind each eye, but it is composed of the ordinary feathers. Other specimens show a tendency to a stripe at this point, and some have the dark feathers tipped with white. Dr. Stejneger has described the downy young from some specimens collected by Lieut. J. E. Lutz on Otter Island, July 17, 1884, as being "dark smoky gray; darker, nearly blackish on the head and sides of neck; chin, throat, and foreneck of the same general color, scarcely paler; rest of the under surface light ashy gray" (No. 100378, U.S.N.M.). "Feet bluish gray, light between the toes, underside black."—(*Lutz.*) Cruise of the *Corwin*, 1884, page 125. The eggs vary from white to others showing very obscure spotting. One that I took on Walrus Island, June 13, 1890, was fresh, and measures 2.15 by 1.42. Two obtained by Elliott on St. George, July 1, 1873, and July 27, 1873, measure, respectively, 2.20 by 1.55, 2.25 by 1.55. No. 118675, ♀, U.S.N.M., June 5, 1890, St. Paul, W. Palmer, measured 10.25 long by 20.50 in extent.

23. Simorhynchus cristatellus (Pall.). Crested Auklet. "*Canooskie.*"

Phaleris cristatellus, COINDE, Rev. et Mag. Zool., 1860, 402.

Simorhynchus cristatellus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 206.—ELLIOTT, Mon. Seal Ids., 1882, 134.—NELSON, Bds. Alaska, 1887, 41.—TOWNSEND, Cruise, *Corwin*, 1887, 98.—COUES, Key, 1890, 807.—A.O.U. Ch. List, 1895, 7.—RIDGWAY, Man., 1896, 13.—STEJNEGER, Cruise, *Corwin*, 1884, 126.—GRANT, Cat., B. Br. Mus., 1898, 601.

This is an abundant species and differs greatly in its habits from its relatives. "This fantastic bird, the plumed knight of the Pribilof Islands," breeds in colonies of some 10 to 20 pairs on the roughest and usually most prominent points on the bluffs, and I think also among the bowlders above high tide, and where the egg is placed in the deepest and most inaccessible recesses. Unlike the preceding species, they usually fly in small compact flocks over the land about their breeding places; and during the season this is a common occurrence, especially near the village of St. George, where, among the countless thousands of the least auklet, small flocks of this dark-bodied and peculiarly crested species are conspicuous when they sweep in over the land. At such times they fly over the arc of quite a large circle, returning again far out to sea. Among the white residents they are known as "sea quail," and this name is certainly suggestive, as their resemblance at even a little distance to California quail is very striking. They are very wary, but may be readily observed with care. Upon approaching a flock perched upon a rocky shelf they will instantly take flight. One can then conceal himself as close to the place as possible, for the birds will soon return, not, however, flying directly to the place, but almost parallel with the shore line. If nothing unusual is noticed, upon their next return they will perch upon the shelf, though a few may repeat the trip. In this way I have made them repeat the journey several times simply by showing myself a little. Some would perch and watch, while other species would gradually gather around, and in their comical way wonder about the strange object moving between the rocks. When disturbed they utter an honk-like sound impossible to describe on paper; but it is when quarreling among the rocks that the climax is reached. While stepping one day from rock to rock under one of the cliffs, I was startled by suddenly hearing the most unearthly sounds issuing from among the rocks at my feet. I was soon satisfied that several foxes were quarreling over some prey, but was rather taken aback when soon after several of these birds emerged and flew off. White filoplumaceous feathers occur on the head of this species directly over each eye, but a few are to be found also elsewhere about the head on some specimens. There are two extremes of the shape and extent of the swollen parts of the bill. In one, usual in male birds and rare in the females, the upper mandible is strongly hooked and the bare mouth parts are very much enlarged and highly colored. In other specimens, apparently immature birds, male and female, there is little or no hooking of the bill, the mandibles are much smaller, and the mouth parts much less in size as compared with the other specimens. As a rule, it would seem that the small-billed birds have the swollen parts smaller and softer, so that they shrivel much; in fact, almost dry up. A male collected August 1 had the bill of a clear pale orange, with the tip horny white. A female, the same day, had a similar colored bill, but the base around the feathering was whitish flesh color. I saw no specimens showing the shedding of the mouth parts. The downy young have been described by Dr. Stejneger from specimens taken on Otter Island by Lieut. J. E. Lutz, July 22, 1884, No. 100374, U.S.N.M. They are uniform dark, smoky, and somewhat brownish gray, scarcely lighter on the underparts. Cruise, *Corwin*, 1884, page 126. The egg is white, with few very obscure spots. Two, taken by Elliott on St. George, June 19, 1873, measure, respectively, 2.25 by 1.45, 2.20 by 1.30. Another, taken the next day, is 2.10 by 1.45.

24. **Simorhynchus pusillus** (Pall.). Least Auklet. "*Choochkie.*"

Phaleris pusillus, COINDE, Rev. et Mag. Zool. 1860, 403.

Phaleris pusilla, DALL and BANNISTER, Trans. Chic. Ac. Sci. 1869, 309.

Simorhynchus pusillus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 208; Key, 1890, 808.—ELLIOTT, Mon. Seal Ids. 1882, 134.—TURNER, Con. Nat. Hist. Alaska, 1886, 120.—NELSON, Bds. Alaska, 1887, 42.—TOWNSEND, Cruise *Corwin*, 1887, 98.—A. O. U. Ch. List, 1895, 8.—RIDGWAY, Man. 1896, 13.—GRANT, Cat. B. Br. Mus., 1898, 605.

About as abundant as all the other species together; certainly no one can be blamed for thinking so after seeing their abundance about the village of St. George. I can only compare their numbers to an apiary where the hives are placed, for acres, about 50 feet apart. Now, imagining that all these hives swarm at once, that each bee is larger than a swallow and flying in an almost straight line, each about its own business, we may then have some idea of what can be seen every summer evening about 7 on the west side of the village of St. George. As Elliott has well said, "it comes here every summer by millions to breed." They are usually quite indifferent to man, but on St. Paul, where their numbers are much less, they will hardly allow one to get nearer than 30 yards before taking flight. "Usually, about the 1st or 4th of May every year, the Choochkie makes its appearance around the islands for the season, in small flocks of a few hundred or thousand, hovering over and now and then alighting upon the water, sporting one with the other in apparent high glee, making an incessant, low, chattering sound. But they are only the van to flocks that by the 1st or 6th of June have swarmed in upon the islands, like those flights of locusts which staggered my credulity on the great plains of the West. They frequent the loose, stony reefs and bowlder-bars on St. Paul, together with the cliffs on both islands; and, what is most remarkable, they search out an area over 5 miles square of basaltic shingle on St. George Island, which lies back and over inland from the north shore line. To the last position they come in greatest numbers. They make no nest, but lay a single egg far down below among the loose rocks, or they deposit it deep within the crevices or chinks in the faces of the bluffs. * * * To walk over their breeding grounds at this season is highly interesting and most amusing, as the noise of hundreds and thousands of these little birds, which are directly under your feet, give rise to an endless variation of volume of sound, as it comes up from the stony holes and caverns below, while the birds come and go, in and out, whistling around your head, comically blinking and fluttering."—(*Elliott.*) On this vast breeding range of this species, on the 28th of May, I accompanied a native for the purpose of getting a few specimens for myself, while he desired a meal. With a large long-handled dip net I crouched behind one of the numerous large moss- and grass-bedecked rocks which so liberally covered the ground. As the birds fly low and in a nearly straight line and have great difficulty, in fact they have little necessity, in making a sudden curve to avoid an object, it was only necessary when a flock was seen approaching to raise the net directly in their path. If the distance and their velocity had been well calculated several birds would be unable to swerve off in time and in consequence would be engulfed in the net. A quick bringing of the net to the ground would then complete the capture. A half-hour's work resulted in my securing some twenty specimens, but the Aleut close by had ten times as many. Sometimes other species are also secured. During the last days of May hundreds of thousands swarm about the anchorage off the village of St. George. They are mating and copulation is going on on all sides. The females remain on the surface of the water while the males approach from behind by a short flight, both then taking flight. Many are diving, the surface is covered with the swimming birds, but the majority are in the air flying in all directions. Their chattering is incessant and rest is unknown. The morning departure and the evening return of the hosts of these little auklets are really the most interesting and attractive features of the bird life on St. George, and one never tires of the fascinating and extremely novel sight. They are most abundant on land about 3 and 4 a. m. and from 7 to 10 p. m. When coming to the surface after a dive they come up with quite a bounce and after a few hasty turns take flight. Individual variation in this species is considerable. Of the decorative white head feathers every possible variation in size and number occurs, evidently having no relation to sex, or age, or color condition (see figs. 5–8, Pl. XLI, and explanation). Of 42 specimens examined in the National Museum collection, the blackest-breasted bird is a female (No. 151453, July 30, 1895, St. Paul, True and Prentiss), even the usual white throat patch being half black, and white feathers being decidedly in a minority on the under parts. The whitest-breasted bird is also a female (No. 62593, May 23, 1872, St. Paul, H. W. Elliott). It has merely one dark feather in center of breast and a few at the sides of the neck. A few others have dark feathers in the white throat patch, and these are all females. In one male a dusky bar runs across the throat at the angles of the mouth and divides the white into two parts. Nearly every specimen that I have seen (over sixty) has a few or a greater number of dingy white feathers mixed in the scapulars, really unmolted winter feathers. Sometimes they are well worn, in contrast with the newer surrounding dark feathers; often, however, they appear as fresh as those. The only two winter specimens that I have seen have the scapulars nearly white. The darkest plumaged summer specimens have little or no white among the scapulars. These dark-backed birds are uncommon in May and can readily be counted among the thousands of the ordinary spotted breasted birds. Two fresh eggs, taken on St. George on May 28, 1890, measure 1.60 by 1.10, 1.55 by 1.17. Of eight taken on St. Paul on June 5, 1890, the largest is 1.60 by 1.20, the smallest 1.55 by 1.08. They are always white.

25. **Synthliboramphus antiquus** (Gmel.). Black-throated, or Ancient Murrelet. *"Starik."*

Brachyrhamphus antiquus, DALL and BANN., Trans. Chic. Ac. Sci. 1869, 310.

Synthliboramphus antiquus, NELSON, Bds. Alaska, 1887, 43.—COUES, Key, 1890, 811.—A. O. U. Ch. List, 1895, 8.—RIDGWAY, Man. 1896, 14.—GRANT, Cat. B. Br. Mus., 1898, 596.

In the List of the Birds of Alaska, Dr. Dall tells us (p. 310) that this species is "common at St. George," etc. It is found throughout the Aleutian Islands, also on the Commander group. It may occur on the Pribilofs, but I can not find any further definite information nor specimens, and Dr. Dall is unable at this late date to furnish conclusive evidence of its occurrence.

26. **Cepphus columba** Pall. Pigeon Guillemot.

U[ria] columba, COUES, Key, 1890, 815.—GRANT, Cat. B. Br. Mus., 1898, 586.

Cepphus columba, NELSON, Bds. Alaska, 1887, 44.—A. O. U. Ch. List, 1895, 8.—RIDGWAY, Man. 1896, 17.

I have no information of this species breeding on the islands but they probably do. I only observed them once, on June 13, while on a boat trip to Walrus Island, when they were quite common to the southward of that place, but very shy. Elliott does not mention them, but Nelson says "they nest on the fur seal islands," and he tells me that he certainly saw them under the cliffs of St. George. The blackness of the bird and the white wing patch render them conspicuous objects on the sea. Their breeding places are among rocks near the water's edge and they may possibly breed on Walrus Island, and perhaps at Polovina on St. Paul, and on St. George. They lay two white eggs, which measure about "2.41 by 1.64."—(*Ridgway*).

27. **Uria troile californica** (Bryant). California Murre. *"Arrie."*

Lomvia troile var. *californica*, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 210; ELLIOTT, Mon. Seal Ids., 1882, 135; Key, 1890, 817.

Uria troile californica, NELSON, Bds. Alaska, 1887, 45.—A. O. U. Ch. List, 1895, 11.—RIDGWAY, Man. 1896, 18.

Uria troile, GRANT, Cat. B. Br. Mus., 1898, 573 (part).

Occurs in small squads on the cliffs of St. Paul and St. George. Seen from the edge of the cliffs above, I found that I could readily distinguish them from the other darker and more robust species. They are much slenderer, with smaller and sharper bills; the upper parts are a light brownish ash color as seen from above when one is directly over them. I could thus readily distinguish them when mixed with the thousands of *arra*. On a visit to Walrus Island, on June 13, I saw none of these birds, those taken being the next species, and my visit being confined to the western and northern parts of the island; but on landing again, on August 7, on the south-eastern part, I was astonished by their abundance, none of the other species being seen. Thus the two forms were occupying different portions of the available space and breeding by thousands. On this last date, from the water's edge, extending back perhaps 30 yards and along on either side for a considerable distance, were thousands of murres, which opened before me and, rushing over the rocks, threw themselves off into the sea by thousands. Some hundreds of eggs nearly ready to hatch were to be seen and young of various sizes were numerous. In some cases an old bird sheltered under her wings several young of different ages. The rocks were very wet and dirty, but by sudden rushes I succeeded in capturing several adults by grasping them by the neck, very few trying to fly and all scrambling in all haste over the rough slippery rocks in the utmost confusion. Their habits are doubtless the same as the more common *arra*. The downy young of *californica* would seem to differ from *arra* in the dry skin by being of a paler color, and by having the upper edge of the white of the under parts blending into the dark neck color, instead of being bluntly and sharply separated, as in *arra*. The first feathering to appear on the young bird is on the wings and scapulars, along the sides of the breast and across the lower neck. Soon the down begins to drop off between the nostrils and the eyes and around the mouth and the base of the lower mandible, and as the birds get older the new feathering extends across the back, up the sides of the neck, and all over the under parts up to the bill. At the same time the feathering extends around the eyes and bill and running well back of the eyes, so that the only remains of the downy plumage is on the top of the head, extending down the back of the neck almost to the scapulars, scattering down the back, and extensive about the rump, where it is still attached to the tips of the new feathering beneath. I see no difference between the sexes. They occur about the islands all winter apparently, as a specimen is in the Museum collection. This is an immature bird, and has the white of the under parts meeting across the back of the neck. No. 118684, ad. ♀, U.S.N.M., August 7, 1890, Walrus Island, W. P.; wing, 8.00; culmen, 1.66; tarsus, 1.52. No. 68332, January 29, 1874, Pribilof Islands, George R. Adams.

28. Uria lomvia arra (Pall.). Pallas's Murre. "*Arrie*."

Uria arra, Dall and Bann., Trans. Chic. Ac. Sci. 1869, 309.

Lomvia arra, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 211; Key, 1890, 817.—Elliott, Mon. Seal Ids. 1882, 135.

Uria lomvia arra, Nelson, Bds. Alaska, 1887, 45.—Townsend, Cruise, *Corwin*, 1887, 98.—A. O. U. Ch. List, 1895, 12.—Ridgeway, Man. 1896, 18.

Uria lomvia, Grant, Cat. B. Br., Mus. 1898, 577 (part).

The interesting account of this bird given by Mr. Elliott in his Monograph is as true to-day as when written. At anchor off the village of St. George at the end of May and early in June one can view one of the most marvelous ornithological exhibitions of the world. Thousands of the Least Auklet are close about us, in the water or flying in every direction in indescribable confusion; but the more stately Murres sweep by in numerous and somewhat regular platoons, as if passing inspection. These platoons consist of perhaps from fifty to five hundred individuals, and while never forming a straight line seem to be continually trying to do so. The central birds are nearly always in advance, the whole usually forming a very wide  and again a ; sometimes a double curve or a combination of flat curves and angles, continually changing, but the approach to a straight line is always the dominant feature. Comparatively few pass between us and the shore; but on the sea side of the vessel their number is legion. As far as the eye can see file upon file are moving, in an apparently endless succession and nearly always in the same direction—into the wind. It is no exaggeration to say that three platoons pass our line of sight every second, often many more; these will average at least a hundred each; thus we have 18,000 birds passing every minute, or 1,080,000 in an hour. But we only see the edge, not the center, of the parade and from one point only, and many are flying over the land or are perched on the cliffs.[1] This parade continues until late in the morn-

[1] I have endeavored to estimate the total number of individual birds of all species occurring on the Pribilofs during a year. My figures reach 9,000,000, which I can not think is an exaggeration.

ing, when hunger admonishes them that it is time to seek food far out on the waters of Bering Sea. In the evening it is again gone over before settling on the rocky shelves of the 900 vertical feet of the great cliff of St. George. As Elliott has well said, "this is a dress parade of ornithological power which I challenge the world to rival;" and, taken in connection with the enormous abundance of the choochkie, it is hard to conceive that its equal can be found. They mass in close ranks on the numerous projecting shelves of the cliffs, where they lay their single large, spotted eggs on places where one wonders if it is possible for them to remain uninjured for the period of about twenty-five days necessary for hatching. When setting they face the rocks, back out, and have to turn before leaving; so that when alarmed or excited during their constant quarrels and making a sudden turn it often happens that the eggs roll off and are dashed upon the rocks below. Like other water birds, they pluck out the feathers of the center of the upper abdomen to permit the egg to come in contact with all the body warmth possible, and this assists in causing the egg to leave its rocky nest when the movement of the bird is hasty. Elliott speaks thus of their actions on the cliffs in the early summer:

> They quarrel desperately, but not by scolding; it is spirited action; and so earnestly do they fight, that all along below the high bluff of the north shore of St. George, when I passed thereunder during the breeding season, I stepped over hundreds of dead birds which had fallen and dashed themselves to death upon the rocks while clinched in combat with their rivals; for they seize one another in mid-air and hang with their strong mandibles so savagely to each other's skin and feathers that, with the swift whirring of their powerful wings, they are blinded to their peril and strike the earth beneath ere they realize their danger and immediate death.

Several times during the season at Walrus Island and, when opportunity offers, elsewhere, the eggs are collected for food. Soon after the 1st of June several natives paid a visit to Walrus Island and selecting the freshest eggs ruthlessly destroyed all the others, so that when we visited the place on June 13 we were able to secure between three and four thousand fresh eggs. This occurs every year with no appreciable effect on their numbers, as later visits are not permitted. The eggs are fairly good eating when one gets accustomed to them, but the albumen is extremely viscid and the yolk dark; the taste is not disagreeable. Like probably all their congeners the small young are fed by disgorged crustaceans, but I know that the larger young and even quite small individuals are fed upon whole fish. On August 4, I collected a young murre and also a small fish, a tufted blenny, *Bryostemma polyactocephalus* (No. 43005 U.S.N.M.), lying at its side. I had previously witnessed the feeding of several others. With the breast to the rock the mother lands, and bending her head downward to her young utters a harsh, croaking sound. The youngster raises its head and, taking the fish from its parent's bill by the tail, works it sideways in its own bill, until it gets the head in its mouth, when the fish rapidly disappears. If the young has had enough the fish is laid at its side until needed. The fish is carried by the parent with the head partly down its throat, the tail sticking out from between the mandibles. In some adult specimens the dilated part of the base of the upper mandible, the tomia, is quite whitish. The tarsi are yellowish pearl gray in color, dark between the scales in front and especially at the joints. The webs are also dark. In some specimens the toes are a brownish yellow. I have a series of seven specimens of the downy young not over a week old, the youngest having been assisted out of the shell by myself. The white of the underbody and the dark of the neck forms a sharp line, little blending showing. The general color of the back is darker than in *cali-*

fornica. The body is densely covered with down, that of the head and neck being blackish, but profusely spotted with white. The white down is less fluffy and is generally longer than the dark, especially on the neck, where it is yellowish. When the young murre emerges from the egg, much of this down is still in the sheaths and all is damp and wiry. As the bird dries, this becomes separated and fluffy, but with the long white and yellowish downs this drying is slower than in the other. Thus until separated each tuft of down appears as a single part and may sometimes be seen as shown in fig. 9, Pl. XLI, where a tuft is held in the center by the persistent remains of the sheath. In fig. 10 will be seen one of the tufts sheathless but not separated, and the tip, really composed of many, appearing as a single piece. The black down soon becomes dry and fluffy, but the longer white tufts remain as an apparent single growth for sometime except on the throat and face, where it is soon separated by the movements of the young bird in rubbing its throat and neck on the rocks. Though to the eye these long, yellowish, pointed downs appear as single, under the microscope they are found to consist of six or more, as shown in fig. 11, where a tuft is beginning to separate. As the new plumage appears it is seen that these bunches of down are attached to the tips of the growing nestling feather, but the constant rubbing of the youngster against the rocks and its parent causes the greater number of these downy parts as they grow out to break off, so that when the bird is three or four weeks old but few remain, and these mostly on the back of the neck. These, however, do not appear as tufts but as filaments, each attached to the tip of a ramus of the new growing feather, as shown in figs. 16 and 17. At the point of apparent juncture there can be seen a slight swelling (*a*, fig. 14), which is greatly enlarged (*a*, fig. 18). Instead of the downy tufts separating, they are often held together around their bases by a somewhat persistent part of the sheath through which the down grew, or by a gluing together (figs. 12 and 13). In such cases friction soon removes all at once from the tip of the growing feather. Therefore it will be seen that the tuft of down has no true rachis of its own, only the temporary one of the sheath. And the parts into which the tuft can be divided are only elongations of the rami of the first true plumage feather, as shown in fig. 14. The bunch or swelling is formed, I believe, in this way. The down grows to its full length before the young murre is hatched. Then the longitudinal growth ceases, but cell making continues and causes the part at or near the surface of the skin, being soft, to swell. Then after a few days the new feather begins to appear, slowly at first but steadily, until the downy stage is all pushed out and its place occupied by the entirely different first-plumage feather.[1] Sometimes several of these downy tips will remain attached to the tips of their respective rami, the whole being held together at the swellings by a sticking or joining (fig. 15). Usually the downy tip breaks off below the swelling, but often above, so that it ends some of the rami of the new feather, but occasionally the break occurs in the center of the swelling (fig. 18). The same process obtains in the case of the underbody feathers but varied somewhat in the belly feathers. Here the joined bases of the downy tufts appear double, as shown in fig. 19. These are numerous and somewhat persistent until separated by the movements of the bird, plus the growth of the new feather. But these downs are not readily broken off, so that they persist attached as filaments to their respective rami much longer than those on the back, except the ones on the back of the neck, which are the last to be lost. It is curious that these last persist in

[1] The swelling is found in many birds which I hope to illustrate later.

pairs on each feather until the youngster is several weeks old. The swelling on the belly downs is seldom as large as on the others. Usually some swelling is noticeable, but often the rachises of the rami continues into the downs with little appreciable increase of size. The figures in Pl. XLI and the explanations opposite will explain these changes. The double effect seen in fig. 19 is common on the belly, and may be caused by two tufts adhering. The radii of the down rachis lie flat against it pointing upward. They evidently adhere until dried and loosened by friction. The first down of these birds differs from the other species of auks in being stronger and shorter.

From some hundreds of eggs I selected nine as typical of extremes of color and markings. These are shown in the accompanying photograph, Pl. XXXIX. The greater number of eggs, by far, is made up of intermediates.

	Wing.	Culmen.	Tarsus.
No. 118689 ♀ ad. August 4, 1890, St. Paul, W. P.	8.92	1.60	1.55
No. 118688 ♂ ad. July 30, 1890, St. Paul, W. P.	9.02	1.77	1.50
No. 151625 ♀ ad. July 29, 1895, St. George, D. W. P, jr	8.50	1.40	1.40

Order LONGIPENNES. Long-winged Swimmers.

Family STERCORARIIDAE. Jaegers.

Three of the four American members of this family occur casually on the islands. Possibly they are more numerous during the migrations. They breed northwards.

29. Stercorarius pomarinus (Temm.). Pomarine Jaeger. "*Raz-boi-nik.*"

Stercorarius pomatorhinus, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 196; Key, 1890, 735.—Elliott, Mon. Seal Ids. 1882, 132.—Saunders, Cat. B. Br. Mus. 1896, 322.

Stercorarius pomarinus, Townsend, Cruise, *Corwin*, 1887, 98.—A. O. U. Ch. List, 1895, 14.—Ridgway, Man. 1896, 22.

A rare visitor. Elliott found one "perched in a listless attitude on the high, mossy uplands between Kamminista and Polovina Sopka." Mr. C. H. Townsend obtained another on the same island. During the summer of 1890 two were seen on St. George eating the carcass of a fur seal. One of these was killed and preserved by Mr. Ed. Lavender. No. 62522, ad. ♀, U.S.N.M., June 23, 1872, St. Paul, H. W. Elliott, light phase. No. 106857, ♂, June 16, 1885, St. Paul, C. H. Townsend.

30. Stercorarius parasiticus (Linn.). Parasitic Jaeger.

Stercorarius parasiticus, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 196; Key, 1890, 736.—Elliot, Mon, Seal Ids., 1882, 132.—A. O. U. Ch. List, 1895, 14.—Ridgway, Man. 1896, 22.

Stercorarius crepidatus, Saunders, Cat. B. Br. Mus. XXV, 1896, 327.

Casual. "I have seen but four or five examples of this species, which may be rated as an infrequent visitor. It may be found upon the grassy uplands, where it will alight and stand dozing in an indolent attitude for hours."—(*Elliott.*) He found half-digested berries of *Empetrum* in the stomachs. No. 62524, ♀, U.S.N.M., June 15, 1872, St. Paul, H. W. Elliott, dark phase.

31. Stercorarius longicaudus Vieill. Long-tailed Jaeger.

Stercorarius buffoni, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 197; Key, 1890, 738.—Elliott, Mon. Seal Ids. 1882, 132.

Stercorarius longicaudus, A. O. U. Ch. List, 1895, 15.—Ridgway, Man. 1896, 23.

Stercorarius parasiticus, Saunders, Cat. B. Br. Mus. XXV, 1896, 334.

Seldom seen. "The specimen in my collection is one of the only two I ever obtained on the Islands."—(*Elliott.*) They were apparently feeding upon insects and upon the small blackberry of *Empetrum.* No. 62523, ad. ♀, June 13, 1872, St. Paul, H. W. Elliott.

Family LARIDAE. Gulls and Terns.

Of the eight members of this family given here from the islands, three are striking features of the summer fauna. The others are either rare breeders or are casual visitors during migrations or in winter. Of two no specimens appear to have been taken, and of several others but few have been seen or collected.

32. Larus schistisagus Stejn. Slaty-backed Gull.

Larus marinus schistisagus, COUES, Key, 1890, 892.

Larus schistisagus, A. O. U. Ch. List, 1895, 18.—SAUNDERS, Cat. B., Br. Mus. XXV, 1896, 281.—RIDGWAY, Man., 1896, 29.

Several of the natives informed me that a large black-backed gull, different from the following, bred sparingly on the cliffs of Otter Island, and that they rarely visited St. Paul. Daniel Webster, an old experienced sealer who had then spent twenty-two years on the islands, also told me that a large dark-backed gull was to be found in small numbers on the cliffs of St. George. On June 11, on St. Paul I saw three, and on June 12, another, which came in over the Reef from the direction of Otter Island. Several evenings after August 1 I noticed some large gulls flying slowly in from the Reef (on one evening I counted seven). The mantle was much darker than in *glaucescens.* They were probably this species, the status of which is very uncertain on the American side of Bering Sea.

33. Larus glaucescens Naum. Glaucous-winged Gull. "*Chikie.*"

Larus glaucus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 198.—ELLIOTT, Mon. Seal Ids., 1882, 132.

Larus glaucescens, SAUNDERS, Cat. B., Br. Mus. XXV, 1896, 284.—COUES, Key, 1890, 741.—A. O. U. Ch. List, 1895, 17.—RIDGWAY, Man., 1896, 27.

Resident except when ice and snow compels its absence. This is the common large gull of the islands, the chief scavenger. Breeds on the cliffs of St. George and Otter islands, and abundantly on the flat central portion of the southern end of Walrus Island. It does not breed on St. Paul, owing, doubtless, to the smallness of the cliffs. It is common there, however, for it is a prime scavenger and regularly visits the rookeries and killing grounds, and nothing in the shape of food comes amiss to it. On Walrus Island the nests are quite numerous. On June 13 many contained three eggs well incubated, some had two fresh eggs, while a few had one or two young and an egg or two. Larger young were picked up on the rocks near the nests. The nests are well made, clean, and are generally composed of dead grass stems, which the birds bring from St. Paul. While most were placed on the flat rock, a few were in depressions of the sand which filled some of the larger crevices of the rocks. The following may possibly be an unique occurrence: After 5 p. m. on June 13, while returning from our trip to Walrus Island, I noticed a large gull flying rapidly toward us. As it approached I saw another a little on its left and somewhat lower. Soon the fixity of this relation and similarity of their movements attracted my attention. The wind had died out and we were taking turns at the oars. The air was chilly, the sea was icy cold, and as I had nothing else to do and nothing except the distant shore of St. Paul was in sight, I watched them. Still they remained in the same relative position, and so I called the attention of the ten Aleuts in the boat to them and asked if they also saw two birds. They all replied "Yes." Still there appeared something peculiar about the birds, and I continued watching. Suddenly they veered off to the right, and I instantly comprehended the situation. The upper one was really a gull, but the lower was only its shadow thrown on a fog bank which was rapidly rolling down on us. Only those who while lying becalmed at sea have seen a fog bank pass in between them and the desired haven can appreciate the rapidity with which this occurs and the solid appearance of the rolling, incessantly changing, and compact-appearing mass of the fog. It was on the upper surface of the front edge of such a fog bank that we saw this shadow. The bank was moving but a very little slower than the gull, and after the bird had veered off toward the land it was but a few moments before we were enveloped, so that it was impossible to see little farther than our boat's length.

These birds feed on pretty much everything in the way of offal. Even the dead seals are soon devoured by them, and they vie with the foxes in their ability to search out and dispose of all animal matter. Evidently the whole colony of this species about St. Paul breeds and roosts during the summer on Walrus Island.

The ground color of the eggs varies from light-drab gray to sepia, with very dark-brown, sharply defined, irregular spots from the size of the head of an ordinary pin to many one-fourth of an inch, and even one three-fourths of an inch, in length. Two of the eggs in a set of three have a few obscure spots, but the other has more than half its spots obscured by the later deposits of egg lime. On one egg the spots are somewhat streaked and penciled. Another set taken the same day, June 13, had two nearly white eggs and one of the normal color. These white eggs are pale-bluish white, with very faint spotting; no dark coloring whatever. The first set measure 2.80 by 2.15, 2.85 by 2.05, 2.86 by 2.07. The pale two are 3.05 by 2.11, and 3 by 2.15, the dark egg having been broken.

34. Larus barrovianus Ridgway. Point Barrow Gull.

Larus barrovianus RIDGWAY, Auk, 1886, 330; Man., 1896, 26.—NELSON, Bds. Alaska, 1887, 51.—A. O. U. Ch. List, 1895, 16.

Larus glaucus, SAUNDERS, Cat. B., Br. Mus. XXV, 1896, 289 (part).—COUES, Key, 1890, 741 (part).

Among the hundreds of *Larus glaucescens* seen I collected one specimen of this large pale gull on Walrus Island on June 13, 1890. It is the only one that I noticed. It had three bare places on its lower underbody, thus indicating that it had been sitting on eggs, though it was a male. Three eggs in the National Museum collection, taken by Mr. Elliott June 4, 1873, and labeled St. Paul (but evidently from Walrus Island), have been identified (perhaps wrongly) as belonging to this form. They measure 2.83 by 2.10, 2.93 by 2, and 3.15 by 2.11. They are similar in color to the eggs of *L. glaucescens*, though there is a slight tendency to blending about the edges of the spots. No. 118713, ad. ♂, U.S.N.M. Walrus Island, June 13, 1890, W. P. Length, 31.50; extent, 63; wing, 18.75

35. Pagophila alba (Gunn.). Ivory Gull.

P[agophila] eburnea, COUES, Key, 1890, 749.—SALVIN, Cat. B. Br. Mus. XXV, 1896, 301.

Gavia alba, A. O. U. Ch. List, 1895, 15.—RIDGWAY, Man., 1896, 24.

A northern species, perhaps a regular visitor in winter. One was taken by the natives in February or March, 1895, and the specimen was afterwards secured by Messrs. F. W. True and D. W. Prentiss. No. 151788, U.S.N.M. Wing, 12.88; tail, 5.28; culmen, 1.42; tarsus, 1.50.

36. Rissa tridactyla pollicaris Stejn. MSS. Ridgw. Pacific Kittiwake. "*Chornie-naushkie Goverooskie.*"

Larus tridactyla, COINDE, Rev. et Mag. Zool., 1860, 401.

Larus tridactyla var. *kotzebui*, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 199.—ELLIOTT, Mon. Seal Ids,, 1882, 132.

Rissa tridactyla pollicaris, TURNER, Con. Nat. Hist. Alaska, 1886, 124.—A. O. U. Ch. List, 1895, 16.—RIDGWAY, Man., 1896, 25.—NELSON, Bds. Alaska, 1887, 49.—TOWNSEND, Cruise, *Corwin*, 1887, 98.

R[issa] t[ridactyla] kotzebuii, COUES, Key, 1890, 748.

Rissa tridactyla, SAUNDERS, Cat. B. Br. Mus. XXV, 1896, 305 (part).

"This gull breeds here by tens of thousands, in company with its first cousin, *Larus* [*Rissa*] *brevirostris*, coming at the same time, but laying a week or ten days earlier than its relative. * * * In building its nest it uses more grass and less mud cement than the *brevirostris* does."—(*Elliott.*) Abundant near the village of St. George on May 28, where a few nests were seen, but no eggs. On June 21, and for days afterwards a perfect stream of kittiwakes was seen carrying material from the vicinity of the ponds on St. Paul toward the Reef cliffs and Otter Island.

Viewed from the cliffs the flight of these birds is remarkably graceful, and especially so when they have been disturbed from a midday siesta. I thus disturbed several dozen one day, and carefully watched them as they passed and repassed the spot where I sat on the edge of the cliff. They were all within 20 yards and continually paraded parallel with the cliff, all the while intently watching me. They would pass by for some 30 or forty yards, then turn and fly an equal distance on the other side before again making a turn. Usually the whole distance was accomplished by sailing, and often the turns and several lengths were traveled in the same way. Thus, selecting an individual and keeping my eyes on him, I often counted from two to three trips without a flap of a wing. One individual thus noted made the trip seven times without once changing his wings from their rigid outstretched position. The length of his parade was fully 50 yards, and he sailed in an almost straight line and rarely varied his level, being about as high above the sea as I was on the cliff. Not a movement of the air was perceptible to my senses. He was often so close that as he passed I could distinctly see the movement of his eye as he slightly turned his head to view me. Several times the fly lines of two birds would cross at about the same level, but rarely would one flap to gain impetus enough to get rapidly out of the way. It was more often accomplished by a quiver of the wings on the part of one of the two, a slight rise as the other passed beneath, and then a similar descent, and the continuation of the journey without any distinct flapping whatever. They thus sailed in plain view as long as I remained on the rocks, probably thirty minutes.

On August 2, most of the nests contained young, but a few had a young and an egg, and sometimes two eggs, rarely three. Curiously enough, I never saw a nest which contained more than one large young. Possibly the first hatched may in its restlessness crowd the other egg or smaller young out of the nest.[1] The nests are usually built on little projecting points of rock, too small to be utilized by any other species, and are generally placed in groups of four or five or more. The adult plumage is attained before the bird is a year old, but a few individuals then show signs of

[1] "The Kittiwakes, in many cases, laid but one egg each; sometimes two, and a set of three eggs was extremely rare, according to my observation."—(*Lutz.*)

immaturity, some of which are described below.[2] No. 118703, im. ♂, August 5, 1890, St. Paul, W. P., has three feathers, next to the two outside ones on each side of the tail, with a black blotch near the end; in some there is a blotch on each web. There is considerable black on the alula feathers and on the primary coverts. A few dark feathers around the eye. Eye ring, dull red; feet, dark brown, paler on the toes and tarsi. No. 118700, im. ♂, July 8, 1890, St. Paul, W. P., has dark spots on tip of alula, slight black edging running down second primary. Eye ring, indian red; bill, greenish yellow, base and tip lighter; angle of mouth and interior, deep orange red; feet dark, except upper part of inner webs and inside of tibia, which are blotched with orange yellow. Length 17.25, wing 12.95. No. 118702, ♂, July 27, St. Paul, W. P. A few black spots on edge of wing, and second primary partly edged with black on the white for an inch. Bill yellow, brightest toward base, tip very pale horny; eye ring vermilion; angle of mouth and interior deep orange red; feet brown, tinged with yellowish; naked part of tibia, angle of webs and sides of tarsi, orange yellow; tongue dark flesh color. No. 118699, ♀. Plumbeous on sides of head; bill pale horny yellow; base of lower, black; angle of mouth and inside orange red, black in front; feet dark brownish, webs a little lighter; iris, dark brown; eye ring, vandyke brown. Length 16.75, spread 39.50, wing 12.37. Two eggs, August 2, St. Paul, W. P., well incubated, measure 2.20 by 1.70, 2.17 by 1.61. Two eggs June 8, 1889, Walrus Island, C. H. Townsend, are 2.42 by 1.63, 2.19 by 1.52. They vary from a white ground color to a pale brownish, and are spotted with numerous irregular small blotches of various shades of brown. Many of these blotches are obscured by later deposits of shell lime. Some eggs show a tendency to a segregation of spots around the larger end and a few show a decided belt, but there is no rule. A few have some wavy lines.

37. Rissa brevirostris (Bruch). Red-legged Kittiwake: "*Goverooskie.*"

Larus Warnecki, Coinde, Rev. et Mag. Zool., 1860, 401.

Larus brevirostris, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 199.—Elliott, Mon. Seal Ids., 1882, 133.

Rissa brevirostris, Dall and Bann., Trans. Chic. Ac. Sci. 1869, 305.—Turner, Con. Nat. Hist. Alaska, 1886, 124.—Nelson, Bds. Alaska, 1887, 50.—Townsend, Cruise, *Corwin*, 1887, 98.—A. O. U. Ch. List, 1895, 16.—Ridgway, Man. 1896, 25.—Coues, Key, 1890, 748.—Saunders, Cat. B. Bri. Mus, XXV, 1896, 312.

To my mind this is the most beautiful species on the islands. Always graceful, whether on the cliffs or flying, its beautiful form and delicate snow white plumage, with its vermilion feet, adds much to the avifaunal wonders of these islands. I can add little to Mr. Elliott's very full account. Unlike its cousin, which carries its feet extended when flying, this species nearly always buries them in the feathers of its underbody as if fearful of showing their beauty except when absolutely necessary. Their eyes are very dark and very large, much more so when alive than when dead; the eye rings are vermilion. When fog envelops these islands, both the land and sea, the sea birds away from home find their way by flying along the edges of the bluffs where the stored heat in the rocks dissipates the rapidly drifting fog. The wily Aleut, knowing these characteristics, ensconces himself behind a rock in a suitable location and with a large dip net intercepts the birds on their way along the bluffs. Thus

[2] These specimens readily suggest color changes by means of pigment movement, but really are imperfectly changed young birds. As the dark color exists always on the apical part of the feather, it indicates in such birds a failure for a brief period to suppress the tendency to continue the color of the first plumage, an individual lapse from the evolutional line of progress of the species.

many a meal is obtained, and unfortunately our pretty red-legged kittiwake too often falls a victim. Some summer specimens show signs of immaturity by having a plumbeous band on the back of the neck or darker plumbeous spots on sides of head back of the eyes and around the eyes.[1] Such specimens have slenderer and less strongly hooked bills than more adult birds, and have more or less yellowish feet. No. 118712, ♀, is evidently immature. Head, spotted; bill, pale greenish yellow, tip lighter; angle of mouth, greenish yellow; interior, deep orange red; feet, dull orange red; toes lighter and yellowish; eye ring, vandyke brown; iris, dark brown; naked part of tibia, and tarsi, yellowish. Six eggs taken by Mr. Elliott on St. George, June 25, 1873, measures 2.06 by 1.61, 2.23 by 1.70, 2.22 by 1.67, 2.31 by 1.58, 2.31 by 1.60, and 2.36 by 1.70. Their color and markings are similar to those of *pollicaris* but perhaps lighter. "Once in a while an egg will have on its smaller end a large number of suffused blood-red spots."—(*Elliott*).

38. Xema sabinii (Sab.). Forked-tailed Gull.

Xema sabinii, A. O. U. Ch. List, 1895, 22.—SAUNDERS, Cat. B. Br. Mus. XXV, 1896, 162.—COUES, Key, 1890, 753.—RIDGWAY, Man. 1896, 38.

Possibly of regular occurrence. Mr. Elliott saw one on St. Paul, June 4, 1890, and I saw probably the same individual several times afterwards up the Lagoon. Several were taken during the summer of 1896, as I am informed by Mr. F. A. Lucas, and one was shot on St. George by Mr. D. W. Prentiss. No. 151605, ad. ♀, U.S.N.M., June 26, 1890.

39. Sterna paradisaea Brün. Arctic Tern.

Sterna macrura, SAUNDERS, Cat. B. Br. Mus. XXV, 1896, 62.—COUES, Key, 1890, 764.
Sterna paradisæa, A. O. U. Ch. List, 1895, 25.—RIDGWAY, Man. 1896, 43.

Capt. D. Webster, who has spent many winters on St. George, informed me that a tern, which he accurately described, was fairly abundant every fall under the cliffs of St. George. None breed on the islands. Mr. F. A. Lucas informs me that he saw two of this species flying over the Lagoon on St. Paul on July 26, 1897.

Order PALUDICOLAE. Cranes and Rails.

40. Grus canadensis (Linn.). Little Brown Crane.

Grus canadensis, TOWNSEND, Cruise, *Corwin*, 1887, 99.—COUES, Key, 1890, 667.—SHARPE, Cat. B. Br. Mus. XXIII, 1894, 256.—A. O. U. Ch. List, 1895, 75.—RIDGWAY, Man. 1896, 35.

Jake, a well-known Aleut sealer, told me on June 28, that he had seen three cranes that morning north of Kamminista Lake. Going there, I found five, but they were very wild. They remained in the neighborhood until after August 1, as I saw them frequently picking up insects on the tundra. One was caught in a trap near the village in June, 1888. "While at St. Paul Island some natives came to me and reported having seen a large, long-legged bird wading in a shallow pond near the village, and gave me a long feather which the bird dropped in its flight."—(*Townsend.*)

Order LIMICOLAE. Shore Birds.

Fourteen species are known to occur, of which one is a common summer resident, almost entirely confined to the islands; another breeds in very limited numbers, while the others are either stragglers or transients. Several occur in enormous numbers.

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[1] Apparently, according to some, a case of feather repigmentation, but evidently due to defective change, a lapse or partial failure to attain the higher colors of the species.

Family PHALAROPODIDAE. Phalaropes.

41. Crymophilus fulicarius (Linn.). Red Phalarope.

Phalaropus fulicarius, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 181; Key, 1890, 614.—Elliott, Mon. Seal Ids. 1882, 129.

Crymophilus fulicarius, Townsend, Cruise, *Corwin*, 1887, 99.—A. O. U. Ch. List, 1895, 82.—Sharpe, Cat. B. Br. Mus. XXIV, 1896, 693.—Ridgway, Man. 1896, 144.

An abundant migrant; found in greatest numbers in the autumn. They arrive about the middle of May in nearly full breeding dress, but soon leave, and few remain after the 10th of June. The first fall arrivals I noted, adult males and females, on July 17; these were very tame, tired, and poor, and a few white feathers of the coming new plumage were showing among the worn breeding feathers. They landed first on the sandy beaches, but soon spread about the lagoon and ponds; were generally solitary, and always silent. The later-arriving birds were much the more advanced in molting. Between June, 10 and July 17, I collected several specimens and saw others. These were about the ponds at Polovina, but though they seemed perfectly at home I do not think that they bred. These generally had some injury to the feet. On May 12, when 800 miles southward of Unalaska, we saw this species, and they gradually became more abundant as we approached land. These were almost entirely in the white plumage. Mr. Townsend collected eight specimens between June 8, and 12, 1885, on Otter Island. Of the June specimens few have entirely changed to the nuptial plumage, nearly all having some white on the under parts and about the face. No. 118748, ad. ♀, June 21, 1890, W. P., has changed least of all; has much white beneath, some on throat, and a great deal in front of eyes and on forehead. Fall specimens indicate the progress of the molt as follows; No. 64278, ad. ♂, July 22, 1873, H. W. Elliott, few white feathers mixed in on scapulars, back, breast, and flanks, and scattered on head and neck, except in front of eyes; No. 118752, ad. ♀, July 29, 1890, W. P., many old feathers on belly, few on neck and around bill, head partly white, base of occiput black, back almost changed; Nos. 151465, ad. ♂, 151466, ad. ♀, August 7, 1895, D. W. Prentiss, almost entirely changed; white feathers in the majority except immediately around bill and on occiput and nape. No molt of the wings or tail in any specimen. Stomach contents: "Predaceous beetles (*Carabidae*)."—*S. D. J.*

42. Phalaropus lobatus (Linn.). Northern Phalarope.

Lobipes hyperboreus, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 180; Key, 1890, 612.—Elliott, Mon. Seal Ids. 1882, 129.

Phalaropus hyperboreus, Sharpe, B. Br. Mus. XXIV, 1896, 698.

Phalaropus lobatus, A. O. U. Ch. List, 1895, 82.—Ridgway, Man. 1896, 145.

Principally migratory; but a few breed. Elliott collected young on St. George in 1873, and I obtained two just from the eggs on St. Paul, near Rocky Point, on July 2, 1890. The birds arrive in small numbers about the end of May and mostly pass northward, only a few pairs remaining on the islands to breed. Elliott found an empty nest on St. George, June 13, 1872. I could find no nest, though the birds soon found the intruder on their domestic affairs. The males show the greatest anxiety, hovering near one, at the same time uttering a shrill series of notes—*tweet-tweet*—for such a small bird. By constantly noting the movements of the adults I had fixed upon a rather dense growth of sedges, near the open water and some 30 feet from shore, as the place where the young were, and was not disappointed upon wading out to find after considerable search two small young clinging to the sedges. They had evidently made their way through the scanty sedge growth for fully 30 feet from the shore. Ever and anon as I was watching the old birds would swim near the place, constantly turning in all directions with head and neck erect. Suddenly the bill would be thrust into the water, a nutritious morsel would be swallowed and the turning and paddling continued. No. 118756, ad. ♂, July 24, 1890, St. Paul, W. P., is beginning to molt; there are a few new white feathers appearing on the scapulars and scattered all over the head and neck. Stomach contents: one specimen, "many diptera."—*S. D. J.*

Family SCOLOPACIDAE. Snipes, Sandpipers, etc.

43. Tringa ptilocnemis Coues. Pribilof Sandpiper. "*Kie-lits-kie.*"

Tringa crassirostris, DALL, Proc. Cal. Ac. Sci. 1873, 28; Am. Nat. VII, 1873, 634.—COUES, in Elliott's Rpt. Seal Ids. 1873; *Reprint*, 1875, 182.

Tringa ptilocnemis, COUES, in Elliott's Rpt. Aff. Alaska, 1873 (note); *Reprint*, 1875, 182; Am. Nat. VIII, 1874, 500.—ELLIOTT, Mon. Seal Ids. 1882, 129.—NELSON, Bds. Alaska, 1887, 105.—HARTLAUB, Jour. für Orn. 1883, 279.—A. O. U. Ch. List, 1895, 87.—RIDGWAY, Man. 1896, 154.—PALMER, Nidiologist, I, 1894, 175.

Tringa gracilis HARTING, P. Z. S. 1874, 243, Pl. XL.

Tringa maritima, DALL and BANNISTER, Trans. Chic. Ac. Sci. 1869, 291; Proc. Cal. Ac. Sci. 1874, 275.

Tringa maritima ptilocnemis, ELLIOT, N. Am. Sh. Bds. 1895, 72.

T[ringa] m[aritima] ptilocnemys, ELLIOT, N. Am. Sh. Bds. 1895, 235.

A[rquatella] ptilocnemis, RIDGWAY, Bull. Nutt. Orn. Club, 1880, 163.—COUES, Key, 1890, 630.

Arquatella ptilocnemis, NELSON, Cruise, *Corwin*, 1883, 86.—STEJNEGER, Bull. 29, U. S. N. M. 1885, 112.

Arquatella maritimus ptilocnemis, SHARPE, Cat. B. Br. Mus. XXIV, 1896, 584.

This bird is unquestionably a good species, and is very distinct in all plumages from *T. maritimus* and *T. couesii*. My series of 64 specimens, together with Mr. Elliott's and others in the National Museum collection, show this conclusively. Comparing adult breeding birds we find that *ptilocnemis* is the largest, is much the whitest, has a strong rufous tinge across the chest, over most of the head and neck, and always has a black pectoral area. The black, however, varies in different degrees, because in all cases the white feathers of the previous plumage are persistent about the center of the breast and down the abdomen, and do not drop until replaced again by similar feathers. The rufous tinge is always found, and is especially marked on some specimens. In one, No. 118776, this ochraceous rufous of the edgings of the back and neck feathers extends strongly across the lower neck between the white of the throat and the black pectoral patch. The scapulars are very broadly edged with the same color. In a few specimens the rufous is confined to a slight tinge around the neck and on the edges of the back feathers, but all specimens show it. While the bill is practically straight on most specimens, a few have it slightly decurved near the tip. The whiteness is quite a prominent feature, and is in great contrast to the darker colors of the related forms. As to the causes of the greater whiteness of this species, it may be suggested that it may be due entirely to isolation, with comparative freedom from enemies, and also from competition with related forms. Ease of acquiring, together with the abundance of food, would also seem to operate. During the summer the adults lead a lazy life. There is abundance of food, easily obtained, and there is very slight cause for activity. They have no competition and no enemies except foxes, from whom it is easy for them to escape. As great activity under contrary conditions tends strongly to produce dark colors, it would seem that the environments of this species would lead, through a kind of inanition, to the nonnecessity of a great production of pigment-bearing cells. I would ascribe the whiteness of gulls and of the snowy owl to the same cause—easy life, abundance of food, and especially, freedom from special enemies which would provoke constant watchfulness and activity.

One result of Mr. Elliott's ornithological work was the discovery of this species as new, and later the knowledge of its restriction to these islands and to St. Matthews as a summer resident. It is abundant and tame, and is usually found all over the moss-covered tundra and in the vicinity of the ponds, and in the autumn on the beaches; but it is rare about the higher and central portions of St. Paul. The nest is a mere hole scratched out in a bed of moss or lichens. Though I tramped many a weary mile over their favorite grounds, where the birds were in pairs and abundant, I did not succeed in finding eggs and but few very small young. This was probably owing to a very early spring. The young leave the nest soon after hatching, and are thoroughly well concealed by their mimicry of the confusing mixture of mosses, lichens, and other forms of vegetation which abounds and are so well intermingled on these islands. It requires much patience and a close scrutiny to detect a crouching young, even when it is directly within reach. Obedient to their mother's cries they flatten themselves with head and neck extended; with each yard of the ground precisely similar in pattern and color with every other yard, and the parents, especially the female, trying their best to coax us in other directions, and the uncertainty as to the exact location of the young, all combine against the collector, so that few specimens reward a tramp that seems exasperatingly needless. The young will not move, though one stands with the foot touching them, but when once handled and released they scamper off with all the quickness their long legs can give them. When we invade the vicinity of a nest or young it is amusing to watch the antics of the female. She invariably flies in front and flutters with feigned lameness but a few feet away. If the ground is rough it is more amusing to watch the precipitancy of her flight until she disappears in a hollow, to reappear in a moment on the other side, cautiously turning round and eying us to see if we are following. She always keeps in front of us, no matter which way we turn, and will continue thus for several hundred yards, when she will suddenly fly off to some distance and after waiting a while will return to the vicinity of the nest or young. They appear stupid when solitary and without a family, and will stand perfectly still, eying one from a little eminence. Occasionally we are startled by a loud *druuett* from the side of a sand dune, and I was at a loss for some time to discover the owner of this most unmusical sound, which finally turned out to be an individual of this species standing motionless and watching us. It would seem impossible for this sound to have issued from this bird if I had not seen it in the act.[1] These sandpipers have the habit in common with others of their kind of suddenly elevating the wing directly over the back. Often when alighting on the tundra, as soon as they stopped up went one wing, followed soon after, perhaps, by the other. Often while watching a flock on the lagoon beach first one would elevate a wing, then another; it was always the near wing which went up first. I never saw a bird elevate the off wing first. I know of no reason for their doing so. They are tame. I have

[1] Their ordinary note is quite musical, something like *wher-wher-wher-wher*, quickly uttered.

walked up to a flock of about fifty, and with care could drive them before me for some distance before they took fight, being but a few feet away. The females always pluck out a patch of feathers on each side of their underbody, and fully half of the males collected had done the same, thus showing that they also had taken part in incubation. They are often seen feeding in the water up to their breasts, and seem to take delight in it. They swim readily, but not often. On June 30, I saw one fly out to a stone in a pool, and, after gathering all the food possible, it deliberately swam to another, and having visited each stone in the same way, flew back to the shore and then bathed itself, occasionally taking a swim.

The downy young are beautiful little things, silvery white beneath, bright, rich ocherous above, varigated with black and dots of white. The general color above lacks the grayness of the similar age of *maritimus*. The white dots are interesting under the microscope. They are composed of a bunch of highly specialized down, in which the radii near the tip are crowded and colorless. Fig. 1, Pl. XL, shows a bunch composed of six downs, and also a single component, 1, *a*. The ordinary down is shown in Fig. 2; these surround each dot or bunch. As they grow older the first feathers appear on the sides of the breast, on the back and scapulars; then the primaries and larger wing coverts appear. Fig. 3 shows the down attached to the tips of the rami of these new feathers, and the amount of wearing near their tips. In fig. 4 a tip of a ramus is shown with a down attached; at *a* is seen the swelling mentioned under *Uria lomvia arra*. The feathering continues until the breast and under parts are covered, when the tail appears. At this time there are no feathers on the rump or on the head or neck. In the next stage feathers have appeared on the occiput and on the auriculars, and are also extending up the neck. At the same time the tips of the back feathers have become somewhat worn, so that the colored margins are narrower and the black more prominent. The wing coverts are also to some extent worn on their tips. When the bill is an inch long the down has nearly all disappeared, and when it has entirely gone the birds appear in small flocks on the beaches, the young generally keeping together. Then another change takes place, for the entire plumage now gives way to another, that in which the bird passes the winter. A few late July, immature birds show the beginning, for No. 118832, im. ♂, July 29, has a few new feathers on the middle of the back and on the scapulars. They soon extend all over the back, so that specimens collected up to August 10 have many of the new whitish feathers on that region. The contrast is striking between these feathers, the latest being of an almost even shade of pale plumbean with darker centers and generally with a narrow white margin. There are no specimens to show the complete change, but it is probable that these young birds remain on the island until it is completed. By the middle of June the adults have fully changed to the breeding plumage, but on some specimens a few feathers of the previous winter's plumage persists much later. Thus on many specimens some alternate feathers of the scapulars and tertials are of the previous winter's well-worn plumage. In fact, few specimens are free from these old feathers. Soon after the middle of July the new plumage of the next winter begins to appear. At first a few feathers show about the breast, then on the scapulars, thence up the neck and over the head, so that by the 10th of August they have changed one-half. On No. 118764, July 12, the three shortest primaries and on No. 118787, same date, the four shortest have been dropped. The tips only of the new feathers can be seen. In No. 118769, July 30, only four old primaries remain, and the new ones are well grown, but do not yet reach to the tips of the unmolted tertials. The order of length in these new primaries is 4–3–2–1–5, and sixth very short, counting from the innermost. No. 118770, August 5, is still further advanced; but three old outer primaries remain in place. The longest new one, the fourth, is as long as the tertials and the fifth is within half an inch of it. The sixth is yet very short. The outer three tail feathers on each side of 118769 are still in place, the central having dropped out and new ones showing. In 118770 the tail is like the other, but one of the middle tail feathers is still undropped. In both these birds many new feathers have appeared all over the body, so that the birds have assumed quite a gray appearance owing to the whiteness of the winter plumage. No. 54586, August 13, 1868, St. George, Capt. E. E. Smith, is an adult still further advanced, and is more than two-thirds changed. The new tail still has the outer feathers short and partly in the sheaths, only the two outer old primaries on one wing and one on the other being in place. But few of the summer feathers are to be seen. It would thus appear that before this species leaves the islands they assume entirely their new dress. "And at this season [August 10] old and young flock together for the first time, and confine themselves to the sand beaches and surf margins about the islands for a few weeks, when they take flight by the 1st or 5th of September, and disappear until the opening of the new season."—(*Elliott.*)

As shown by Hartlaub (Journ. für Ornith., 1883, p. 257), Drs. Arthur and Aurel Krause found this species wintering along the Portage Bay shore of Alaska. Mr. J. W. Johnson in April, 1885, also collected a number at Nushagak which are in the National Museum collection. One, an adult female, is beginning to change to the summer dress. A few black-tipped feathers of the pectoral patch have appeared on the breast, and some new ones, full grown, dot the back, scapulars, and the occiput. On two immature males, taken about the same time, there are a few dark feathers scattered on the back; otherwise they are in the whitish winter plumage.

We have in this brief sketch of the life history of this species four conditions or phases which are possibly unique among the *Limicolae*. First, they remain at their summer home until the autumn molt is complete, and, conversely, they remain at or near their winter habitat until the spring molt is at least well advanced; second, they have possibly the shortest migration range of any species of the order; third, their migration route is first eastward[1] 200 miles over Bering Sea and thence southward for some distance, to be reversed in the following season; and, fourth, it is probably the fewest in numbers and the most restricted in habitat, during the summer especially. "These snipe are now in the lagoon at low water in flocks of from ten to fifty or more. They run readily into the water up to their wings and sometimes swim the small pools in the sand. They are constantly feeding, and will allow one to approach with caution within a few feet. They feed head to the deeper water and keep the bill well under the surface. They are apt to quarrel at such times, uttering a low, harsh cry."—(*Notes, W. P., August 5.*). When several are flying past, one or more may return and perch upon a rock or bank and indulge in a period of watching. The

[1] This probably indicates the ancient proximity or continuity of the Alaskan shore line to the islands.

blackest breasted specimen is a female. A glance at the measurements will show that the female is rather the largest and always has a longer bill.

Catalogue No.	Sex.	Date.	Collector.	Locality.	Wing.	Tail.	Culmen.	Tarsus.
118759	♂ ad.	June 5, 1890	W. P.	St. Paul	5.28	2.40	1.32	0.98
118760	♂ ad.	June 5, 1890	W. P.	St. Paul	4.90	2.20	1.19	.96
118764	♂ ad.	July 12, 1890	W. P.	St. Paul	5.00	2.38	1.14	.96
118769	♂ ad.	July 30, 1890	W. P.	St. Paul	4.90		1.19	.99
118770	♂ ad.	Aug. 5, 1890	W. P.	St. Paul	4.90	2.35	1.22	.96
Average					4.99	2.33	1.21	.97
118771	♀ ad.	June 5, 1890	W. P.	St. Paul	5.20	2.48	1.40	1.00
118786	♀ ad.	June 7, 1890	W. P.	St. Paul	5.20	2.54	1.43	1.02
118781	♀ ad.	July 5, 1890	W. P.	St. Paul	5.38	2.54	1.38	1.06
118782	♀ ad.	July 5, 1890	W. P.	St. Paul	5.04	2.31	1.38	.94
118787	♀ ad.	July 12, 1890	W. P.	St. Paul	4.92	2.39	1.36	.97
Average					5.14	2.44	1.39	.99
64249, Type	♀ ? ad	July 22, 1873	H. W. E.	St. George	5.10	2.25	1.12	.90

The eggs have rarely been collected. They were described by Dr. Coues in Elliott's reports for 1873 and 1875, and the specimens—a set of four—are in the collection of the National Museum, No. 16767, June 19, 1873, St. George Island, H. W. Elliott and George R. Adams. "The ground is nearly clay color, but with an appreciable olivaceous shade. The markings are large, bold, and numerous, of rich burnt-umber brown of varying depth, according to the quantity of the pigment. These surface markings occur all over the shell, except the extreme point, and are solidly massed by confluence on the larger half of the egg. All the markings are strong, as if laid on freely with a heavily charged brush. With these surface spots occur numerous shell markings of the same character, but of course obscure, presenting a stone-gray or purplish-gray shade. Some of them look as if the color of the surface spots had 'run' and soaked into the olivaceous drab of the general surface."—(*Coues.*) These eggs measure 1.55 by 1.08, 1.52 by 1.05, 1.50 by 1.08, 1.48 by 1.05. Another set of four was taken on St. Paul, July 6, 1895, by Messrs. True and Prentiss, and are now in the National Museum collection. Stomach contents: "The Pribilof sandpipers had taken predaceous beetles (*Carabidae*), but had also caught parasitic wasps and a fly."—*S. D. J.*

44. Tringa maculata Vieill. Pectoral Sandpiper.

A[ctodromus] maculata, COUES, Key, 1892, 626.
Heteropygia maculata, SHARPE, Cat. B. Br. Mus. XXIV, 1896, 562.
Tringa maculata, A. O. U. Ch. List, 1895, 88.—RIDGWAY, Man. 1896, 156.

Directly east of the village of St. Paul and but a few yards from it lies a shallow and irregular pond, a favorite resting and feeding place for migrating birds. I generally made an early morning visit to this pond, and was frequently rewarded with desirable specimens. The morning of June 12 I was especially fortunate, obtaining three species which I did not see at other times, two being new to the islands. On a little grassy islet I flushed and secured two females of this species, in company with a semipalmated sandpiper. There are few instances of the capture of this species in the Pacific, though according to Nelson and Murdock it is abundant from the mouth of the Yukon to Point Barrow. Nos. 118833, 118834, ♀ ♀, June 12, 1890, St. Paul, W. P. Length, 8.25; extent, 16.55; wing, 5.10; tail, 2.22; tarsus, 1.10; culmen, 1.15. Stomach contents, two specimens: "These birds had eaten predaceous beetles (*Carabidae*) and pupae."—*S. D. J.*

45. **Tringa damacensis** (Horsf.). Long-toed Stint.

Tringa damacensis, RIDGWAY, Auk, 1886, 275; Man. 1896, 158.—TOWNSEND, Cruise, *Corwin*, 1887, 100.—COUES, Key, 1890, 886.

Limonites damacensis, SHARPE, Cat. B. Br. Mus. XXIV, 1896, 553.

This bird has a place as North American solely on a specimen secured by Mr. C. H. Townsend on Otter Island. "It was feeding in a shallow salt-water pond, with other *Tringae*, which I supposed to be *Actodromas*."—(*Townsend*.) No. 106809, ad. ♀, June 8, 1885, Otter Island, C. H. T. Wing, 3.55; culmen, 0.72; tarsus, 0.88; tail, 1.50; middle toe and claw, 0.94.

46. **Ereunetes pusillus** (Linn). Semipalmated Sandpiper.

Ereunetes pusillus, COUES, Key, 1890, 624.—A. O. U. Ch. List, 1895, 90.—SHARPE, Cat. B. Br. Mus. XXIV, 1896, 514.—RIDGWAY, Man. 1896, 161.

I saw and obtained but a single bird, which was in company with two *Tringa maculata*. They had evidently just arrived from the South and were quite tame. This is probably the first instance of the taking of this species in Bering Sea. The allied species, *E. occidentalis*, has often been taken on the islands of the Aleutian chain, and may occur on the Seal Islands. I took two at Unalaska August 15, 1890. My bird was not recognized by the natives, who give the general name *kie-lits-kie* to waders. No. 118835, ♀, June 12, 1890, St. Paul, W. P. Length, 6.13; extent, 11.61; wing, 3.70; tail, 1.57; tarsus, 1.82; culmen, 0.72. Stomach contents: "Minute flies."—*S. D. J.*

47. **Limosa lapponica baueri** (Naum.). Pacific Godwit.

Limosa uropygialis, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint;* 1875, 187; Key, 1890, 636.—ELLIOTT, Mon. Seal Ids., 1882, 130.

Limosa lapponica novae-zealandiæ, SHARPE, Cat. B. Br. Mus. XXIV, 1896, 377.—NELSON, Cruise, *Corwin*, 1883, 89.

Limosa lapponica baueri, A. O. U. Ch. List, 1895, 92.—RIDGWAY, Man. 1896, 163.

A fairly abundant migrant through the islands. They appear early in May and a few small flocks were seen up to June 13, when I saw eight, and secured one on Walrus Island. On July 7 I saw two, which after being disturbed flew directly northward up the island. No migrants had returned by August 10. A great difference exists in size between the sexes. The natives invariably picked out a female as being the "man," that being their idea of the superiority of the sex, and no argument could convince them that the contrary was correct. Elliott says that they return "toward the end of August, going south in flocks of a dozen to fifty, making then, as before, scarcely an appreciable visit." In the ponds they feed by keeping their bills in the water and move invariably all in the same direction, heads to the wind. With care I could approach within a few feet. Beneath, all my specimens are still in the old feathering, except that on all save one the new reddish breeding plumage is scattered over the under parts, mostly, however, on the breast and slightly up the under neck and throat. Otherwise there are no new feathers, and no pinfeathers, the back, tail, and wings especially being well worn. Few of the specimens have a majority of rufous feathers, and it would seem that as a rule, after examining many, that this bird rarely assumes a fully changed new breast plumage. All these birds have the upper tail covarts strongly barred, and the barring obscured or absent on the epical half of the rectrices. There are no pure white feathers on the rumps, but several specimens have a few feathers with a reddish tinge, but all are barred. Pinfeathers are not found on these birds. It would seem to be the case that the long ocean migration of the species prevents the completion of the molt. It would seem, also, that ornithologists generally have considered the presence of new feathers, together with others more or less worn, on waders as evidence tending to prove the renewal o. growth in such feathers without a molt. But it seems to me that a better explanation is possible. As a rule waders acquire their summer plumage before they migrate, though it may not be completely changed before they leave for their summer habitat. If, for instance, molting is but half completed on the breast when the bird obeys its seasonal instinct, then on its journey those feathers which are still in their sheaths complete their growth, though often with less pigment, because the powers of the bird are more necessary for its preservation during its journey; and no others grow out, perhaps not during that summer. Again, as a rule, waders make very long migrations, and spend but a very short time at their summer habitat, hence the necessity for molting before they start or during the early stages, for later all their time and strength are taken up in other affairs more important for the preservation of the species. That feathers well worn, and some entirely unworn, together with others in all intermediate stages of wearing, are found on waders taken near their summer habitat is undoubtedly true, but their presence can be explained on the lines laid down above. It is very rare indeed that pin feathers are found on such birds when within several hundred miles of their summer home, especially on those which have traveled over vast stretches of ocean during their long journey. Land-migrating waders show greater molting changes than those species which move northward over vast tracts of ocean. A fully molted spring specimen of *baueri* is rare, but not so with *lapponica*. No. 62443. ♀, May 16, 1872, St. Paul, H. W. E., is the reddest breasted bird, few feathers of the winter plumage being left. No. 62447, ♀, July 5, 1872, St. Paul, H. W. E., is one of the palest, few new breeding feathers having appeared. No. 118843, ♀, June 11, 1890, St. Paul, W. P., has not a single feather of the breeding plumage. The extreme sensitiveness of the bill of this bird is shown by the character of their food as here shown.

Stomach contents: "Much the greater part of the stomach contents of these birds consisted of hundreds of minute threadlike aquatic larvae of a midge (*Chironomis*). Pieces of mollusks' shell had been swallowed by several of the birds. Flies, closely related to our common house fly, and tiger beetles were detected in small quantities. Of the six godwits, five had been killed on St. Paul Island, and had fed for the most part upon midges, which were probably abundant in a fresh-water pond on the island. The sixth bird was taken on Walrus Island. It had caught over five hundred specimens of a species of beetle (*Aegialites debilis*[1]), the sole representative of a unique family of beetles, described some time ago and subsequently lost sight of until recently discovered again."—*S. D. J.*

Measurements of eight specimens.

Cat. number.	Sex.	Date.	Length.	Extent.	Wing.	Culmen.	Tarsus.	Locality.	Collector.
118838	♂	June 11, 1890	14.13	27.38	8.61	2.87	1.94	St. Paul Island	W. P.
118842	♂	.....do	14.50	27.75	8.87	3.13	2.27	.....do	Do.
118841	♂	.....do	14.75	27.94	8.75	3.38	2.13	.....do	Do.
118844	♂	.....do	15.38	27.52	9.38	3.25	1.96	.....do	Do.
118856	♂	June 13, 1890	16.38	31.00	8.87	3.06	2.00	Walrus Island	Do.
118840	♀	June 11, 1890	17.06	31.75	9.32	4.06	2.32	St. Paul Island	Do.
118843	♀	.....do	16.87	31.13	9.38	3.94	2.15	.....do	Do.
118839	♀	.....do	17.32	30.61	9.06	4.50	2.25	.....do	Do.

[1] These beetles were quite common on the higher shelf rocks of Walrus Island.

48. **Totanus flavipes** (Gmel.). Yellow-legs.

Totanus flavipes, A. O. U. Ch. List, 1895, 93.—COUES, Key, 1890, 638.—SHARPE, Cat. B. Br. Mus. XXIV, 1896, 431.—RIDGWAY, Man. 1896, 166.

On June 11, 1890, I walked up to a flock of godwits, feeding in the village pond on St. Paul, to see how close I could get to them. Feeding with them, a dwarf among giants, I looked down on a bird of this species. Having only my cane gun, and being but 15 feet off, I aimed just over its back, hoping to secure it without much damage, but it flew away uninjured with the godwits and failed to return when they did. Apparently this species is not otherwise known from Bering Sea.

49. **Heteractitis incanus** (Gmel.). Wandering Tattler.

Heteroscelus incanus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 187; Key, 1890, 643.—ELLIOTT, Mon. Seal Ids. 1882, 130.

Heteractitis incanus, TOWNSEND, Cruise *Corwin*, 1887, 100.—A. O. U. Ch. List, 1895, 95.—SHARPE, Cat. B. Br. Mus. XXIV, 1896, 453.—RIDGWAY, Man. 1896, 168.

A migrant; I saw none in May except at Unalaska. It is the first species to return in the fall; adult birds, July 10, and afterwards. Usually in pairs on the surf-swept rocks, but sometimes seen—usually the brownish, unbarred, and less wary immature—on open sandy places, and sometimes with the turnstones on a sandy beach. They are not shy, but are seldom noticed when perched on the wet rocks which harmonize so well with their color. Solitary birds remain quiet and unseen, and will permit one to approach quite close, frequently startling us as they get up suddenly, almost under our very feet, and uttering their loud, shrill cry, flying off to another resting place. But when two are together it is difficult to stalk them, as one is sure to tattle. No. 62249, May 27, 1872, St. Paul, H. W. E. No. 106521, ♀, June 8, 1885, Otter Island, C. H. T. No. 118854, ♂, July 29, 1890, St. Paul, W. P. No. 115855, ♀, July 31, 1890, St. Paul, W. P.

50. **Numenius hudsonicus** Lath. Hudsonian Curlew.

Numenius hudsonicus, COUES, Key, 1890, 645.—A. O. U. Ch. List, 1895, 97.—SHARPE, Cat. B. Brit. Mus. XXIV, 1896, 364.—RIDGWAY, Man. 1896, 171.

Probably a regular migrant. Mr. F. A. Lucas saw one at very close range on St. Paul, on July 16, 1897.

51. **Numenius borealis** (Forst.). Eskimo Curlew.

Numenius borealis, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 188.—ELLIOTT, Mon. Seal Ids. 1882, 130.—SHARPE, Cat. B. Br. Mus. XXIV, 1896, 368.—A. O. U. Ch. List, 1895, 97.—COUES, Key, 1890, 646.—RIDGWAY, Man. 1896, 171.

Mr. Elliott collected a single specimen on St. Paul, which is still the only one I know of from the islands. No. 62448, ad. ♂, May 26, 1872; wing, 3.18.

Family CHARADRIIDAE. Plovers.

52. **Charadrius dominicus fulvus** (Gmel.). Pacific Golden Plover.

Charadrius pluvialis, COINDE, Rev. et Mag. Zool. 1860, 400.

Charadrius fulvus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 179.—ELLIOTT, Mon. Seal Ids. 1882, 129.

Charadrius dominicus, SHARPE, Cat. B. Br. Mus. XXIV, 1896, 195 (part).

Charadrius dominicus fulvus, NELSON, Bds. Alaska, 1887, 125.—COUES, Key, 1890, 600.—A. O. U. Ch. List, 1895, 100.—RIDGWAY, Man. 1896, 174.

Common, and a migrant. "The single specimen of golden plover preserved by

Mr. Elliott is of special interest and importance, since it is conclusively determined to be the true Asiatic *fulvus* and not the North American var. *virginicus*."—(*Coues*.) I saw but one. It was alone in the grass of the village pond on St. Paul. "A few stragglers land in April, or early in May, on their way north to breed, but never remain long. They return in greater number in the latter part of September, and grow fat upon the larvae generated on the killing grounds, leaving for the south by the end of October."—(*Elliott*.) Coinde says of Mr. Warneck's specimens: "Three examples of this species have been given me exactly identical with individuals that we find in Europe. They had been killed in the port of St. Paul the 18th and 20th of April, 1852." In the male the black of the under parts has a few white old worn feathers in the center of the breast and a few on the throat; the female has some few new black feathers mixed in with the old plumage on the breast. Both specimens are unchanged otherwise, and the feathers are well worn on the back and wings. No molting feathers are to be found on the birds. No. 64273, ad. ♀, May 1, 1873, St. Paul, H. W. E. Wing, 6.37; tarsus, 1.70. No. 119085, ad. ♂, June 12, 1890, St. Paul, W. P. Length, 9.75; extent, 21.75; wing, 6.50; culmen, 0.93; tarsus, 1.78. Stomach contents: "Ten predaceous beetles (*Carabidae*) and seeds of crowberry (*Empetrum nigrum*)."—*S. D. J.*

53. **Aegialitis semipalmata** Bonap. Semipalmated Plover.

Aegialeus semipalmatus, SHARPE, Cat. B. Br. Mus. XXIV, 1896, 250.
Aegialitis semipalmata, A. O. U. Ch. List, 1895, 100.—RIDGWAY, Man. 1896, 176.
Ae[gialitis] semipalmatus, COUES, Key, 1890, 602.

I saw none, nor did Mr. Elliott. Mr. D. W. Prentiss, jr., secured one in very worn plumage from a flock at Northeast Point. No. 153543, ad. ♀, July 6, 1895, St. Paul, D. W. P., jr. Wing, 4.70; culmen, 0.40; tarsus, 0.87.

Family ARENARIIDAE. Turnstones.

Genus ARENARIA.

Genus characters.—Nonpalmate hind-toe shore birds of moderate size, about 11 inches long; culmen, shorter than head or tarsus; bill, hard, gently tapering from a stoutish base and with a slightly upward trend toward tip; black or blackish across breast and shoulders; under parts and upper and middle back white; tail coverts white; tail, white, with apical half broadly banded with black or blackish; axillaries, white; feet and tarsi, robust; midtoe little shorter than tarsus; tarsi, regularly and broadly sealed in front, smaller scaled and reticulated behind.

GEOGRAPHICAL DISTRIBUTION OF THE SPECIES.

Europe, Asia, Africa and Pacific islands, Western Alaska from the Aleutians to Point Barrow; Greenland. Breeds from Japan and Alaska westward around to the more northern British islands, Azores (?), and Greenland .... *A. interpres.*

America from the Arctic regions north of Hudson Bay and westward to the Mackenzie River, along the Atlantic watershed, though generally coastwise, to Patagonia and the Falkland Islands. Rare on the Pacific slope. Breeds about Hudson Bay, northward and eastward.. *A. morinella.*

Western Alaska from the Arctic Ocean to and through California. Breeds in northwestern Alaska. *A. melanocephala.*

KEY TO THE SPECIES, BREEDING PLUMAGE.

With chestnut above, feet reddish, throat white	Large, wing usually more than 6.00. Black above predominant, with little clove brown, feet vermilion	*interpres.*
	Smaller, wing nearly always less than 6 00 Chestnut above predominant, with much clove brown, feet orange red	*morinella.*
Without chestnut above, feet blackish, throat dark		*melanocephala.*

54. Arenaria interpres (Linn.). The Turnstone. "*Krass-nie ko-lits-kie.*"

Strepsilas collaris, Coinde, Rev. et Mag. Zool., 1860, 400.

Strepsilas interpres, Dall and Bannister, Trans. Chic. Ac. Sci., I, 1869, 290.—Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint,* 1875, 180; Key, 1890, 605 (part).—Elliott, Mon. Seal Ids., Alaska, 1882, 129; Ibis, 1882, 478.

Arenaria interpres, Nelson, Nat. Hist. Alaska, 1887, 128.—Ridgway, Man. 1887, 180 (part).—Sharpe, Cat. B., Brit. Mus. XXIV, 1896, 92 (part).—A. O. U. Ch. List, 1895, 103 (part).

Adult ♂, breeding plumage.—Interscapular, glossy black, slightly greenish, medially divided by a narrow line of chestnut; scapulars, anteriorly chestnut, longer feathers glossy greenish black, irregularly tipped and notched with chestnut and occasionally with whitish; body, white; lower back, blackish; breast, extensively black and extending forward, nearly encircling the neck with a broad band margined with white, a narrower line reaching the base of the lower mandible and margining the white throat, another, but broader, black line extending from the center of this last and encircling the eye, but mostly in front, from whence a branch runs forward to the center of the base of the bill; head and neck otherwise white, somewhat streaked down the upper neck with dusky and heavily and distinctly streaked on the pileum with black with slight rufous edgings; a black blotch on the sides of the base of the head behind eye; flight feathers, dark olive brown lightening to white on the lower portions, the dark color simply as a blotch near the tips of the innermost secondaries; shafts white, browning toward bases; tertials whitish toward bases, their greater length very dark olive, nearly black, variously tipped and indented with chestnut and whitish; lesser wing coverts, dusky olive mixed with black and white; median coverts, chestnut with extensive black centers; long coverts, chestnut broadly banded with black; tail, white, irregularly and broadly banded toward tip with blackish; tail coverts, white; legs and feet, vermilion, joints darkish; bill, black with reddish spot near base of lower mandible.

Adult ♀, breeding plumage.—Similar in pattern to the ♂, but larger, with white of head and neck more obscured with dusky and spotting; but little or no chestnut on wings; chestnut spotted all over back near tips of the feathers, and strongly so on front part of scapulars, otherwise nearly as black as the males.

Immature ♂, first plumage.—Pattern of coloration as in adult, but generally obscured or less defined, especially about the head and neck. Above, dark dusky brown, each feather margined with sandy buff or rufous, on the wings with deeper rufous, on the head and neck with paler brown or buff. Breast patch obscured by pale rufous and white tips to the feathers. Tail white, with subterminal band of blackish, which narrows toward outside feathers, each feather irregularly clouded at tips with rusty, especially the central ones. Throat white, somewhat sharply bordered by the dusky of breast and sides of face. Sides of face generally brownish, drab gray, broken under eyes, with white inclosing drab spots, and by a black triangular spot in front of eyes, paler brown drab gray at base of mandibles and on forehead. Bill slaty black; legs deep orange, blackish around joints.

Immature ♀, *first plumage.*—Similar to ♂, slightly duller and larger.

Wearing rapidly darkens the plumage so that migrating birds vary, some being darker than others. Birds in their second summer are usually smaller than the fully adult, and the black of the breast is less extensive, being then very similar in area and appearance to the following species. Sometimes the chestnut of the wing coverts is entirely wanting in the males, as in the females, the winter coverts persisting.

This bird differs from its American relative by its more extensive black areas and much less amount of chestnut. It is larger and the feet and legs are more strongly colored. A comparison of a good series of Pacific birds from the Pribilofs, Japan, and other points, with a fine series from eastern America shows their unlikeness; and a comparison of these Pacific birds with birds from Europe, Greenland, and Africa shows a great general resemblance; in fact, two Greenland adult specimens kindly loaned me by Mr. F. M. Chapman are indistinguishable from *interpres*, though easily so from our eastern bird. Female birds from the Pacific seem to be blacker than the European bird, but whether a good comparable series of these last taken in spring and summer would show it I am unable to say, my series not being extensive enough. All Alaskan and Greenland specimens that I have seen, about forty, are readily distinguished from our common eastern American species. Alaskan and Unalaskan specimens are a trifle smaller than Japanese or Pribilof birds, but they may be younger. I am not aware that this species occurs in spring on the Pribilofs, but there would seem to be no reason why they should not.

It is an abundant fall migrant on the Pribilofs. I saw none in May or June, except four at Unalaska May 19. On July 12, 1890, I saw probably the first birb that landed on St. Paul during the fall migration. From that date they daily increased rapidly until by the end of July they swarmed everywhere. They reach the island by way of the northeastern shore and in straggling flocks or singly fly southward through the island during the day, banking up in large numbers when the village killing ground is reached. They spread out on the slopes, resting on the rocks and little hillocks during the day. They soon find the feast awaiting them on the killing ground, and the marks of their work around nearly every seal carcass is soon noticeable. As the water disappears by soakage and evaporation in the village pond they turn up the black sand in thousands of little hillocks, each with a narrow depression made by their bill beside it. At low tide the lagoon beaches are a favorite resting and feeding place. By the end of July many become so fat that they are run down and captured by the young Aleuts. Their departure from St. Paul is quite a feature of the avifaunan exhibition. About 6 in the evening a small flock of perhaps forty birds will rise into the air from about the village pond and uttering loud shrill cries will fly up to near the head of the lagoon. Here making a wide sweep they return, gathering fresh recruits on their way, until the vicinity of the pond is again reached. Sweeping around in a constantly ascending course they return up the lagoon, and turning once more, screaming as they go, and adding to their numbers, they make a straight course high over the village hill and on out to sea over the Reef point. This invariably took place every evening during the latter part of my stay on the island. It was always the rule that a dense fog bank hung all around the island at that time, so that even the Reef point was not visible, but the birds went into the fog without the slightest hesitation. They left their landmarks behind. Several flocks averaging about a hundred birds left nearly every evening from the end of July until I left on August 10. The first arrivals on the island were always adults; the young were not noted for at least ten days. According to Elliott they all leave the islands after the 10th of September. On August 12, when the mountains of the Aleutian chain were but faintly outlined to the southward of our steamer, a turnstone in full straight flight passed the vessel. It was hardly more than a few feet from the surface of the sea and so close to the vessel that standing on the deck I looked directly down on the back of the bird. It continued its course direct for the land as long as I could see it. I saw none at Unalaska during the week next following. Elliott says, "I have met with it at sea 700 miles from the nearest land, flying northwest toward the Aleutian Islands, my ship being 800 miles west from the Straits of Fuca." There is nothing, perhaps, very remarkable about the journey of these birds from the Pribilofs to the Aleutians. Let us trace it. They gather in flocks about 6 p. m., and after the maneuvering that I have already described head directly into the fog and fly southward. We can be sure, first, that many in each flock, and especially the leaders, have made the trip on previous occasions, hence they know the way. Now, assuming that they fly at the rate of 30 miles an hour, and knowing that it is about 200 miles to the Aleutians, it would take them about six hours to make the trip. As darkness in that region at that time does not set in until near midnight, they have sufficient time in which to make the vicinity of the Aleutians. Their rate of travel is undoubtedly faster than 30 miles an hour, so that they readily reach the Aleutians before dark.[1] As to their movements thence we know little.

I have been unable to find molting feathers on any specimens, but nearly all have mixed in with the colored summer plumage some of the dull-colored feathers of the winter plumage. Evidently these birds start on their spring migration after the plumage has almost entirely changed. The strength of the bird is then needed for the long journey, so that molting stops and the remaining unchanged feathers are retained. These unmolted feathers are found in the plume feathers of the wing, the tertials, the median coverts, and the scapular plumes. In some cases only a few are found, in others many. Their worn condition, and especially their lack of black and chestnut, render them distinctly noticeable. Fall specimens show these feathers also, so that the evidence of their retaining is complete. It would thus seem that these birds molt all their essentially important feathers before they migrate, the purely decorative ones—the tertials, wing coverts, and scapular plumes—changing last and being interrupted in their growth and change by the effects of an extremely long oceanic journey. Few Pribilof specimens show a complete change, while on the contrary Asiatic specimens are the reverse, thus indicating, probably, that the Pribilof birds winter on the islands of the Pacific.

[1] Our steamer made at least 12 knots. The bird mentioned as passing the vessel easily distanced us, going at least three times as fast, and was soon out of sight.

Arenaria morinella, (L.). The Ruddy Turnstone.

Tringa interpres LINNAEUS, Syst. Nat. ed. 10, 1758, 148 (part).—WILSON, Am. Orn., VIII, 1813, 32, pl. 57, fig. 1.

Tringa morinella LINNAEUS, Syst. Nat. ed. 12, 1766, 249 (based on "The Turn-stone, or Sea-Dottrel," Catesby, Nat. Hist. Carolina, etc. I, 1731, 72, pl. 72, and *Arenaria cinerea* Brisson= Catesby.—GMELIN, Syst. Nat. 1788, 671.—LATHAM, Ind. Orn. 1790, II, 738).

Tringa hudsonica P. L. S. MÜLLER, Syst. Nat. Anhang, 1776, 114 (based on "The Turn-stone, from Hudson's Bay," Edwards, Nat. Hist. Birds, III, 1750, 141, pl. 141).—CASSIN, Proc. Phila. Ac. Sci. 1864, 246.

Cinclus interpres, GRAY, Gen. Bds. III, 1849, 549 (part); Hand-list, Bds. III, 1871, 22 (part).

Morinella interpres, STEJNEGER, Proc. U.S.N.M. 1882, 34 (part).

Strepsilas interpres, ILLIGER, Prodr. Orn. 1811, 263 (part).—LEACH, Syst. Cat. Mam. and Birds, Brit. Mus. 1816, 29 (part).—STEPHEN, Gen. Zool. XI, 1826, 520 (part).—AUDUBON, Orn. Biogr. IV, 1838, 31, pl. 304; Synopsis N. A. B. 1839, 227 (part); B. Am. V, 1842, 231, pl. 323 (part).—BONAPARTE, Syn. N. A. B. 1828, 299; List, 1838, 46 (part).—SWAINSON, Faun. Boreali Am. 1831, 371.—JARDINE, ed. Wilson's Am. Orn. II, 1832, 321, pl. 57, fig. 1.—NUTTALL, Manual Orn. 1834, 30 (part).—FRASER, P. Z. S. Lond. 1843, 118 (Chile).—GIRAUD, B. Long Island, 1844, 220.—DE KAY, Nat. Hist. N. Y. pt. 2, Birds, 1844, 216.—HOLDER, Pub. Lynn, N. H. Soc. I, 1846, 6 (Mass.).—TSCHUDI, Fauna Peruana, Aves 1846, 297.—GOSSE, Birds, Jamaica, 1847, 333.—CABANIS, in Schomburgk's Reis. Brit. Guiana, III, 1848, 751; Journ. für Orn. IV, 1856, 423 (Cuba).—LEMBEYE, Aves de la Isla de Cuba, 1850, 100.—BURMEISTER, Syst. Ueb. Th. Bras. III, 1856, 364 (Brazil).—CASSIN, Rep. Pacific R. R. Surv. IX, 1858, 701 (part).—BRYANT, Proc. Bost. Soc. N. H. VII, 1859, 121 (Bahamas).—NEWTON, Ibis, 1859, 256 (St. Croix, W. I.); Handb. Jamaica, 1881, 115.—BREWER, Proc. Bost. Soc. N. H. VII, 1860, 309 (Cuba); Cat. B. N. Engl. 1875, 12.—MCILWRAITH, Canad. Jour. V, 1860, 6; Proc. Essex Inst. V, 1866 (Hamilton, Ontario).—GUNDLACH, Repert. Fisico-Nat. Cuba, I, 1866, 357; Journ. für Orn. 1875, 331 (Cuba).—WHEATON, Rep. Ohio S. Bd. Agri. 1861, 368, 371; reprint, 10; 1880, 460.—ALBRECHT, Journ. für Orn. 1862, 205 (Jamaica).—BOARDMAN, Proc. Bost. Soc. N. H. IX, 1862, 128 (Maine).—COUES, Proc. Phila. Ac. Sci. 1861, 228 (Labrador); Proc. Ess. Inst. V, 1868, 292 (N. Engl.); Proc. Phila. Ac. Sci. 1871, 29; Key, N. Am. B. 1872, 246; 1881, 609; 1890, 608 (all part); B. N. West, 1874, 459 (part).—BLAKISTON, Ibis, 1863, 130 (Mackenzie R.).—MARCH, Proc. Phila. Ac. Sci. 1864, 66 (Jamaica).—SALVIN, Ibis, 1864, 385 (Brit. Hond.); l. c. 1866, 198 (Guatemala); l. c. 1886, 178 (Brit. Guiana); l. c. 1889, 379 (Cozumel and Yucatan).—LAURENCE, Ann. Lyc. N. Y. VIII, 1867, 100 (Sombrero); Mem. Bost. Soc. N. H. II, 1874, 308 (Mazatlan, Mex.); Bull. U.S.N.M. 1, 1878, 67 (Dominica), 197 (St. Vincent).—BAIRD, Am. Jour. Sci. Arts, XLI, 1866 (part); Ibis, 1867, 281 (part).—SCLATER, P. Z. S. Lond. 1867, 339 (Chile).—SAMUELS, Birds N. Engl. 1868, 436, 478.—LANGDON, Journ. Cin. Soc. N. H I, 1870, 184 (Ohio); List, Cin. B. 1879, 16.—ROSS, B. Canada, 1871, 79.—SUNDEVALL, Oefv. k. Vet. A kad. Forh. Stockh. 1869, 588 (St. Bartholomew), 602 (Porto Rico).—PELZELN, Orn. Bras. 1871, 297 (Brazil).—SCLATER and SALVIN, Nomencl. av. Neotr. 1873, 143.—TACZANOVSKI, P. Z. S. Lond. 1874, 560 (Peru); Orn. Péron, III, 1886, 349.—REID, Zoologist, 1877 (Bermuda); Bull. U.S.N.M. 25, 1884, 230 (Bermuda).—MERRIAM, Trans. Conn. Ac. IV, 1877, 103.—MAYNARD, B. East. N. Am. 1879, 366.—RATHBUN, List B. Cent. N. Y. 1879, 30.—MCCHESNEY, B. Dakota, Bull. U. S. Geo. Surv. I, 1879, 88.—CORY, B. Bahamas, 1880, 151.—BROWN, Cat. B. Portland, Maine, 1882, 24.—CHAMBERLAIN, Bull. Nat. Hist. Soc. N. Brunswick, 1882, 52.—DIONNE, Ois. Canada, 1883, 171.—STEARNS, Proc. U.S.N.M. 1883, 119 (Labrador).—TRISTRAM, Ibis, 1884, 168 (Sto. Domingo).—WELLS, Proc. U.S.N.M. IX, 1886, 627 (Grenada).—HANCOCK, Bull. Ridgw. Orn. C. Chic. 1887, 13 (Texas).—SEEBOHM, Geogr. Distr. Charadr. 1887, pp. xxv, 410, figs.—FEILDEN, Ibis, 1889, 192 (Barbadoes).—AVERILL, List B. Bridgeport, Conn., 1892, 9.—HARTERT, Ibis, 1893, 307 (Aruba, W. I.).—BARBOUR, Auk, XIII, 1896, 297 (Nebr.).

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Adult ♂, *breeding plumage*.—Similar in pattern to *A. interpres*, but smaller and general color above chestnut with sides of interscapular black; scapulars for the most part chestnut, the outer feathers broadly tipped with black and slightly with white, longer feathers blackish olive irregularly tipped with chestnut; body, head, and neck as in *interpres*, but the black of the breast less extensive and narrower, white areas on head more extensive, and the black streaking on top of head with whiter edgings; wings with more extensive white areas; tertials, various shades of clove brown, rarely blackish, broadly blotched, margined and tipped with chestnut with white tips; lesser wing coverts pale dusky olive, with much less black and more white posteriorly than in *interpres;* median coverts extensively chestnut with little or no blackish centers; long coverts, chestnut with black blotches or narrow bands near the tips of the feathers; tail as in *interpres*, but usually less broadly banded and less sharply defined; legs and feet, deep orange red strongly and broadly crossed at the joints with blackish; bill, black.

Adult ♀, *breeding plumage*.—Similar to the male in pattern, but larger and more subdued in color, grayer with white of head and neck obscured with dusky; chestnut of mantle obscured with dark streaking; chestnut all over much less rich than in males; pileum less strongly black, with wider rufous edgings; median wing coverts, mixed grayish and pale chestnut with dark sometimes black center streaks; much grayer and less black than in ♀ *interpres;* tail band as in ♂ but duller; long tertials more plain colored, less positively chestnut tipped and margined; feet and tarsi as in ♂.

Immature ♂, *first plumage*.—Similar to same age of *interpres*, but with the pileum and face and upper neck drab gray obscurely and sparingly dark streaked and paler on forehead and at base of mandibles. Margins of dorsal feathering more whitish. Sides of face much whiter. Throat patch larger and much less sharply bordered with the dusky of breast and spotting of face. Wing coverts with much less black, being generally of varying shades of drab gray and rusty, with blackish streaky centers. Bill slaty black, legs orange with dusky joints.

Immature ♀, *first plumage*.—Similar to ♂, but larger and paler.

Immature ♂, *winter plumage*.—Pattern as in summer adult, but very much less definitely marked, especially on head and neck. White of face and throat more extensive even than in first immature plumage. Dark breast feathers broadly tipped with white. Dark dorsal feathers margined with dusky buff and broadly and irregularly shaded at tips with white or whitish. Pileum dark drab gray, each feather with a pronounced blackish center. Feet and bill as before. 4149, W. P. Collector, Smiths Island, Virginia, September 2, 1895. Wearing results in a darkening of the back and across the breast, though never to the same extent as in *interpres*. Thus immature *morinella* are readily distinguishable by smaller size, paler colors, larger throat patch less definitely margined, and whiter face, and paler pileum. The blackish of the wings is much less extensive and the margins of the dark feathers of the back are much less buffy and rufous, being almost whitish. In the winter plumage *morinella* is very similar to *interpres* of similar age, but the black of the back and breast is much less intense, and the throat patch is much less sharply defined. The general hue of *interpres* is always darker. Specimens in undoubted winter non-breeding plumage are so few, and these so badly made up and so old, that it is difficult to determine the extent of change that has taken place. Usually the specimens are unsexed or wrongly sexed. The winter dress is undoubtedly worn for but a brief period. The change to the breeding dress is by a molt, and not by a "change in the pattern of the feather," as stated by Dr. Sharpe, (Cat. B. Br. Mus., Vol. XXIV, 98). In a molting specimen collected on Marguerite Island, Venezuela, by Lieutenant Robinson (No. 151634) there are in the wings feathers of three plumages, those of the new winter, a few of the chestnut summer, and a number of the previous winter's, these last being mostly present in the tertials.

The common turnstone of eastern North America, as shown above, is quite a different bird to its *Palearctic* relative. It is smaller and more highly colored, and lacks the extensive black areas of *interpres*, besides lacking the chestnut and black mottling of that bird on the median wing coverts. The scapular and tertiary plumes are usually without the black, and are much more highly and more extensively chestnut. My series of 32, fresh male, Smiths and Cobbs islands, Virginia, specimens, all in complete breeding dress, together with some dozen other males taken at various places in the eastern United States and in Mexico, show little variation, and all agree closely with that described above, though several are much more highly colored. The females of *morinella* never appear to reach the extreme blackness observable in *interpres* from the Pacific. Two males, collected by myself, one at Mingan, Labrador, and the other on Smiths Island, Virginia, in August and September, show the extent of summer wearing, and are thus comparable with specimens of *interpres* collected on the Pribilofs by Mr. Elliott and myself at about the same dates. One specimen only of *interpres* collected by Mr. Elliott approaches my autumn *morinella* in the amount of faded chestnut on the center median coverts, but the extensive blackness and larger size puts to rest any doubts as to its proper place. One specimen of *morinella*, No. 154384, ♂, Smiths Island, Dr. E. M. Hasbrouck, has the chestnut of the interscapular much decreased in area and the black correspondingly increased, but the other coloration and its size prevent any doubt as to its place. These are the only specimens that I have seen showing much variation. Wearing of the feathers of *morinella*, both males and females, tends to a graying of the plumage as viewed from above; in *interpres* it itensifies the blackness, so that autumnal birds are much blacker than spring and summer specimens. None of these Virginia male specimens are in absolutely full breeding plumage, though nearly so. A few well-worn feathers of the preceding winter plumage are still to be found among the feathers of the wing coverts and among the tertials and long scapular plumes. In some cases each alternate feather of the tertials is an uncolored worn and a new highly colored one respectively, while sometimes either predominates. In fact few individuals of either *morinella* or *interpres* ever attain a complete breeding (psychological) plumage, though in the latter the change seems to be the more complete, especially in Japanese specimens.

In *interpres* the contrast of dark color and chestnut on the scapulars and tertials is nearly always sharp; in *morinella* it is nearly always blended. The first is mostly black, the latter mostly clove brown. Fully one-half of the specimens of *morinella* show an absence of black at the junction of the black eye and bill stripes; in some, except a little black at the base of the bill, the forehead is entirely white; in others partly white feathers obscure the black at their bases, so that few specimens show the decided black lines common in *interpres.* The feet and legs of *morinella* lack the rich, deep, orange red or vermilion color of *interpres.* They are orange red in color, but pale in contrast to the deeper and highly colored *interpres.*

The female *morinella* from Smiths Island, Virginia, as contrasted with the males from the same place, collected in the same month, show an interesting condition. Whereas in the males nearly the whole of the body plumage is new and unworn, thus indicating a recent molt; in the females the reverse is generally true. On these the new feathers are confined to the under parts and to but a slight extent on the upper parts. The strengthening of the contrast of the black and white on the sides of the head and neck seems to be due almost entirely to wearing, but it seems probable at least that the white of the underbody, on account of the slightly unworn condition, may be due to a recent molt. Scattered about the back and in the tertials on some specimens are unworn feathers, in ones and twos, which are somewhat chestnut colored and are usually tipped with a little white. Surrounding them are grayer feathers most decidedly worn at the tips and sides. This contrast of wearing and color is so positive, that one can not do otherwise than believe that the abundant worn feathers are really the wintering plumage, while the unworn and much fewer are an effort toward a summer breeding plumage. There is no regularity whatever as to the position of these new feathers. No two specimens are alike and hardly a dozen occur on some; on others, fewer. Another explanation of the presence of these unworn feathers may be mentioned. The autumnal molt of the adult turnstones takes place after they have reached their winter habitat. It is possible that the feathers mentioned above may be the last grown, possibly appearing just before the bird leaves for its journey northward. A specimen taken on Smiths Island, August 24, 1895, No. 4072, W. P. collection, is an adult female in a very much worn condition with no new feathering; but among the tertials of the right wing there are two sets of feathers, the plain feathers of the previous winter's plumage and others darker and deeply indented with the originally chestnut-colored parts similar to the same feathers of the male. Thus a comparison of these birds leads inevitably to the conclusion that the amount of spring plumage change is different in the sexes; nearly complete in the males, but slight and varying in the females, though rarely nearly complete. Thus the change is not a physiological or a necessary one, but is traceable to the superabundant sexual energy of the males and perhaps also of the older females. No molting feathers are to be found on any of these specimens, so that the case is a similar one to that considered under *Limosa.*[1] But as these birds have less of an ocean journey and of course have frequent stoppages, greater progress has been made in the changes of the plumage of the males, the less masterful spirit of the females tending to prevent the evolution of their plumage. Among the *Limicolae* we find numerous gradations of plumage change from the species which makes an almost complete spring molt to others where the change is slight and confined to a few colored feathers. Evidently such changes are purely psychological, but modified by many causes, chief among which is the distance to which the winter habitat extends and the retardation or prevention of change caused by the return journey.

Several immature birds that I collected on Smiths Island, Virginia, in September, 1897, were just beginning to molt from the worn first plumage into the winter dress. No adults were to be seen, and it would seem probable that all wintering birds in the United States are immature birds. The material from the west coast of South America that I have examined consists of five specimens, two from the Galapagos Islands, two from Chile, and one from Peru. They are in differing degrees of change and plumage, though mostly in winter dress. The Galapagos birds are referable to *interpres*, the coast birds to *morinella.*

The name *Tringa morinella* of Linnaeus is based primarily on Mark Catesby's plate 72. The specimen figured is most evidently an adult female,[2] and, as Catesby remarks, was taken alive on board his ship while off the coast of Florida. The picture is defective in fine detail drawing of the feathering, but as a whole it is very well done, a credit to the time and artist. In his letterpress Catesby tells us:

> All the Upper-part of the Body is brown, with a Mixture of White and black. The Quill-Feathers of the Wings are dark brown; the Neck and Breast black; the Legs and Feet light red. In a Voyage to *America, Anno* 1722, in 31 Deg. N. Lat. and 40 Leagues from the Coast of *Florida*, the Bird from which this was figur'd flew on Board us and was taken. It was very active in turning up Stones, which we put into its Cage, but not finding, under them the usual Food, it died.

In the figure the wing is 5 inches, the bill 0.90, but the tarsus is 1.37—evidently guesswork. Müller's name of *hudsonica* ten years later was based on Edward's "The Turn-Stone from Hudson's Bay," which was a specimen collected by Mr. Isham. Edward's elaborate description, and his generally excellent plate, evidently fits our male bird very well. He says first: "This bird is here figured of its natural bigness." (Wing, in figure, 5.40; bill, 0.72; tarsus, 1.05.) At the close of his remarks he says: "The Turn-Stone is also found on the western coasts of England, * * * but as Willoughby's and Catesby's differ from each other, and mine widely from them both, I believe them to be distinct species. The above-described at least from its great difference I must pronounce a nondescript. It agrees very nearly in size, shape of body, and parts with the Turn-Stone found with us [viz, in England], but differs very greatly in color." In his plate he figures and in his description he tells us of the black collar. I have only found one specimen (No. 572, E. J. Brown collection, Smith's Island), which has a full black collar; but several others approach it.

It may be held by some that the differences between *interpres* and *morinella* are but subspecific, but I can not agree with that, for the difference in their lines of

[1] Late summer adult birds taken in the United States show no molting, but a specimen, No. 151635, Margarita Island, off Venezuela, July 7, 1895, Lieut. Wirt Robinson, is an adult female, though not sexed, changing to the winter plumage. As others were seen it is probably a nonbreeding bird that failed to reach its arctic home.

[2] Not a young, as usually considered by authors.

migration indicates a separation for the whole of that vast period since the Glacial period began. During and since that time these birds have differentiated in opposite directions as wide as their winter habitats are apart. It seems certain that *morinella* during the whole of Glacial time was a resident of North America, while probably *interpres* was excluded therefrom, owing to the frigid conditions of Greenland and Alaska. The presence now in these places of *interpres* indicates an extension of its range due to the retreat of the ice. It would thus seem that *morinella* was cut off from the parent stock by the Arctic ice accumulations and has continued isolated.

Since the retreat of the ice to its present position the birds have reextended their habitat to its present limits. Thus the distinctness and causation of the habitats of the two birds, their varied migrating lines, the smallness and brighter coloration of *morinella* are correlated factors bearing on the question of relationship. That *morinella* has escaped its proper place till now is due to several causes. First, the confusion by ornithologists of generic and specific characters in such a strongly specialized genus; second, the absence of specimens in American museums showing what the European bird really is, and also a lack of home specimens, and, third, a lack in European collections of a series of properly made fresh skins of the American bird. For instance, Mr. Seebohm had but two unsexed specimens of *morinella*, yet had positive views. The fact that individuals of *morinella* winter about the southern borders of the United States will perhaps account for the differences observable in the extent of the spring change, those that winter in southern South America perhaps undergoing a less change on account of the greater length and severity of their migration. To Drs. C. W. Richmond and E. M. Hasbrouck, and especially to Mr. E. J. Brown, I am indebted for the use of many specimens. I have examined in all 167 specimens—85 of *interpres*, 82 of *morinella*.

Measurements of thirty-one Virginia Spring specimens of A. morinella.

Cat. number.	Sex.	Date.	Locality.	Collector.	Wing.	Tail.	Culmen.	Tarsus.
546	♂	May 23, 1892	Cobbs Island	E. J. Brown	5.50	2.30	0.87	1.00
540	♂	May 27, 1892	do	do	5.65	2.37	.89	1.02
543	♂	May 16, 1892	do	do	5.85	2.52	.92	1.05
544	♂	do	do	do	5.45	2.45	.89	.96
542	♂	May 11, 1892	do	do	5.60	2.47	.86	1.00
541	♂	May 13, 1892	do	do	5,78	2.55	.87	.95
	♂	May 15, 1894	Smiths Island	do	5.95	2.47	.95	1.05
	♂	May 23, 1894	do	do	5.67	2.35	.95	1.02
647	♂	May 21, 1894	do	do	5.73	2.35	.90	1.00
646	♂	May 15, 1894	do	do	5.74	2.25	.90	.89
3779 W. P.	♂	May 24, 1894	do	do	5.77	2.20	.90	1.03
135322	♂	May 25, 1894	do	C. W. Richmond	5.72	2.45	.88	.96
135319	♂	May 16, 1894	do	do	5.90	2.48	.93	1.04
135320	♂	May 15, 1894	do	do	5.70	2.44	.90	1.05
1102	♂	May 16, 1892	Cobbs Island	E. J. Brown	5.73	2.58	.90	1.03
1337	♂	May 15, 1894	Smiths Island	E. M. Hasbrouck	5.80	2.42	.93	1.07
1336	♂	do	do	do	5.50	2.32	.89	1.04
1342	♂	May 21, 1894	do	do	5.74	2.30	.86	1.06
1335	♂	May 15, 1894	do	do	5.70	2.50	.94	.99
4143	♂	Sept. 1, 1895	do	W. Palmer	5.80	2.37	.88	.98
1338	♀	May 15, 1894	do	E. M. Hasbrouck	5.87	2.33	.99	1.05
1339	♀	do	do	do	5.72	2.41	.89	1.02
1340	♀	do	do	do	5.82	2.35	.88	1.01
1341	♀	May 21, 1894	do	do	6.08	2.44	.91	1.05
135321	♀	May 16, 1894	do	C. W. Richmond	5.75	2.35	.91	.99
643	♀	May 15, 1894	do	E. J. Brown	6.00	2.53	.90	1.00
	♀	May 16, 1894	do	do	5.75	2.43	.97	1.00
645	♀	May 19, 1894	do	do	5.80	2.40	.96	1.01
644	♀	May 21, 1894	do	do	6.00	2.40	.96	1.01
545	♀	May 16, 1892	Cobbs Island	do	5.80	2.42	.91	1.02
4072	♀	Aug. 24, 1895	Smiths Island	W. Palmer	5.92	2.42	.99	1.07

Average measurements of A. morinella and A. interpres.

	Wing.	Tail.	Culmen.	Tarsus.
20 Virginia spring males:				
Average	5.70	2.40	0.90	1.02
Largest	5.95	2.47	.95	1.05
Smallest	5.45	2.45	.89	.96
11 Virginia spring females:				
Average	5.86	2.40	.91	1.02
Largest	6.08	2.44	.91	1.05
Smallest	5.75	2.35	.91	.99
10 Pribilof autumn males: [1]				
Average	5.83	2.38	.86	1.02
Largest	6.00	2.40	.85	1.04
Smallest	5.70	2.37	.88	1.03
5 Pribilof autumn females: [1]				
Average	6.05	2.47	.91	1.02
Largest	6.35	2.60	.95	1.04
Smallest	5.77	2.32	.89	.98
6 Japanese spring males, average	6.06	2.53	.86	1.02
2 Japanese spring females, average	6.24	2.47	.90	1.05
2 Bering Island males,[1] average	5.87	2.38	.86	1.02
3 Alaskan summer males,[1] average	5.83	2.43	.84	1.03
3 Alaskan summer females,[1] average	5.79	2.39	.85	1.06
5 European females,[1] average	6.01	2.41	.87	1.02
3 European males,[1] average	5.99	2.51	.86	1.00
1 Greenland female [1]	6.11	2.56	.90	1.04
1 Greenland male [1]	(?)	2.50	.81	.99
Breeding males, as given in British Museum Catalogue	6.20	2.30	.90	.95
Breeding females, as given in British Museum Catalogue	6.30	2.45	.90	.95

[1] Worn wings and tails, summer or fall birds.

Order RAPTORES. Birds of Prey.

Three hawks and two owls are known from the islands, but several others possibly occur. The limited area doubtless prevents undue increase in individuals of raptorial species, though the great abundance of other birds during the summer, at least, would naturally lead us to expect the reverse. Hawks and owls are rarely seen, but oftener on St. George than on St. Paul, because of the presence there of numerous lemmings.

Family FALCONIDAE. Falcons, Hawks, Eagles, etc.

55. Haliaeetus leucocephalus alascensis Townsend. Cliff Eagle.

Haliaeetus leucocephalus, SHARPE, Cat. B. Br. Mus. I, 1874, 304.—COUES, Key, 1890, 555.—A. O. U. Ch. List, 1895, 136.—RIDGWAY, Man. 1896, 243 (all part).

I took with me to St. Paul a specimen that I had shot at Unalaska, and it was immediately recognized by many of the natives as being occasionally seen about the islands. Usually abundant on the cliffs about Unalaska, especially in severe weather.

56. Falco rusticolus gyrfalco (Linn.). Gyrfalcon.

Falco sacer, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 179; Key, 1890, 532.—ELLIOTT, Mon. Seal Ids, 1882, 128.

Hierofalco gyrfalco, SHARPE, Cat. B. Br. Mus. I, 1874, 416 (part).

Hierofalco gyrfalco sacer, BEAN, Proc. U.S.N.M., 1882, 161.

Falco rusticolus gyrfalco, NELSON, Bds. Alaska, 1887, 146.—A. O. U. Ch. List, 1895, 137.—RIDGWAY, Man. 1896, 246.

Mr. Elliott collected a specimen, the only one he saw. Dr. T. H. Bean collected one that was trying to alight on the vessel while 60 miles east-southeast of St. George. No. 64296, im. o., March, 1873, St. Paul, H. W. E. No. 81398, ♀, September 24, 1880, off St. George, T. H. B. (Length, 21.00; extent, 44.00; wing, 14.00; tail, 9.00; tarsus, 2.37, Dr. T. H. B.).

57. **Falco peregrinus anatum** (Bonap.). Duck Hawk.

Falco communis, Sharpe, Cat. B. Br. Mus. I, 1874, 376 (part).
F[alco] peregrinus, Coues, Key, 1890, 534.
Falco peregrinus anatum, A. O. U. Ch. List, 1895, 138.—Ridgway, Man. 1896, 247.

An early spring and late fall migrant, but some may winter. "Usually seen as a mere dot circling high up in the air, and are sometimes shot by the natives as they come in over the bluffs in bad weather." (*Natives.*) I dug the remains of one from a sand dune; it had been killed the previous December. A large hawk seen on St. George during the summer of 1890 may have been of this species.

Family BUBONIDAE. Horned Owls, etc.

58. **Asio accipitrinus** (Pall.). Short-eared Owl.

Asio accipitrinus, Sharpe, Cat. B. Br. Mus. II, 1875, 334.—Coues, Key, 1890, 507.—A. O. U. Ch. List, 1895, 142.—Ridgway, Man. 1896, 258.

One was seen by Mr. Elliott and myself on the north side of the village hill on St. Paul June 17, 1890. The same or another had been seen by Mr. Elliott up the island in May. This bird often visited the same place during the night or early in the morning to feed upon the least auklets which were breeding in the vicinity. I often found on the moss a round patch of feathers, which showed the fate of a *Choochkie.* A few are seen every winter by the natives, but they all agree that hawks and owls are more abundant on St. George, owing to the presence of numerous lemmings, which are entirely absent from St. Paul. An owl, No. 68348, ♀, is recorded on the Museum catalogue as having been taken by G. R. Adams February 12, 1874. I have been unable to find it.

59. **Nyctea nyctea** (Linn.). Snowy Owl.

Nyctea scandiaca, Sharpe, Cat. B. Br. Mus. II, 1875, 125.—Coues, Key, 1890, 510.
Nyctea nyctea, A. O. U. Ch. List, 1895, 149.—Ridgway, Man. 1896, 264.

Usually seen in winter, but occasionally in summer. One was killed on St. George June 10, 1890, which had been seen repeatedly since and during the previous winter. I killed one on St. Paul on June 13, 1890. One of the Treasury agents shot seven during the winter of 1884–85. Mr. F. A. Lucas saw three during the summer of 1896. June 13, 1890, St. Paul, ad. ♂. Length, 2450; extent, 58.00; wing, 16.25. Stomach contents: full of the flesh and feathers of the least auklet.—(*W. P. and Dr. A. K. F.*)

Order COCCYGES. Cuckoos, etc.

Family CUCULIDAE. Cuckoos, Anis, etc.

60. **Cuculus canorus telephonus** (Heine). Siberian Cuckoo.

Cuculus canorus, Shelly, Cat. B. Br. Mus. XIX, 1891, 245 (part).
Cuculus canorus telephonus, Palmer, Auk, 1894, 325.—Ridgway, Man. 1896, 596.—Bendire, Life Hist. II, 1896, 32.—A. O. U. Ch. List, 1895, 155.

Above, plain bluish-gray, darker across back and on wing coverts, paler on forehead; chin, throat, and chest light ash-gray, darkening on sides of head and neck; under parts, buffy-white with narrow blackish bars; tail, dark bluish-gray, blackening toward tip, each retrix white tipped and white spotted at intervals along shafts, smaller on central and larger on external ones, the basal spotting forming bars; inner edges of rectrices, saw-edged with white; wings, brownish; primaries, white spotted along inner edges; lateral and basal edges of longest upper tail coverts narrowly edged with white with a long white shaft streak; longer under tail coverts irregulary barred with blackish. Bill horny black; base of upper yellowish, of lower greenish; bluish in center; base, yellowish; angle of mouth, orange-yellow; eye ring, bright lemon-yellow; inside of mouth, bright orange-red, lighter toward tip of bill; feet, deep yellowish. Length, 14 inches; extent, 18.25; wing, 8.70; tail, 6.65; culmen, 0.81; tarsus, 0.83. Outer primary, 2.30 less than the third, the longest. Outer retrix, 1.80 less than the longest. Iris, dull yellow. No. 118864, ad. ♂, U.S.N.M., July 4, 1890, St. Paul Island, Bering Sea, W. Palmer.

While becalmed in a fog on June 13, 1890, between Walrus and St. Paul islands, a bird with a long tail and broad wings, short head and neck, circled over us for a short time and then flew northward. On June 30, at Northeast Point, near Cross Hill, I saw what I then thought was a hawk, which was perched on the sand or driftwood, and which now and then flew up and captured flies. The next morning I saw it again, and with a glass determined it to be a cuckoo with bars on the breast, and thus an Asiatic species. As the use of my gun at this point was tabooed, in fact it was locked up because a report might possibly affect the next morning's kill of seals, I was unable to secure it, and consequently returned to the village leaving my prize behind. On July 4, I tramped the weary stretch of 13 miles to the Point, this time with my little .22 cane gun, and after a considerable chase among the grass-grown sand dunes secured the bird by a lucky shot. It had been seen for fully two weeks by the natives stationed there, and was probably the same bird that I saw on June 13, and is the only one of its kind known from North America. Stomach contents: Literally packed with large bottle flies. "This cuckoo contained more than 100 crane flies. Many of these insects were full of dark-brown eggs."—(*S. D. J.*)

Order PASSERES. Perching Birds.

Of this vast order of birds it would appear that but nine species are known from the islands. These belong to five families. Of these, four are common summer residents; the others are only casual or accidental. The four residents thrive exceedingly well in summer, but their powers of endurance (in the cases of three, the other being migratory usually) are sorely tested in the long, dark, and stormy times of winter. Indeed, if it were not for the shelter afforded by the exceedingly rugged rocky crevices in the cliffs and on the surface of much of the islands, and their adaptability as lurking places for abundant insect life, it is doubtful if even these species could hold their own on these exposed and storm-swept shores. In fact, their ranks are often greatly thinned in severe winters. Other casual species may be expected and will undoubtedly be found in time.

Family TURDIDAE. Thrushes, Stonechats, etc.

61. Merula migratoria (Linn.). American Robin. "*Rap-o-loof.*"

Turdus migratorius, Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 172; Key, 1890, 244.—Sharpe, Cat. B. Br. Mus. V, 1885, 220.—Elliott, Mon. Seal Ids. 1882, 127.
Merula migratoria, A. O. U. Ch. List, 1895, 320.—Ridgway, Man. 1896, 577.

The history of this bird on the islands is as follows: "I was most agreeably surprised, one cool morning early in October [1872], while walking upon the village hill, St. Paul Island, to see a robin, a red-breasted robin, silent and gloomy, hopping and fluttering before me. It had evidently been brought to the island by the gale which blew two days previously, and was even now casting about for a good chance to leave. In order that I might observe the length of time this old friend of mine would stay with us I did not shoot him, but strolled out to the locality every morning and evening until the end of the third day, when I missed him. The natives recognized it as a chance visitor, though seen almost every year in this manner."—(*Elliott.*)

Family MOTACILLIDAE. Wagtails.

62. **Anthus pensilvanicus** (Lath.). American Pipit.

Anthus pensylvanicus, SHARPE, Cat. B, Br. Mus. X, 1885, 596.

Anthus ludovicianus, COUES, Key, 1890, 286.

Anthus pensilvanicus, A. O. U. Ch. List, 1895, 289.—RIDGWAY, Man. 1896, 536.—NELSON, Bds. Alaska, 1887, 208.

A specimen of this species is in the collection of the National Museum, which was taken on St. George by Dr. W. H. Dall. They probably occur in small numbers every year. No. 54407, ♂, August 15, 1868, St. George, W. H. D.

Family TROGLODYTIDAE. Wrens, etc.

63. **Anorthura alascensis** Baird. Aleutian Wren. "*Limmershin*"=Chew of tobacco.

Troglodytes alascensis, DALL and BANN. Trans. Chic. Ac. Sci. 1869, 280, Pl. XXX, fig. 3.—BAIRD t. c. 315, Pl. XXX, fig. 3.—NELSON, Bds. Alaska, 1887, 210.—A. O. U. Ch. List, 1895, 301.—RIDGWAY, Man. 1896, 555.

Troglodytes hyemalis var. *alascensis*, DALL, Proc. Cal. Ac. Sci. 1874, 273.

Troglodytes parvulus var. *alascensis*, ALLEN, Bull. N. O. C. II, 1877, 82.

Anorthura troglodytes var. *alascensis*, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 173; Key, 1890, 279.—ELLIOTT, Mon. Seal Ids. 1882, 127.

Anorthura alascensis, NELSON, Cruise, *Corwin*, 1883, 61.—SHARPE, Cat. B. Br. Mus. VI, 1885, 273.

The following extracts are the beginnings of the history of this bird: "A single specimen of a very common bird was obtained at St. Georges Island, Bering Sea. A number were shot but were lost in the luxuriant growth of grass and weeds. It is found all the year round on the island; breeds in May, building a nest of moss in the crevices of the rocks, and, according to the Aleuts, lays six eggs."—(*Dall.*) "This wee bird is not migratory, but remains permanently upon St. George; its nest is built in small, deep holes and crevices of the cliffs. I have not myself seen it, but the natives say that it lays from eight to ten eggs in a nest made of dry grass and feathers, roofed over, with an entrance at the side to the nest chamber, being thus elaborately constructed. The male is exceedingly gay during the period of mating and incubation, flying incessantly from plant to plant or from rock to rock, and singing a rather loud song for a small bird. * * * Although St. Paul Island is but 27 miles to the northwest, as the crow flies, from St. George, not a single specimen of this little wren has been seen there."—(*Elliott.*) The specimen taken by Dr. Dall was made the type of a new species by Professor Baird, and has since been ascertained to inhabit most of the Aleutian Islands. It is fairly common on St. George, but, strange to say, no one has ever seen it on St. Paul. I saw five or six on May 28, near the village of St. George, and secured several at the same place on August 11. Dr. J. A. Allen has described the nest and eggs. (Bull. Nutt. Ornith. Club, Vol. II, 1887, p. 82.) They were collected by a native and forwarded by Mr. W. J. McIntyre. He says: "The nest is quite large and very compactly built, being composed externally of fine moss of a light green color interwoven with fine roots and lined heavily with hair and feathers. Conspicuous among the latter are the rosy-tipped feathers of the *Leucosticte griseinucha*. The hairs are rather coarse and white, 3 to 4 or 5 inches in length, and appear to be hairs of the Polar bear." But two eggs out of a set of twelve were saved. The birds live entirely about the bluffs and even seek their food under the huge bowlders at the bases of the cliffs, where they enter the crevices and, remaining under some minutes, reappear some ten or more feet away. Eggs: "Dull white with a very few minute dots of reddish, so few and small as to be easily overlooked, 0.68 by 0.51, 0.60 by 0.50."—(*Allen.*) No. 54447, im. ♂, Type, August 17, 1868, St. George, W. H. Dall. Length, 3.50; extent, 6.00.

Family HIRUNDINIDAE. Swallows.

64. Hirundo erythrogastra unalaschkensis (Gmelin). Alaskan Swallow.

Hirundo erythrogastra, SHARPE, Cat. B. Br. Mus. X, 1885, 137 (part).
H[*irundo*] *erythrogastra horreorum,* COUES, Key, 1890, 322 (part).
Chelidon erythrogaster, RIDGWAY, Man. 1896, 461 (part).
Chelidon erythrogastra, A. O. U. Ch. List, 1895, 258 (part).

Similar to *H. erythrogastra*, but larger, with longer wings and tail and relatively smaller bill; white areas of tail larger, with narrow white outer edgings to the feathers.

Walking along the bluffs near the village of St. George on May 28, 1890, with Mr. Ed. Lavender, we saw a swallow skimming along the edge of the bluff, catching the flies which the warm sun had enticed from the crevices of the rocks. Shortly afterwards it flew just over my head while among the houses of the village. Drs. Noyes and Hereford, who have each spent more than ten years on the islands, assured me that a swallow was unknown there, but later in the evening I had the opportunity of showing them the bird on another part of the bluff. It remained about the village for nearly two weeks. On June 4, while standing on Black Bluffs, St. Paul, I watched a swallow coming in to the land and then fly northward up the island.

I found a nest at Unalaska, on August 13, containing three large young, a male and two females, and secured the adults also. The nest is of mud held together by grass rootlets. It is 9 inches wide and 4 inches deep; the cavity is 2½ inches in diameter and 1¾ inches deep. Grass rootlets encircle the cavity, which is well-lined with gull and raven feathers. It was built in a large cavity, almost a cave, of a rock on a hillside, and was placed on the slightly sloping face of the back portion, about its center. A slight inequality of the rock face was sufficient to hold it in place. To enter the cavity the birds had to fly to the face of the rock and then dip downward between the rock and many tall plants, which effectually hid the opening. I saw no others.

Family FRINGILLIDAE. Finches, Sparrows, etc.

65. Ammodramus sandwichensis (Gmel.). Sandwich Sparrow.

Passerculus sandwichensis, SHARPE, Cat. B. Br. Mus. XII, 1888, 674 (part).—COUES, Key, 1890, 362.
Ammodramus sandwichensis, A. O. U. Ch. List, 1895, 224.—RIDGWAY, Man. 1896, 408.

On June 3, 1890, in a grassy patch near Lukanin Beach, on St. Paul, I several times flushed a sparrow which I identified as this species, having seen and collected a number several days before at Unalaska.

66. Calcarius lapponicus alascensis Ridgway. Alaskan Longspur. *Karesch-narie Snaguiskie.*

Plectrophanes lapponicus, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint,* 1875, 177.—ELLIOTT, Mon. Seal Ids. 1882, 128.
C[*entrophanes*] *lapponicus,* COUES, Key, 1890, 357.
Calcarius lapponicus, SHARPE, Cat. B. Br. Mus. XII, 1888, 579 (part).—A. O. U. Ch. List, 1895, 221 (part).—RIDGWAY, Man. 1896, 404 (part).
Calcarius lapponicus alascensis RIDGWAY, Auk, 1898, 320.

"An abundant bird on the island in summer but rare or absent in winter. This bird is the vocalist par excellence of the Pribilof group, singing all through the month of June in the most exquisite manner, rising high in the air and hovering on fluttering wings over its setting mate."—(*Elliott.*) And this is certainly true. It could always be found, and its song was a most beautiful variation on the usually monotonous stretches of foot-wearying tundra. The male invariably spends his time in the close vicinity of the setting female but never lends his assistance to the ornithologist in finding the nest. He either sits close by on a little eminence, watching silently, or flies off to a little distance, and when we move follows us for some distance.

No constant differences are noticeable in the sexes of the young of this species in the nestling plumage, like the snowflake; variation in the amount of spotting on the breast and in the general amount of paleness and darkness is noticeable, but it is individual. An immature male, August 15, that I took at Unalaska is acquiring the new teleoptile plumage, a streak of half-grown pale-chestnut feathers having appeared down each side of the neck, and under the nestling feathers of the breast the tips of new feathers can be seen as jet black as in the adult, with rather broad edgings of tawny. Many new feathers can be seen all over the back by lifting the feathers of the nestling plumage. An adult female, July 29, St. Paul, has many new pinfeathers of the new plumage just jutting out from the skin, and easily felt. Nests were found as follows: June 20, 5 eggs; June 21, same; same date, 3 eggs, 2 young; July 2, 6 young, well feathered; July 5, 5 young, just from the nest. The down is very pale, tawny in color, almost white, and is quite long. A bunch is shown in fig. 5, Pl. XL, attached to the nestling feather, and another somewhat separated. At *a* is shown a single ramus with its down attached and the slight swelling between.

The nest is placed on a slight slope, usually under a tall plant, but sometimes on the open tundra where a bunch of dried sedge or grass at its upper side partly or wholly conceals it. It is sunk even with its rim. The female will not leave it until almost stepped upon, and then tries her utmost, by feigning lameless, to entice the intruder away. This undoubtedly works very well with the numerous foxes. Her colors harmonize so well with the surroundings that it is certainly difficult to detect her when on the nest and only a few feet away. The young are to be found by the end of June. Externally the nest is composed of old coarse grass and plant stems, inside of fine grass tops compactly interwoven and lined with a few white and dark small feathers. It measures 4½ inches in diameter, with the opening 2¼ by 1¼ inches deep. The eggs agree well with those from other places—a confusion of faint brownish blotches on a slightly paler base, with a few spots, and irregular, wavy, short lines of dark brown generally about the center of the eggs. My series varies from 0.80 by 0.63 to 0.91 by 0.63. The small young have the bill dark, with the edges yellowish white. In some the tip was yellowish. Feet yellow ocher, with the upper sides darkest. Stomach contents, six species: "These birds were nestlings, and, save one in which there were a few bits of insect cuticle, they contained nothing but pieces of red and black volcanic lava."—(*S. D. J.*)

67. Passerina townsendi (Ridgw.). Pribilof Snowflake, "*Snaguiskie.*"

Plectrophanes nivalis, Dall and Bann., Trans. Chic. Ac. Sci., 1869, 282 (part).—Dall, Proc. Cal. Ac. Sci., 1874, 273.—Coues, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 176; Key, 1890, 356.—Elliott, Mon. Seal Ids., 1875, 128.—Nelson, Bds. Alaska, 1887, 180 (part).

Plectrophenax nivalis, Townsend, Cruise *Corwin*, 1887, 100.—Sharpe, Cat. B., Br. Mus. XII, 1888, 579 (part).

Plectrophenax nivalis townsendi Ridgway, Man., 1887, 1st ed., 405.—A. O. U. Ch. List, 1895, 220.

I have been unable to find any examples of intergradation between this form and the bird inhabiting the adjacent shores of Alaska proper. Its larger size, much longer and larger bill, more extensive whiteness, and more strongly colored larger eggs, give it a distinctiveness which should entitle it to specific rank. It inhabits the Aleutian, Pribilof, and Commander islands.

"The snowbird is another permanent resident of these islands, but one which, unlike the *Leucosticte*, is rather shy and retiring, nesting high on the rocky, broken uplands, and only entering the village during unusually severe or protracted cold weather."—(*Elliott.*)

It is always in sight wherever one goes, either singing its cheery song on the uplands or else flying to the rocky shores at low water, where it often picks up a meal. Ordinarily it utters only a "chir-r-r," but the song of the male is quite striking in its brilliancy, but though louder than the longspur's is hardly as sweet. They sing very early in the morning, about 3 or 4 a. m., and I often heard them while lying in bed. A pair had a nest just behind the house in which I lived, and often on awaking I could have sworn that I heard a white-eyed vireo, so close is the resemblance sometimes to the well-known notes of that bird. Usually, however, it has a higher pitch and is sweeter. They nest commonly under the bowlders which dot the hillsides, the entrance, well worn, being on the southern side and looking more like the entrance to the burrow of a mammal. The nest is placed on the ground, just about an arm's length in, so that it can not be reached by a fox. Some nests are built in crevices, or behind a rock in the face of a cliff, not, however, in those which face the sea, our bird having no such inclination for the surf-swept shores like the *Leucosticte*. "Upon the female the entire labor of the three weeks' incubation required for the hatching of her brood devolves. During this period the male is assiduous in bringing food, and at frequent intervals sings his simple but sweet song, rising, as he begins it, high in the air, as the syklark does, and at the end of the strain drops suddenly to the ground again."—(*Elliott.*)

I have seen a female repeatedly make trips to the lagoon shore, where she picked up dead sea fleas for her young. They are also not averse to the capabilities of the killing grounds to produce food, for the young bred about the village are soon found in those places, the effects soon being visible on their plumage, which becomes extremely dirty beneath. A series of nine young from the nestling to quite long-tailed birds illustrates the changes incident to the nestling plumage. In three, taken June 16 from a nestful of six, the long dusky down[1] is abundant along the sides of the head and along the sides of the back and on the rump. The nestling plumage is covering the body except on the throat and down the center of the breast. This plumage is as follows, and, curiously enough, the females are much the darkest:

Nestling ♂.—Above, mouse gray, obscurely streaked with darkish; beneath, very

[1] This down has received the name of Neossoptiles, given by Dr. Gadow in Newton's Dictionary of Birds, 1893, page 243. To the mature feathers, all that follow, he has applied the name Teleoptiles, but curiously enough he does not distinguish between the really mature feathers—those to which every species ultimately attains—and the nestling plumage, which in many species is so transitory and always intermediate; that is, between the Neossoptile and the first Teleoptile. This so-called nestling plumage, which is always, in point of time and position, between the other two named, may be called the Mesoptile. Thus first we have the Neossoptile, which is usually attached to the tips of the rami of the Mesoptile, and this again as the succeeding growth appears is seen (often) attached to the tips of the rami of the Teleoptile, which sometimes are found entering the umbilicus inferior of the Mesoptile. Thus these feather growths are common to nearly all birds in the order mentioned, are quite different in structure, are variously connected, and differ in their uses and periods of growth and disconnection.

pale yellowish, darkening on throat, which is somewhat streaky; nearly white on abdomen. Tips of primaries and secondaries slightly showing. Wing coverts as far as grown out, about half their length, entirely white; tail just appearing. No. 118964, U.S.N.M. Coll.

Nestling ♀.—Much darker above, with darker streaks; also darker (slaty) and more heavily streaked on the under neck and sides of breast; much less yellowish beneath. No. 118965, U.S.N.M. Coll.

This difference between the sexes is noticeable at a glance at any age of the nestling plumage. As they are growing this difference intensifies, so that the darker slaty-colored females are readily distinguishable from the much paler and tawny males. This color difference also holds good in the sexed specimens of *P. nivalis* that I have seen. But in *nivalis* of similar age there is very much less white on the wing coverts and also on the secondaries, and the bill is smaller.

The nest is quite a cosy affair, about 5 inches in diameter, with an opening of 2½ by 1½ inches deep. It is made of old weathered grass and plant stems, lined inside with some finer grass and an abundance of white gull feathers which entirely cover the inside. A few long black hairs are also added. The eggs are nearly always six in number, sometimes seven. A set taken June 4, 1890, is pale greenish, profusely spotted and blotched at larger end, sparingly at small end, with some small, distinct, very dark wavy lines, and spots. Blotches dark vinaceous. Large space at large end bare of blotches but not of spots. These eggs vary from 0.93 by 0.70 to 0.95 by 0.70 and 0.94 by 0.72. Another set of six, June 24, is creamy with many blotches of dark vinaceous, and brownish generally covering the larger end and to a great extent the smaller. Small place at center of larger end with few blotches or none. A very few very dark wavy lines on nearly all. These eggs vary in size from the smallest, 0.96 by 0.74, to the largest, 1.01 by 0.74. The general color of all these eggs is much darker than in *nivalis*, the blotches are more numerous and darker, and the eggs are decidedly larger. Base of the bill in the immature is bright yellow, with the tip dark; feet dark gray. In the summer adult the bill and feet are black entirely. Stomach contents, seven specimens: "The snow buntings had obtained maggots (fly larvae) from abundant decaying carcasses. They had also eaten midges by the hundreds and crane flies in quantities. Two of the birds had taken seeds, and one a leaf-eating beetle (*Chrysomellidae*)."—(*S. D. J.*)

The following measurements were made to show the range of size, the larger measurement in each group indicating by the plumage that the bird was fully adult, while the smaller shows a bird of the previous summer:[1]

PASSERINA TOWNSENDI.

Cat. number.	Sex.	Date.	Locality.	Collector.	Wing.	Tail.	Culmen.	Tarsus.
118953	♂	June 19, 1890	St. Paul Island	W. Palmer	4.60	3.05	0.47	0.97
64195	♂		St. George Island	H. W. Elliott	4.48	2.80	.49	.91
62410	♂	May 18, 1872	St. Paul Island	do	4.43	2.80	.43	.92
106698	♂	June 12, 1885	Otter Island	C. H. Townsend	4.37	2.60	.49	.88
118950	♂	June 7, 1890	St. Paul Island	W. Palmer	4.27	2.88	.43	.90
64198	♀		St. George Island	H. W. Elliott	4.21	2.54	.45	.93
118959	♀	June 5, 1890	St. Paul Island	W. Palmer	4.20	2.60	.42	.90
106696	♀	June 8, 1885	Otter Island	C. H. Townsend	4.11	2.67	.41	.92
118960	♀	June 20, 1890	St. Paul Island	W. Palmer	4.11	2.57	.45	.90
118957	♀	June 4, 1890	do	do	4.10	2.64	.42	.90

[1] Immature *townsendi*—that is, birds of the previous summer—are larger than the oldest Alaskan specimens of *nivalis*.

PASSERINA NIVALIS.

Cat. number.	Sex.	Date.	Locality.	Collector.	Wing.	Tail.	Culmen.	Tarsus.
88752	♂	May 8, 1882	Point Barrow	J. Murdock	4.48	2.60	0.40	0.87
88751	♂	Apr. 9, 1882	do	do	4.39	2.74	.40	.86
95560	♂	Apr. 24, 1882	Nushagak	C. L. McKay	4.39	2.62	.40	.88
88748	♂	June 18, 1882	Point Barrow	J. Murdock	4.26	2.50	.40	.88
110128	♂	July 3, 1886	Aliaskan Peninsula	J. W. Johnson	4.20	2.70	.41	.87
106069	♀	June, 1885	Cape Lisburne	H. D. Wolfe	4.18	2.52	.40	.87
88754	♀	June 19, 1882	Point Barrow	J. Murdock	4.02	2.65	.42	.88
93111	♀	June 18, 1882	do	do	4.00	2.50	.40	.89
54493	♀	Apr. 30, 1868	Nulato	W. H. Dall	4.00	2.51	.38	.85
93412	♀	June 22, 1883	Point Barrow	J. Murdock	3.90	2.50	.39	.85

68. Acanthis linaria (Linn.). Redpoll.

Acanthis linaria, SHARPE, Cat. B. Br. Mus. XII, 1888, 245.—A. O. U. Ch. List, 1895, 217.—RIDGWAY, Man. 1896, 397.

"*Aegiothii*," ELLIOTT, Mon. Seal Ids. 1882, 136.

Mr. Elliott collected several specimens on St. Paul, June 21, 1872. They were preserved in alcohol, but have not been seen since. He saw others in October, 1872. They doubtless occur as migrants in small flocks.

69. Leucosticte griseonucha (Brandt). Aleutian Rosy Finch "*Patoshkie*."

Leucosticte tephrocotis var. *griseinucha*, COUES, in Elliott's Rpt. Aff. Alaska, 1873; *Reprint*, 1875, 174.—ELLIOTT, Mon. Seal. Ids. 1882, 127.

Leucosticte tephrocotis, HARTING, Fauna Prybilov, 1875, 16.

Leucosticte griseinucha, DALL and BANNISTER, Trans. Chic. Ac. Sci. 1869, 282, Pl. XXIV, fig. 1.—BAIRD, t. c., Pl. XXIV, ibid.—COUES, Key, 1890, 351.

Leucosticte griseonucha, TURNER, Cont. Nat. Hist. Alaska, 1886, 171, Pl. VIII.—NELSON, Bds. Alaska, 1887, 176.—TOWNSEND, Cruise, *Corwin*, 1887, 100.—A. O. U. Ch. List, 1895, 215.—RIDGWAY, Man. 1896, 391.

Montifringilla griseinucha, SHARPE, Cat. B. Br. Mus. XII, 1888, 275.

Dr. Dall collected a number of these birds on St. George in August, 1868. He says: "This beautiful bird had no song at that season except a clear chirp, sounding like 'wéet-a-wéet-a-wee-wéet.' It was on the wing a great part of the time, avoiding lighting on the ground, but darting rapidly in a series of ascending and descending curves, now swinging on the broad top of an umbelliferous plant and now alighting on some ledge of the perpendicular bluff, jumping from point to point, and seemingly delighting in testing their own agility." Unlike the longspur, which is never seen about the houses in summer, and the snowflake, which is not often found at the same place, the *pahtoskie* appears in the greatest abundance about the villages of St. Paul and St. George, and even frequents the houses and streets. "This agreeable little bird, always cheerful and self-possessed, is a regular and permanent settler on the islands, which it never leaves. In the depth of dismal winter, as well as on a summer's day, the pahtoskie greets you with the same pleasant chirrup, wearing the same neat dress, as if determined to make the best of everything."—(*Elliott*.) They love to stay about the bold cliffs, in the chinks and crevices of which they build their rather large nests, and about the rocks of which they obtain the great part of their insect food. I have picked from the mouth of a freshly killed bird the most minute insects, and have watched them feeding on the drying carcass of a seal hanging outside the house of an Aleut, and they do not scorn the possibilities afforded by the decaying seal carcasses on the killing ground. I have seen no specimens of nestlings.

There is no noticeable variation in the immature birds, or, in fact, in the adults. Young birds had up to the end of July completed the growth of the wings and tail, but no new feathers of the winter plumage had appeared. In the young the bill is very dark dusky and in the summer adults it is black. Winter specimens of all ages from other localities have pale-yellowish colored bills, with dark tips. No specimens are at hand showing the change, but as the bills of winter birds (=0.46–0.48–0.50) are much shorter than in summer specimens (=0.51–0.53–0.57), it may be that the change occurs by a molt or renewal of growth. After the young leave the nest they remain about their rocky home for some days and are then taken by their parents to the killing grounds. The nest is quite bulky, 6 inches or more in diameter, made outside of old, coarse grass stems and lined thickly with new, small, and apparently well-chewed clean grass stems and a few white feathers with a little hair. Sometimes a little moss is added to the outside material. The eggs are large, the shell very thin and pinky when fresh; white with a slight gloss in the cabinet. A set is five or six, and they measure from 0.93 by 0.68 to 0.96 by 0.71 and 0.98 by 0.70. Stomach contents, two specimens: "A carabid beetle, crane flies, grass seeds, and fruit skin formed the contents of the stomachs of these birds."—(*S. D. J.*)

RECENT LITERATURE OF THE AVIFAUNA OF THE PRIBILOF ISLANDS.

Quite a number of very important reports dealing with the birds of this region have been issued by various departments of the United States Government; in fact little of importance has been effected by private means. They are the results of the labors and experiences of a number of naturalists who have spent from a season to several years in the region. The specimens, numbering perhaps several thousand, and containing many types and unique and unusual specimens, are in the United States National Museum collection in Washington, instead of being scattered through many widely separated collections, or perhaps lost, as they might have been if more of the pioneer work in this region had been done otherwise than under Government auspices. The wisdom of the late Prof. S. F. Baird, Secretary of the Smithsonian Institution, and of the various Secretaries of the Treasury and other Government officers in assisting and permitting in every way in their power the detailing of naturalists to accompany the various naval and revenue vessels which have had business in those waters, has been many times proved, and the work done in the many branches of science, as shown in the various reports, has certainly justified the undertakings. Our knowledge of the fauna of that region, small as it really is, would be but meager if these opportunities had been neglected. In the following list I have attempted to note all of these papers dealing with the birds and published in recent times. I have noted especially the year in which the work was done, the Department to which the author was attached, and some mention as to the extent of the results. Many of the writers have visited the seal islands for short periods, though few had opportunities for any extended collecting. Such notes as they made were incorporated in general results, and special mention was made in most cases concerning one or more species of Pribilof birds. I have added also a few general works dealing with the waters of Bering Sea. A very full bibliography of Alaskan birds will be found in Mr. Nelson's work of 1887.

GENERAL PAPERS.

1842. J. P. Coinde: Notice sur la fauna ornithologique de l'ile de Saint Paul, suivie de l'énumeration de quelques espéces d'insectes (Coléopteres) des Aleoutiennes et du Kamtschatka. In Revue et Magasin de Zoologie, xii, 1860, 396–405.

Mention of nine species collected on St. Paul by Mr. Warneck. One described as new, *Larus Warneeki*,= *Rissa brevirostris*.

1865–1868. W. H. Dall and H. M. Bannister, of the Russo-American Telegraph Expedition: List of the Birds of Alaska, with Biographical Notes. In Transactions Chicago Academy of Sciences, I, Pt. II, 1869, 267–310.

Notes on 212 species, 8 plates of 16 birds.

S. F. Baird, Smithsonian Institution: On Additions to the Bird Fauna of North America, made by the Scientific Corps of the Russo-American Telegraph Expedition. In Transactions Chicago Academy of Sciences, I, Pt. II, 1869, 311–325.

Critical notes and descriptions of 16 species. Based on Dall and Bannister's collections, as above, with same plates. *Troglodytes alascensis* described as new, from St. George.

[E. Coues], United States Army and Smithsonian Institution: Ornithological Results of the Exploration of the Northwest. In The American Naturalist, IV, 1870, 367–371.

A review of Dall and Bannister's list as above. *Fulmarus rodgersi*, p. 371, second known specimen, noted as from St. George.

1871–72. W. H. Dall, United States Coast Survey: Notes on the Avifauna of the Aleutian Islands, from Unalaska eastward. In Proceedings California Academy of Sciences, V, first series, 1873, 25–35.

Notes on 54 species; some mention of the Pribilofs.

1873. W. H. Dall, United States Coast Survey: Notes on the Avifauna of the Aleutian Islands, especially those west of Unalaska. In Proceedings California Academy of Sciences, V, first series, 1874, 270–281.

Notes on 45 species; some mention of the Pribilofs.

1872–73. H. W. Elliott, United States Treasury Department: Report on the Pribilof Group, or Seal Islands, of Alaska. Appendix. Ornithology of the Pribilof Islands, by Dr. Elliott Coues. Washington, 1873.

Based on Mr. Elliott's collections, with copious notes by Mr. Elliott. *Tringa ptilocnemis* described as new. Forty species mentioned.

H. W. Elliott. A Report upon the Condition of Affairs in the Territory of Alaska, by H. W. Elliott, Washington, 1875. Chapter IX. Ornithology of the Pribilof Islands, by Dr. Coues.

A reprint of above; no new matter.

J. E. Harting, London, England: The Fauna of the Pribilof Islands, etc., abridged from Elliott's report as above. In The Field, London, 1875; also reprinted in pamphlet form, 38 pages, 1 plate.

Based on Elliott's report and Dr. Coues's treatment of the specimens collected.

1872–73–1876. H. W. Elliott, United States Fish Commission, for Census Report of 1880: A Monograph of the Seal Islands of Alaska. Special Bulletin No. 176, U.S.F.C., 1882.

Catalogue of the birds, pp. 125–136. Copious notes on 41 species, and illustrations.

1874–1881. L. M. Turner, Signal Service, U. S. A.: Contributions to the Natural History of Alaska. Arctic Series of Publications, No. II, Signal Service, U. S. A., 1886. Part V, Birds, 115–196, 11 plates, 14 species figured.

Extensive notes on 165 species; some Pribilof mention.

1877–1881. E. W. Nelson, Signal Service, U. S. A.: Report upon Natural History Collections made in Alaska. In Arctic Series of Publications, No. III, Signal Service, U. S. A., 1887, Part 1, Birds of Alaska, 35–226.

Copious notes of 258 species, 12 plates of 21 species; some Pribilof mention.

1880. T. H. Bean, United States Fish Commission: Notes on Birds collected during the summer of 1880 in Alaska and Siberia. In Proceedings United States National Museum, V, 1883, 144-173.

Notes on 77 species, some from the Pribilofs.

1880-81. L. M. Turner, Signal Service, U. S. A.: Notes on the Birds of the Nearer Islands, Alaska. In the Auk, 1885, 154-159.

Notes on 70 species.

1881. E. W. Nelson, Signal Service, U. S. A.: Birds of Bering Sea and the Arctic Ocean. In Cruise of the *Corwin* in Alaska and the Northwestern Arctic Ocean, 1883.

One hundred and ninety-two species mentioned, some from the Pribilofs.

1882. Arthur and Aurel Krause. Beitrag zur Ornithologie von Alaska. Nach den Sammlungen und Noten von Dr. Arthur Krause und Dr. Aurel Krause. In Journal für Ornithologie, 1883, 257-286.

Notes on 83 species, especially *Tringa ptilocnemis*, showing winter habitat.

1882-83. Leonhard Stejneger, United States National Museum: Results of Ornithological Explorations in the Commander Islands and in Kamtschatka, Bulletin No. 29, U.S.N.M., 1885, 1-382, 9 plates.

Critical notes on 142 species; some Pribilof mention.

1884. J. E. Lutz, lieutenant, United States Revenue Marine: In Cruise of the *Corwin*. Report for 1884 (1889).

Mention of 14 species and their eggs; noted on Otter Island during the summer of 1884.

Notes on the Downy Young of the Parrot Auk and the Crested Auk, by Leonhard Stejneger. In Cruise of the *Corwin*, 1889, 2 plates.

Descriptions, based on Lieutenant Lutz's specimens and notes.

1885. C. H. Townsend, United States Fish Commission: Notes on Birds [etc.] between the Aleutian Islands and Kotzebue Sound. In Cruise of the *Corwin* for 1885 (1887), 98-101.

Notes on 49 species; some from the Pribilofs.

1885. C. H. Townsend, United States Fish Commission: Notes on the Natural History of Northern Alaska. In Cruise of the *Corwin* for 1885 (1887), 90-94.

Mention of 58 species, some from the Pribilofs.

The following are short notes of interest relating directly to the birds of the Pribilofs, generally of single species:

W. H. Dall: American Naturalist, VII, 1873, 634.

Note on occurrence of *Tringa crassirostris* = *T. ptilocnemis*.

E. Coues: American Naturalist, VIII, 1874, 500.

Note on *Tringa ptilocnemis*, with description.

H. W. Elliott: A Ton of Birds' Eggs Picked up in an Hour. Am. Sportsman, IV, 1874, 170.

Murres on Walrus Island.

J. E. Harting: On a new Species of *Tringa* from Alaska, Proc. Zool. Soc., Lond., 1874, 243, Pl. XL.

Description of *Tringa gracilis* = *T. ptilocnemis*.

J. A. Allen: Nest and Eggs of the Alaskan Wren. Bull. Natl. Ornith. Club, II, 1877, 82.

Eggs and nest of *Troglodytes alascensis* described.

R. Ridgway: On a new Alaskan Sandpiper. Bull. N. O. C., V, 1880, 160.

Includes description of *Tringa ptilocnemis*.

R. Ridgway: Note on the Anser leucopareius of Brandt. Proc. U.S.N.M., 1885, 22.

Description of *Branta minima*.

R. Ridgway, *Tringa damacensis* (Horsf.) in Alaska: A Sandpiper new to the American Fauna. Auk, 1886, 275.

Mention of *Tringa damacensis* from Otter Island. An addition to North American birds.

R. Ridgway: Manual of North American Birds, 1887, 403.

Description of *Plectrophenax nivalis townsendi* from Otter Island.

W. Palmer: An Asiatic Cuckoo on the Pribilof Islands, Alaska. Auk., 1894, 325.

Note on occurrence of *Cuculus canorus telephonus* on St. Paul Island. An addition to North American birds.

D. G. Elliot: North American Shore Birds, 1895, 72, 235.

Discussion concerning the validity of *Tringa ptilocnemis*.

C. Bendire: Life Histories, II, 1895, 32.

Mention of *Cuculus canorus telephonus* as an American bird.

R. Ridgway: Auk, 1898, 320.

Description of *Calcarius lapponicus alascensis*. Type from St. Paul.

The following popular works contain more or less mention of the birds of the islands and surrounding waters:

Alaska and its Resources, by W. H. Dall, 1870.

Contains list of the birds of Alaska, pp. 580–586.

Our Arctic Province, by H. W. Elliott, 1886.

Bird matter, pp. 208, 225, three illustrations.

The Voyage of the *Vega*, A. E. Nordenskiöld. Translation, 1882.

Popular bird matter concerning the islands of Bering Sea.

Bidrag till kännedomen om Sibiriska Ishafskustens Fogelfauna. In A. E. Nordenskiöld's Vega-Expeditionens Vetenskapliga Iakttagelser, Stockholm, 1887.

Bird matter in vol. 5, eighty species mentioned, with full notes.

A Few Sea-Birds, by H. W. Elliott, in Harper's Magazine, LVIII, 1879, 497, 505.

A popular account of the sea-fowl about the seal islands.

EXPLANATION OF PLATE XXXVIII.

Figs. 1, 2. *Uria troile californica;* as seen on Walrus Island, August 7, 1890.

Fig. 3. *Phalacrocorax urile;* nest of four eggs in situ, with dead adult, June 13, 1890, Walrus Island.

Fig. 4. ——; nest with two eggs and live bird, August 7, 1890, Walrus Island. These pictures show the rugged character of the island surface and shore line.

EXPLANATION OF PLATE XXXIX.

Eggs of the Pacific Murre, *Uria lomvia arra.* Nine specimens selected as typical of *extremes* of color and markings. Nos. 2, 3, 6 represent more nearly the average eggs. Specimens in National Museum collection.

No. 1. White, with but few faint markings; rare, 3.35 by 2.15.

No. 2. The darkest, deep glaucous green, with irregular band of mostly confluent black blotches mixed with some brown; spots black; very common, 3.26 by 2.08.

No. 3. Very pale greenish, many small black and obscure spots; a blotched mass of black covers the larger end, with a few brown blotches; common, 3.10 by 2.03.

No. 4. Uniformly pale greenish; has some wavy and roundish light brown spots; no black; uncommon, 3.37 by 2.08.

No. 5. Dull glaucous green; no spots, but long wavy lines of varying shades of brown; rare, 3.10 by 2.10.

No. 6. Creamy; numerous black and obscure blotches all over; very common, 3.30 by 2.01.

No. 7. Deep glaucous green; few black spots, mostly with light greenish centers; very rare, 3.10 by 1.95.

No. 8. White, nearly equally covered with obscure and a few black spots; no blotches; uncommon, 2.95 by 2.00.

No. 9. White, the smallest of thousands; large light brown or yellowish spots, many obscure; rare, 2.86 by 1.90.

The darker eggs all have much paler areas at their smaller ends than shown in the plate. Those in the lower line do not show, in comparison with the others, as dark as they really are. They are arranged in the plate according to color, beginning with the palest in the upper left-hand corner (fig. 1) and ending with the darkest (fig. 2). These color differences fail to show in the reproduction.

EXPLANATION OF PLATE XL.

Fig. 1. *Tringa ptilocnemis;* a bunch of white-tipped neossoptiles from the back and a single neossoptile from the same bunch.
Fig. 2. ——; one of the unicolored neossoptiles which surrounds the dots.
Fig. 3. ——; a back mesoptile with worn neossoptiles attached.
Fig. 4. ——; the tip of a mesoptile ramus with neossoptile attached and showing the swelling or hatching point between.
Fig. 5. *Calcarius lapponicus alascensis;* a neossoptile bunch attached to the tips of the rami of the growing mesoptile, confined by a part of the sheath remains; also, another mesoptile with somewhat separated neossoptiles and a single one showing the slight swelling.
Fig. 6. *Phalacrocorax urile;* a filoplume from breast of adult.
Fig. 7. ——; a filoplume from neck of immature (June).
Fig. 8. ——; a filoplume from neck of immature, showing a ramus along the rachis; sometimes two or more are found.
Fig. 9. ——; three filoplumes from neck of young about two months old.
Fig. 10. ——; the basal part of a fully grown neossoptile, showing the uneven division of the upper part of the calamus into double, triple, etc., parts.
Fig. 11. ——; a part of the calamus of a similar neossoptile bunch, more highly magnified, with one of the parts torn down to show the homogeneous nature of the calamus.
Fig. 12. ——; a bunch of down from a nestling about a week old, showing the bases of the growing rami forming a temporary calamus, which separates as it grows.

EXPLANATION OF PLATE XLI.

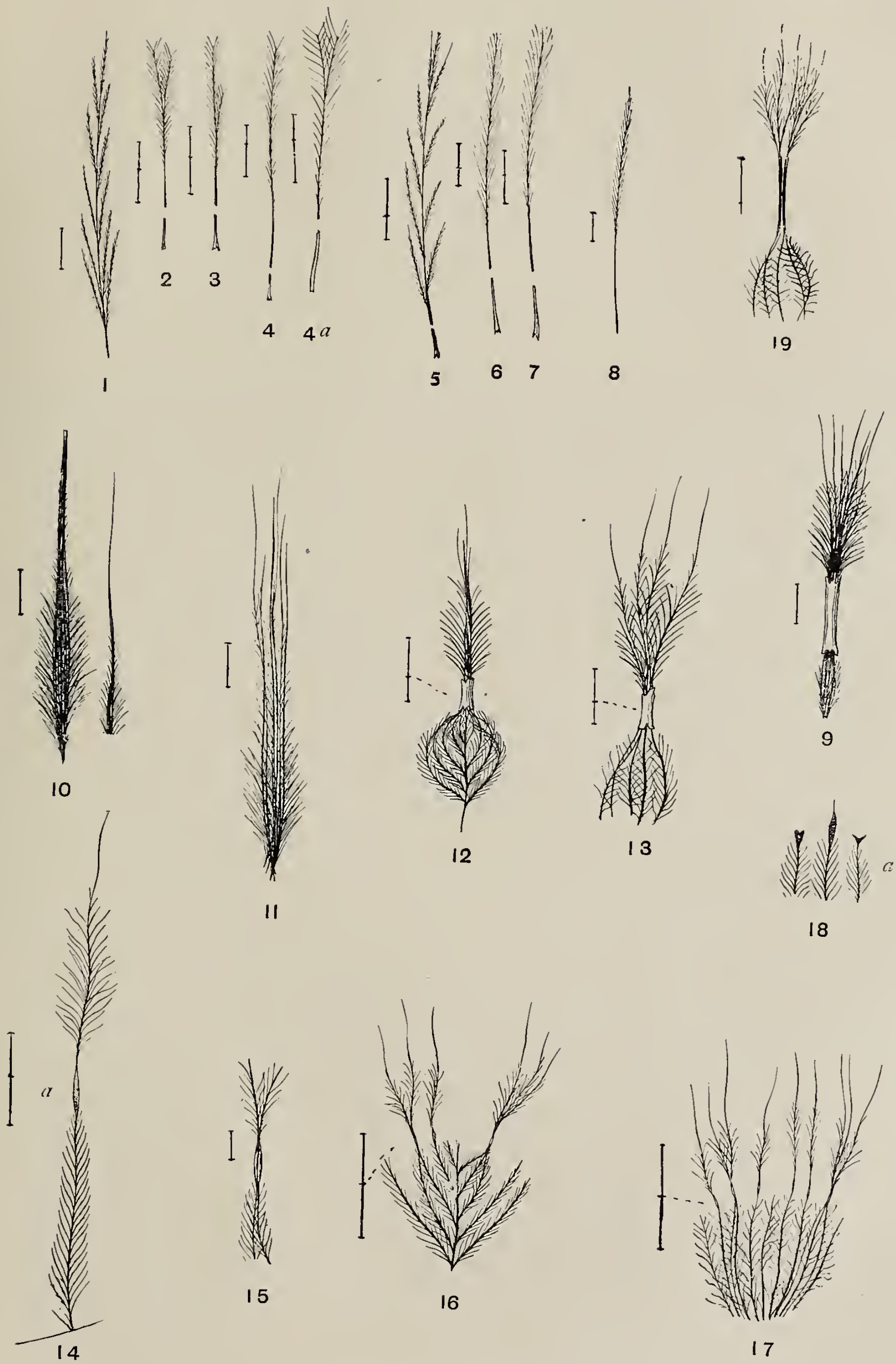
Fig. 1. *Cyclorrhynchus psittaculus;* tip of feather from white eye stripe.
Figs. 2, 3, 4. ——; filoplumes from the nape and face.
Fig. 4*a*. ——; large, worn filoplume from the nape, showing crossing of radii.
Fig. 5. *Simorhynchus pusillus;* tip of white feather from eye stripe.
Figs. 6–7. ——; filoplumes from back and nape.
Fig. 8. ——; white feather from forehead.
Fig. 9. *Uria lomvia arra;* a downy (neossoptile) bunch from the neck of a few-days-old young, still partly inclosed by the sheath remains.
Fig. 10. ——; an unseparated neossoptile bunch and tip of same.
Fig. 11. ——; a bunch partly separated.
Fig. 12. ——; a bunch attached to the rami of a nestling back feather (mesoptile), but held by the persistent remains of the sheath.
Fig. 13. ——; a similar bunch with part of the rami of a breast feather, the mesoptile rami being longer than on the back.
Fig. 14. ——; a mesoptile ramus with the neossoptile attached and showing the swelling between at *a*.
Fig. 15. ——; bases of two neossoptiles and the tips of two mesoptile rami longitudinally adhering—a common effect.
Figs. 16–17. ——; tips of a back and a breast mesoptile with many of the neossoptiles attached.
Fig. 18. ——; shows the point of breakage of the neossoptile rachis, usually below the swelling, but sometimes above, rarely central; also one double-tipped—rare.
Fig. 19. ——; a belly mesoptile with neossoptiles, showing double and long connection.

VIEWS ON WALRUS ISLAND.

From photographs by William Palmer.

EGGS OF THE PACIFIC MURRE, *Uria lomvia arra*, SHOWING VARIATION IN MARKINGS.

DEVELOPMENT OF FEATHERS.



DEVELOPMENT OF FEATHERS.

XVIII.—THE FISHES OF BERING SEA.

By David Starr Jordan and Charles Henry Gilbert.

The fishes of Bering Sea were first studied by George Wilhelm Steller, naturalist of Bering's Sea voyage of 1741, and by Stephan Krascheninnikof, another able naturalist, likewise connected with the great exploring expeditions of the Commander Vitus Bering. Steller died in 1745 and Krascheninnikof about 1750, and the observations of both men were printed posthumously by others.

The manuscript notes of Steller were published in part by Tilesius, Pallas, and others, 1809 to 1811, and a portion of them appear in Krascheninnikof's own work, "Description of Kamchatka," which appeared about the time of his death. We have not seen the original of this work, and in the English translations the parts relating to natural history are greatly condensed. Both Steller and Krascheninnikof confined their attention mainly to the salmon and trout of Kamchatka, describing correctly the different species under the Russian names they now bear. In 1792 these vernacular names were taken as scientific designation by Walbaum (Artedi Piscium), the descriptions being copied from Krascheninnikof through Pennant's compilation, all these authors, Pennant, Krascheninnikof, and Steller, being nonbinomial.

Later the fishes of the Aleutian Islands and Kamchatka, as collected by Steller, Merk, Billings, and others, were carefully studied by Tilesius, and especially by Pallas, whose Zoographia Rosso-Asiatica (1811) ranks with the best ichthyological work of the time. Most of the larger fishes of Kamchatka and Unalaska were described by Pallas, and the fuller study of our day shows the comparative accuracy and completeness of his work.

Later explorers brought some material to the museum at Paris, where it was studied by Cuvier and Valenciennes, to the museum at London, and to the collections of the Smithsonian Institution. It is only within the last fifteen years that large collections have been made in Bering Sea. The various collections made by the officers of the revenue cutters and the weather observers have been especially studied by Dr. Tarleton H. Bean, and the rich results of the deep-sea dredging of the *Albatross* have been described by Dr. Gilbert and Dr. Bean, while Dr. Bean and his brother, Barton A. Bean, have placed on record the collections of Dr. Leonhard Stejneger and Col. Nikolai A. Grebnitzki from Bering Island, Medni Island, and Kamchatka.

In the summer of 1896 the steamer *Albatross*, Capt. Jeff. F. Moser, was assigned to the use of the Commission of Fur Seal Investigation. Under Dr. Jordan's direction collections were made about Unalaska, off Bogoslof Island, off St. George, and off St.

Paul. Other specimens were obtained from tide pools and by hook and line fishing. After the *Albatross* left St. Paul, Captain Moser and Dr. Stejneger, with the assistance of Mr. N. B. Miller, photographer and preparator, made collections by dredge and seine about Petropaulski, off Robben Reef, and among the Kurile Islands and Yeso. The collection thus obtained was especially valuable, as it includes numerous species not seen since the time of Kracheninnikof and Pallas. A small collection of fishes, mostly from Tareinsky Bay, Kamchatka, was received from Mr. Gerald E. H. Barrett-Hamilton, of the British commission. A small collection was also made by the *Albatross* under Dr. Jordan's direction in the Shelikof Straits, off Karluk, in 1897.

On these various collections the present paper is based. For completeness sake reference is made to all species of fishes thus far authentically recorded from Bering Sea. As the synonymy of each of these species is given in Jordan and Evermann's Fishes of Northern and Middle America, it is not repeated here. The new species here described are also included in the latter work, the second part of which was published October 3, 1898, the third, Nov. 26, 1898, both dates being prior to the appearance of the present paper, which was, however, written first.

Family PETROMYZONIDÆ.

1. Lampetra aurea (Bean).

Recorded only from the Yukon River; not seen by us.

2. Entosphenus tridentatus (Gardiner).

Taken by Dr. Gilbert at Unalaska; common southward along the coast. Five specimens were found by Mr. Lucas in the stomach of a fur seal from Bering Sea.

3. Entosphenus camtschaticus (Tilesius).

Tilesius and Pallas briefly describe a lamprey from Kamchatka. It has not been recorded by later writers. It probably belongs to *Entosphenus*, but this is not certain. A larval lamprey obtained by Stejneger in the Paratunka River, near Petropaulski, Kamchatka, is apparently of some species of *Entosphenus*. It can not be distinguished from the larva of *E. tridentatus*, though the adult may show peculiar characters.

Family SQUALIDÆ.

4. Squalus sucklii (Girard). Dogfish.

A single specimen of the dogfish was brought by Stejneger from Bering Island. It is otherwise unknown from Bering Sea. The dried specimen referred to this species by Mr. H. W. Elliott, found by Mr. William Palmer on Zoltoi Sands, St. Paul Island, is a shriveled ray, *Raja parmifera*. The dogfish is said to occur about Kadiak, but we did not find it there. The salmon shark, which is destructive to the salmon at Karluk, is not the dogfish, but *Lamna cornubica*.

Family SOMNIOSIDÆ.

5. Somniosus microcephalus (Bloch). Sleeper shark.

Not uncommon in Bering Sea; not seen by us.

Family RAJIDÆ.

6. Raja parmifera (Bean).

Common in Bering Sea; found by us on the beaches of St. Paul; recorded by Bean from St. Michael and Unalaska.

7. Raja stellulata (Jordan & Gilbert).

An adult female was taken with hook and line on the halibut bank at Dutch Harbor, Unalaska. Length, 21¼ inches. It has been compared with specimens from Alaska, Washington, and California. The median row of spinous bucklers is interrupted along middle of back in our specimen, none being present between shoulders and point opposite base of ventrals. Sides of tail without definite series of differentiated spines, the spinous prickles of the upper surface of tail being somewhat enlarged aterally; no supraocular spines.

Similar specimens were dredged off Karluk in 31 and 110 fathoms.

8. Raja roseispinis Gill and Townsend.

Several specimens taken by the *Albatross* in Bering Sea, the one described as *Raja obtusa* being the young of the other.

9. Raja interrupta Gill and Townsend.

Bering Sea, in deep water.

10. Raja aleutica Gilbert.

Originally described from Sannakh Pass, Aleutian Islands, Albatross station 3257, in 81 fathoms. A second large specimen dredged off Karluk in Shelikof Straits, in 1897, station 3676, in 120 fathoms.

Family CATOSTOMIDÆ.

11. Catostomus catostomus (Forster).

Obtained by Mr. Dall from the Yukon River at Nulato.

Family SYNAPHOBRANCHIDÆ.

12. Histiobranchus bathybius (Günther).

Known from various localities in the Pacific. One specimen recorded by Dr. Gilbert as taken in Bering Sea by the *Albatross*.

Family CLUPEIDÆ.

13. Clupea pallasi Cuvier and Valenciennes. Pacific Herring.

Common in Bering Sea, southward on both shores. Seen by us at Unalaska. Recorded by Dr. Bean from Petropaulski, Unalaska, St. Michaels, and Port Clarence, and by Dr. Gilbert from Unalaska and Herendeen Bay. The original type was from Kamchatka. The species was described from Unalaska under the name of *Spratelloides bryoporus* by Cope.

Family ALEPOCEPHALIDÆ.

14. Ericara salmonea Gill and Townsend.

One large specimen of this remarkable fish is known from the deep waters of Bering Sea.

Family SALMONIDÆ.

15. Coregonus kennicotti Milner.

Described from Fort Good Hope, British America; also recorded from Yukon River at Nulato.

16 **Coregonus quadrilateralis** Richardson.

Recorded by Dr. Bean from Nulato.

17. **Coregonus clupeiformis** (Mitchill).

Recorded from St. Michaels and Nulato by Dr. Bean.

18. **Coregonus nelsoni** Bean.

Described from Nulato; also recorded from Bristol Bay.

19. **Argyrosomus pusillus** Bean.

Recorded from St. Michaels and other localities in northern Alaska.

20. **Argyrosomus laurettæ** Bean.

The original types from Port Clarence and Point Barrow; also recorded from Nulato, Yukon River, and by Dr. Gilbert from Nushagak and Naknek rivers, Bristol Bay.

21. **Argyrosomus alascanus** Scofield. (Plate XLII.)

Described from Point Hope and Grantly Harbor.

22. **Oncorhynchus nerka** (Walbaum). Redfish; *Krasnaja Ryba.* Blue-back.

Recorded from many localities in southern and western Alaska and from Kamchatka; the common salmon of the canners in Alaska. Obtained by us in Captains Harbor, Unalaska, at Karluk, and Bering Island.

23. **Oncorhynchus kisutch** (Walbaum). Silver salmon. Kisutch.

Summer Bay, Unalaska (fresh-water lake), July 3, 1896; Nikolski. Bering Island, July 31, 1896; Karluk, 1897.

From the lake near Summer Bay we have three sizes, probably representing as many years' growth. The smallest are 30 to 60 mm., the second size 110 to 135 mm., the third 200 to 215 mm. Intermediate sizes are of course likely to occur, but the majority of specimens seem to range themselves in these groups. The larger size show the parr marks faintly and much more silvery than the smaller specimens, appearing as though they were recently in from the sea. The black blotch on dorsal followed by the sharply contrasting white posterior rays forms a very conspicuous mark in advanced stages. The adipose fin is black margined. Coarse black spots or blotches are present along the back in the very young, in addition to the parr marks. They are soon replaced by the finer spots of the adult. Very young specimens have a whitish anterior margin to dorsal and anal fins, followed by a blackish intramarginal band, and the anterior rays may be produced. Common at Unalaska, the young abounding in the sea and lakes. The dorsal fin largely black in life. The species is recorded by Dr. Bean from various stations in Alaska.

24. **Oncorhynchus keta** (Walbaum). Dog salmon; Hayko; Calico salmon; Chum salmon.

Seen by us only at Karluk. Found in Bering Sea, but the localities uncertain. It is probably, like the two preceding species, universally diffused, but it is less abundant than either of these. It is not used by the canners, as it is said to "taste like mush" when boiled. It is said to be of fair quality when fresh. It was not taken by Stejneger on Bering Island.

25. **Oncorhynchus tschawytscha** (Walbaum). King salmon; *Tschawytscha; Tsaricha.*

Recorded by Dr. Bean from Yukon River, and by Dr. Gilbert from Unalaska and from the Nushagak River, Bristol Bay; not seen in the summer of 1896, except at

Karluk. It is widely distributed in Bering Sea, but in relatively small numbers. Although superior in quality to the other species and much larger, it is not abundant enough to be of much value to the canner. Not seen by Stejneger on Bering Island, but he reports that it is occasionally taken there and on Copper Island mostly in August.

26. Oncorhynchus gorbuscha (Walbaum). Gorbuscha; Humpback salmon.

Common in Bering Sea; seen by us at Karluk. Two adult specimens from Petropaulski Harbor. The young common in the salt lagoon on St. Paul. Recorded by Dr. Steindachner from Decastris Bay, by Dr. Bean from Plover Bay, and by Stejneger from Bering Island.

27. Salmo mykiss Walbaum. Mykiss; Somka; Kamchatka salmon-trout. (Plate XLIII.)

By an unfortunate error, the writers have heretofore used the name *Salmo mykiss* for the Cut-Throat trout of the Northwest. It was known that the Cut-Throat was the only true or black-spotted trout in Alaska, and it was assumed that its range extended along the coast to all streams in Bering Sea. But our recent explorations have shown that it probably does not occur in Bering Sea, nor is there any undoubted record to the north of Wrangel. If it reaches Kadiak, or Sitka, or Prince William sound, it is only rarely, and the streams of the Aleutian Islands and the east coast of Bering Sea contain no species of *Salmo*. The name *Salmo mykiss* must therefore be restricted to the Kamchatkan species, while the species of the American rivers heretofore called *Salmo mykiss* must be *Salmo clarki*.

We have therefore studied with great interest a specimen of the genuine *Salmo mykiss*, the first on record since the times of Pallas, Krascheninnikof, and Steller. The specimen, an adult male 960 mm. long, was taken by Dr. Leonhard Stejneger, September 15, 1897, in the Kalakhtyrka River, near Petropaulski, Kamchatka. It was called "sonka" or "somka" by the natives. It is said to occur rarely and to be found in but few rivers, the Kalakhtyrka among them. It is considered to be superior as food to other Salmonidæ, except the king salmon (*O. tschawytscha*).

Head, 4 inches in length; depth, $4\frac{1}{4}$. D. 11. A. 10 (developed rays). Scales, 24–125. Mouth, large, the maxillary $1\frac{1}{5}$ in head, being somewhat produced at the top. Vomerine teeth, few, evidently deciduous, only three being present. Eye, $8\frac{1}{2}$ in head; snout, $2\frac{2}{3}$. Pectoral, 2 in head, longest anal ray, $2\frac{2}{7}$. Anal fin high and somewhat falcate; ventrals inserted under anterior third of dorsal, reaching about halfway to vent. Adipose fin over posterior end of anal. Caudal lunate.

Color, dark grayish above, sides silvery; a few small, faint, round, black spots on back and on top of head, these sparse and obscure; a few faint spots on base of dorsal, and some on adipose dorsal. Spots on caudal small, but distinct, especially in middle of fin.

No trace of red at throat in example preserved in formalin and doubtless none in life. The specimen is now a half skin, in good condition.

The following measurements were taken from the fresh specimen by Dr. Stejneger:

	mm.
Total length	960
Total length without caudal	853
Head	215
Tip of nose to anterior end of dorsal	400
Length of base of dorsal	100
Posterior end of dorsal to anterior end of adipose fin	167

	mm.
Length of base of adipose fin	17
Posterior end of adipose to caudal	81
Posterior end of anal to caudal	81
Length of base of anal	71
Anterior end of anal to posterior of ventrals	165
Height of body in front of dorsal	195
Height of body at posterior end of adipose and anal	105
Height of body at beginning of caudal	77

Ventrals under anterior third of dorsal.
Adipose fin over posterior end of anal.
Ventrals reach about one-half distance to vent.
Twenty-four scales in transverse series from origin of dorsal to lateral line.
One hundred and twenty-five scales in lateral line.
Color, silvery, gray on back, black spots obsolete.

This species is evidently a close ally of the Atlantic salmon, belonging to the restricted subgenus *Salmo*; from *Salmo salar* it differs in the slightly larger mouth and rather different coloration, and in very little else.

The names *Salmo mykiss* Walbaum, *Salmo penshinensis* Pallas, and *Salmo purpuratus* Pallas, belong to this species.

28. **Salvelinus malma** (Walbaum). Golet; "Salmon trout." (Plate XLIV.)

Everywhere very abundant in fresh-water streams and along the beaches. Pyramid Creek, Captains Harbor, Unalaska, Nikolski, Bering Island, Karluk, Petropaulski.

In all these specimens the head is short ($4\frac{1}{4}$ to $4\frac{1}{2}$ in length) as compared with specimens from farther south (head, $3\frac{3}{5}$ to $3\frac{3}{4}$). The latter may be possibly recognizable as a distinct subspecies, *Salvelinus malma parkei* (Suckley). We have not at hand, however, sufficient material to determine this point.

The species is very common along the Aleutian Islands, as also on Bering Island, where many specimens were seen. Specimens taken above the fall in Pyramid Creek, a little tributary of Captains Harbor, Unalaska, are very small—not over 5 inches long—and brightly colored. They are not otherwise different.

29. **Salvelinus kundscha** (Pallas). Kundscha. (Plate XLV.)

Kundscha, Krascheninnikof, Descr. Kamtch., 1745.
Salmo kundscha, Pallas, Iter. App., 706.
Salmo kundscha, Gmelin, Syst. Nat., 1788.
Salmo leucomaenis, Pallas, Zoogr. Rosso. Asiat., III, northern and eastern shores of Kamchatka. Günther Cat., VI, 145.—Brevoort, Narr. Exped. to China and Japan, 276, Pl. X, fig. 3.
Salvelinus leucomænis, Bean, Proc. U. S. Nat. Mus. 1896, XIX, 382.
Salmo curilus, Pallas, Zoogr. Rosso. Asiat., III, 251, 1811, Kurile Islands.

One specimen taken by Mr. Barrett-Hamilton at Petropaulski. It has also been recorded by Dr. Bean as *Salmo leucomænis*, from Petropaulski, where it was taken by Stejneger and Grebnitzki. This interesting species is well known in Kamchatka, and its distinction from *Salvelinus malma* is very evident.

One specimen, about 14 inches long, collected at Petropaulski by Barrett-Hamilton agrees with Bean's description above cited, except in the longer head, which is contained $4\frac{1}{7}$ times in length to base of caudal. We present a figure of this specimen.

30. **Cristivomer namaycush** (Walbaum).

Recorded from the Yukon region.

Family THYMALLIDÆ.

31. Thymallus signifer Richardson.

Recorded by Dr. Bean from Nulato and St. Michael.

Family ARGENTINIDÆ.

32. Mallotus villosus (Müller). Capelin.

Two females were taken at Captains Harbor, Unalaska, where it is common. The young were very abundant around the island and were marked by their translucent body, pointed snout, and very long adipose fin. Great numbers were seen at Sitka at the end of September running on the shore at high tide and dying there.

It is recorded by Dr. Bean from St. Michael, Cape Lisburne, Point Belcher, and Plover Bay, and by Stejneger from Bering Island.

33. Thaleichthys pacificus Richardson. Eulachon; Candlefish.

Recorded from Nushagah River by Dr. Gilbert.

34. Osmerus albatrossis Jordan and Gilbert. Kadiak smelt: New species. (Plate XLVI.)

Length, 8 inches; head, $4\frac{4}{5}$ in length; depth, $5\frac{1}{2}$; dorsal rays, 2–10; anal, 1–20; scales, 75; maxillary, $2\frac{1}{10}$ in head; eye, $5\frac{1}{4}$; snout, $3\frac{4}{5}$; mandible, 2; pectorals, $1\frac{1}{2}$; ventrals, $1\frac{2}{5}$; dorsal, $1\frac{2}{5}$; base of anal as long as head; caudal, $1\frac{2}{5}$.

Body elongate, moderately compressed. Back elevated at nape, so that anterior profile is somewhat depressed between and behind eyes. Interorbital space $3\frac{2}{3}$ of head. Mouth large; lower jaw heavy, strongly projecting. Opercle with concentric striæ. Pectorals moderate. Ventrals long. Dorsal high. Anal fin low, very long; its longest ray $2\frac{2}{5}$ in head. Caudal moderate, well forked. Ventrals inserted before dorsal. Scales small, deciduous; those on back still smaller. Lateral line distinct. Gill rakers long and slender, about 12 below angle of arch; longest about as long as eye. Tongue with moderate teeth, the anterior two to four small hooked canines. Upper jaw with small sharp teeth similar to those in lower jaw, none of them canine-like. Small teeth on palatines and pterygoids. Vomer with two very small canines scarcely fang-like. Color bluish above with bright reflections. Scales margined with dark points. Sides silvery with golden and coppery luster. Inside of gill openings dusky. Fins white, somewhat dotted.

Two specimens caught in the upward haul of a dredge in Shelikof Straits, north of Karluk, Kadiak Island, Alaska, Albatross station No. 3675. The depth of the dredge haul was 109 fathoms, but these fishes were no doubt taken from near the surface. One specimen is 8, the other about 7 inches in length.

The species is allied to *Osmerus dentex*, the rainbow smelt, but differs in the extremely long anal and in the very weak vomerine and lingual canines.

35. Osmerus dentex Steindachner. Rainbow smelt.

One specimen from Petropaulski. Head, $4\frac{2}{7}$; depth, $4\frac{9}{10}$; dorsal, 1, 10; anal, 1, 14; lateral line, 68. It seems not to differ from Alaskan specimens.

It was also obtained at Petropaulski by Stejneger and Grebnitzki. It is found on the east shore of Bering Sea from Bristol Bay northward.

Originally described from Decastris Bay. It has been recorded by Dr. Bean from St. Michael and Port Clarence, and by Dr. Gilbert from Naknek and Nushagak rivers, and in Bristol Bay.

36. Osmerus thaleichthys Ayres.

Several young specimens from Nushagak River were referred to this species by Dr. Gilbert. There is no other record of it from Alaska, and these northern examples may prove distinct from the Californian species.

37. Mesopus olidus (Pallas).

Petropaulski Harbor, Shana Bay, Iturup Island. Also recorded from Petropaulski by Stejneger.

The posterior insertion of the ventral fins has been exaggerated in this genus. Instead of being below or posterior to the middle of the dorsal, we find it approximately under front of dorsal, varying from slightly in advance of this point in the young to slightly behind in the adults.

Specimens from the two localities given above differ somewhat from each other in length of dorsal and in scale formula. Those from Petropaulski have 65 to 67 scales, and 9 or 10 developed rays in the dorsal; from Iturup Island, 57 to 60 scales, and 8 or 9 rays in the dorsal. We do not venture to separate the two lots on the basis of our limited material, although the distinctive characters are constant in about 20 specimens of each. In *M. oligodon* Kner (=*M. olidus*) from Decastris Bay there are said to be about 60 scales, but the figure of Kner shows 68. Representatives of this species from St. Michael, Alaska, are reported as having 56 to 60 scales, thus agreeing with those from Iturup. In the former, however, the paired fins appear to be longer. *M. pretiosus* from southeastern Alaska and Puget Sound differs from *M. olidus* from Petropaulski no more than the latter do from Iturup or St. Michael specimens here called *M. olidus*. It seems probable that we are dealing either with one species or with three or four.

The generic name *Mesopus* was regularly proposed, the genus characterized, and type specified on page 14, Proceedings Academy Natural Science, Philadelphia, 1862. On the following page, in a key to the genera, there appears in its place the name *Hypomesus*. In the index to the volume the name *Mesopus* alone appears. There is nothing in the article to indicate which of the names was the final choice of the author. Even were that evident, we consider it safer to conform strictly to the law of priority without permitting any exceptions.

38. Leuroglossus stilbius Gilbert.

Recorded from near Unalaska in 351 to 406 fathoms.

39. Therobromus callorhini Lucas, new species. Seal fish. (Plate XLVII.)

Among the fishes obtained from the stomachs of fur seals by Messrs. Townsend and Alexander were many examples of an undescribed isospondylous fish related to the Argentinidæ, although possibly representing a new family. For this species the name *Therobromus callorhini* is proposed, from the fact that it is so extensively eaten by the fur seal. Owing to the tenderness and small size of this fish, it is so quickly acted on by the gastric juice that nothing but bones remained of the many hundred specimens that were seen and while evidently common, it can be described only from the skeleton. No example of *Argentina* being available it can only be said that *Therobromus* differs from that genus in the shape and proportions of the component bones of the jaw and gill covers, and that it finds its nearest relative in *Mesopus*, from which it may be readily distinguished by its cranial characters as well as by the small number of vertebrae, 26, 22 as against 32, 22.

The species may be diagnosed as follows: Chondrocranium well developed; superior maxillary edentulous; pointed teeth on vomer and anterior portion of palatines; lower jaw very deep; pointed teeth on dentary; articular well developed. Vertebral formula 26 precaudals, 22 caudals, plus 1 hypural; last 4 precaudals with short, wide hypapophyses; other hypapophyses long; neural spines of first 22 vertebræ double, remainder confluent; an epineural present and confluent with basal part of neurapophysis on many of the anterior vertebræ; short transverse processes, directed downward from lower part of anterior vertebræ. Vertebræ simple; anterior but very little shorter than the posterior; centra not sculptured, but bearing many fine longitudinal ridges.

Total length of fish, 3½ to 4½ inches. The seal fish, as it may well be called, from the large numbers eaten by the fur seal, has been found in the stomachs of seals taken between latitude 54° 43′ N. to 55° 29′ N. and longitude 167° 41′ W. to 170° 53′ W. Seals taken on August 20, in the vicinity of 55° 24′ N., 167° 49′ W., contained large numbers of this little fish, and it was abundant September 1 to 15, in 55° 29′ N., 170° 26′ W. As these localities lie outside the 100-fathom line, it would seem that *Therobromus* inhabits the open sea, but swims near the surface. (F. A. Lucas.)

Details of structure are shown on Plate XLVII.

Explanation of abbreviations on plate showing details of structure.

Art	Articular.	*Pop*	Preoperculum.
Den	Dentary.	*Prf*	Prefrontal.
Hy	Hyoid.	*PT*	Post temporal.
Hym	Hyomandibular.	*Ptf*	Post frontal.
Iop	Interoperculum.	*Pto*	Pterotic.
Mx	Maxillary.	*Qu*	Quadrate.
Na	Nasal.	*SO*	Supra-occipital.
Op	Operculum.	*Vo*	Vomer.
Pal	Palatine.		

Family MICROSTOMATIDÆ.

40. Bathylagus borealis Gilbert.

From Bering Sea, north of Unalaska, Albatross station 3,027, in 322 fathoms.

Family MYCTOPHIDÆ.

41. Nannobrachium leucopsarum (Eigenmann and Eigenmann).

Recorded by Dr. Gilbert from Bering Sea, near Unalaska, in 225 to 1,625 fathoms. The original locality was the Cortez Banks, near San Diego.

42. Nannobrachium nannochir (Gilbert).

Found in the North Pacific and Bering Sea in many localities in 313 to 1,625 fathoms. The original type came from the Santa Barbara Channel.

Family CHAULIODONTIDÆ.

43. Cyclothone microdon (Günther).

One specimen from station 3634, off Bogoslof Island, in 664 fathoms. The species is widely diffused through the North Atlantic and Pacific. Dr. Gilbert records it from off the Pribilof Islands in 1,033 and 1,625 fathoms.

Family PLAGYODONTIDÆ.

44. Plagyodus æsculapius (Bean).

A specimen $4\frac{1}{2}$ feet long came ashore at Summer Harbor, Unalaska, August 29, and was taken alive by James G. Blaine, United States Marshal at Unalaska, who has presented it to the United States National Museum. Another specimen ran ashore alive at Unalaska the preceding year. The species is said to be common in that locality. The following is a description of the specimen when fresh:

Head, $6\frac{1}{4}$; depth, 13; D., 40; A., 16: V. I., 8; P., 13 or 14. Length of longest dorsal ray, $5\frac{1}{6}$ in body; pectoral, $1\frac{1}{12}$ in head; ventral, $3\frac{1}{3}$ in head; longest ray of anal, $2\frac{1}{2}$ in head; maxillary, $1\frac{1}{3}$; snout, $2\frac{1}{3}$; eye, $6\frac{1}{3}$.

Body not much compressed, the flesh somewhat pellucid and gelatinous, covered with thin, smooth, mackerel-like skin. Lateral line beginning anteriorly above level of eye, becoming straight at about two-thirds distance from its origin to ventral, where it gradually rises to a high fleshy keel, black in color, and conspicuous nearly all the way from the ventrals to caudal. Maxillary with many small teeth in an irregular series or narrow band; lower jaw laterally with 11 stout, saw-like teeth turned backward, then with three much longer but similar teeth directed backward, their length about half diameter of eye; a slender canine on each side at tip of lower jaw; then about 8 short, slender, sharp teeth between these and the enlarged lateral teeth already described. Front of vomer with three immense fixed canines as long as eye, two close together in front, one behind them, all sharp, flat, and knife-shaped. Palatines each with a stout compressed canine like those in side of lower jaw; then five broad, close-set, saw-like teeth behind it. Opercles with strong striæ which radiate from the upper anterior corner; these not parallel with the strong subhorizontal striæ of the subopercle. Lower jaw with striæ which radiate from behind.

Eye very large, two sharp, low ridges above it; interorbital space broad and smooth; gill rakers small, few, and sharp; pseudobranchiæ present, a membrane below them joining the first gill arch.

Pectorals long, the first ray broader than the following, strongly serrate on outer edge; first ventral ray with a few distant serrations, mostly confined to basal portion. Ventral fins small, few rayed, inserted at a distance behind the head nearly equal to twice its length. Dorsal much lower than in a specimen from San Luis Obispo County, Cal.,[1] the first ray serrulate inserted just behind gill opening; adipose fin high and long, narrower at the base than above, inserted but little behind middle of anal. Caudal unequal, slightly forked, the upper lobe the longer; caudal peduncle slender, as thick as deep.

Color dusky gray, not silvery anywhere, but with metallic reflections. Fins and lateral keel black; lower side of head whiter; some green shades in eye, and dull blue luster on dorsal fin.

Family STERNOPTYCHIDÆ.

45. Sternoptyx diaphana Lowe.

Four fine specimens found by the schooner *Allen* floating at the surface off Kurile Islands, said to have been with many others killed by the earthquakes. We can not see that these differ from Atlantic specimens.

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[1] Notes on a specimen of *Alepisaurus æsculapius* Bean, from the coast of San Luis Obispo County, Cal. Flora Hartley (Mrs. C. W. Greene), Proc. Cal. Acad. Sci., V, 1895, 49.

Family DALLIIDÆ.

46. Dallia pectoralis Bean. Blackfish.

Common in the rivers and swamps of Alaska; recorded by Dr. Gilbert from Nushagak River. Originally described from St. Michael.

Family SYNAPHOBRANCHIDÆ.

47. Histiobranchus bathybius (Günther).

Recorded by Dr. Gilbert from station 3308 in Bering Sea, 1,625 fathoms.

Family NOTACANTHIDÆ.

48. Macdonaldia challengeri (Vaillant).

One specimen dredged at station 3308, west of the Pribilof Islands, in 1,625 fathoms. The type from off Tokio.

Family AMMODYTIDÆ.

49. Ammodytes personatus Girard. (*Ammodytes alascanus* Cope.)

Numerous specimens were taken at Bering Island. In six specimens the lateral folds count 146 to 159, the dorsal fin 60 to 64, the anal 30 or 31. The single specimen obtained at Unalaska has 183 lateral folds, a number much larger than we have found in any other individual. It agrees in this respect with the type of *A. alascanus*, but probably represents merely extreme variation in this direction. In this specimen the dorsal rays are 61, the anal 31. It does not differ except in number of lateral folds from specimens obtained by the *Albatross* at Makushin Bay, Unalaska, in 1890. In eight of these the folds range in number from 145 to 159. In three specimens the dorsal varies from 61 to 63 and the anal from 30 to 32. Compared with specimens from Puget Sound, the counts average slightly higher. In six individuals from the Sound the dorsal has 58 or 59 rays, the anal 29 to 31. In one specimen the lateral folds are but 136 in number, in the other five ranging from 144 to 158. In these counts all of the folds are given, including the very short ones at the side of the nape.

Dr. Bean records the species from many localities from Kadiak to Plover Bay.

50. Rhynchias septipinnis (Pallas.)

This species, which would seem from the description to be an *Ammodytes* with ventral fins, has not been seen since the original description. It is not certain what it is nor to what family it belongs. It has been made by Professor Gill, the type of a distinct genus, *Rhynchias*.

Family GASTEROSTEIDÆ.

51. Gasterosteus cataphractus (Pallas).

This species is distributed universally along all shores from Bering Sea south to California. When strictly marine it exhibits little variation, but on becoming colonized in fresh water it is subject to more or less important modifications, which are mainly in the same direction, but occur in varying degrees in different localities. Some of these colonies are strictly isolated and would receive recognition were it not that they are extremely variable among themselves and that it seems impossible as yet to devise a scheme which shall present at the same time their relations to the parent form and to the limitless number of other colonies. We have them along the entire range of typical marine *G. cataphractus*, where they seem to present an accompanying series of variant fresh-water groups, which have been in the main independently derived from the marine stock. The amount of divergence which they exhibit from typical *cataphractus* is not geographically progressive. Thus we have in the present collection, from a lake on Medni Island, specimens in which all of the lateral plates are invariably present, though narrow and perfectly smooth, the modification being evident in the reduction of the spines, the pubic plate, and the pectoral fins. On the neighboring island, the fresh-water form develops but 8 plates or less. (See Bean, Proc. U. S. Nat. Mus., 1896, 250.) In San Francisquito Creek at Palo Alto there is an average of 6 plates; in San Gregorio Creek, but a few miles away, there is an average of 20 plates, while other neighboring streams have fully plated specimens only. It seems evident, therefore, that the partially plated form ("*G. microcephalus*") does not possess the characteristics of a subspecies, its divergence from the parent form not being geographically progressive. Still less can we recognize it as a species, the fully plated groups into which it passes being indistinguishable from *G. cataphractus*. Further evidence of complete intergradation of fully plated, partially plated, and wholly naked forms is found in a carefully prepared table by C. Rutter (Proc. Cal. Acad. Sci., 1896, 248). The naked forms are confined to a few streams in southern California, and may be designated *Gasterosteus cataphractus williamsoni*. A larger amount of material and more detailed investigation may ultimately demonstrate the possibility of recognizing among the fresh-water groups of stickle-backs subspecies coextensive in range with the fresh-water faunal areas in which they occur, but this does not seem probable. An apparently similar condition is presented by *G. bispinosus* of the North Atlantic coast of America and *G. aculeatus* of northern Europe. The characters alleged to separate these species from each other and from *G. cataphractus* can not be considered satisfactory. It seems probable that all will be ultimately united under one specific name.

Specimens in the present collection are from Tareinsky, Kamchatka (collected by Mr. Barrett-Hamilton); Nikolski, Bering Island; the Lagoon, St. Paul Island; Summer Harbor, Unalaska; Freshwater Lake, Medni Island.

Among all the collections we note here as elsewhere the great preponderance of females over males. The males can be distinguished at sight by the larger head and longer pectorals. As already noted, the marine specimens exhibit little variation. We note, however, that those from the Kamchatka coast, Bering and St. Paul islands, as compared with those from southeastern Alaska and Puget Sound, exhibit slightly longer heads, longer pectoral fins, deeper sculpturing on the head, and much rougher spination of the plates, which are also deeper. In this they agree with specimens which we have examined from Alaskan coast near Bering Straits. Unalaska specimens agree, however, with the southern form.

52. Pygosteus pungitius (Linnæus).

Petropaulski Harbor, fresh-water lake near Tareinsky Bay. In the specimens from Petropaulski the ventral spines average shorter than in those from the lake, being contained $2\frac{2}{3}$ to 3 times in the head in the former, $2\frac{1}{4}$ to $2\frac{2}{3}$ in the latter. The pubic bone varies greatly in length and in relative width. It is evident that neither bone nor spines are available for subspecific distinction, and the form *brachypoda* should be no longer recognized.

Family BERYCIDÆ.

53. Plectromus lugubris (Gilbert).

One specimen taken from station 3327, north of Unalaska, in 322 fathoms.

Family SCORPÆNIDÆ.

54. Sebastolobus alascanus Bean.

Common in deep waters, 106 to 786 fathoms, from Monterey to Unalaska and Unimak.

55. Sebastolodus altivelis Gilbert.

With the preceding; the type taken south of the peninsula of Alaska in 625 fathoms.

56. Sebastodes introniger Gilbert.

Numerous specimens in 85 to 350 fathoms, recorded by Dr. Gilbert, from about Unalaska.

57. Sebastodes alutus Gilbert.

Numerous specimens taken in 38 to 350 fathoms, recorded by Dr. Gilbert, from the waters about Unalaska, Unimak, and Bristol Bay.

58. Sebastodes aleutianus[1] Jordan and Evermann. New species. (Plate XLVIII.)

Perca variabilis, Pallas, Zoogr. Rosso-Asiat., III, 241, 1811. Aleutian Islands; in part, the supposed adult specimen. No. 8145, Berlin Mus.

Sebastichthys matzubaræ, Jordan, Proc. Ac. Nat. Sci., Phila., 1883, 291. Jordan, Cat. Fish. N. A., 1885, 108. Probably not *Sebastes matzubaræ*, Hilgendorf, Sitzungsb. Ges. Naturf. Freunde, Berlin, 1880, 170.

Head, $2\frac{3}{5}$; depth, 3; D., XIII, 13; A., III, 8; scales, 55. Gill rakers, 4 by 20; maxillary, 2.1 in head; eye, 4; snout, 4; interorbital space, 4; pectoral, $1\frac{3}{5}$; ventral, $1\frac{5}{6}$; third dorsal spine, $3\frac{3}{4}$; soft dorsal rays, $2\frac{1}{3}$; second anal spine, $3\frac{3}{4}$; soft anal rays, 2; caudal, 1.9; longest gill raker, $\frac{1}{2}$ eye.

Body rather deep, back arched, the anterior profile stiff and nearly straight, the top of head broad and flattish. Interorbital space very broad, with a frontal ridge on each side halfway between the median line and the orbital rim, on either side of which the surface is somewhat concave, most concave along median line. Nasal spine sharp. Preocular spine short and sharp. Supraocular ridge low, its spine inconspicuous but present; postocular similar, but larger; tympanic similar, but still larger. Frontal ridge on either side naked, without spine, but with a short, sharp coronal spine behind it and continuous with it under the scales. Occipital ridge sharp, ending in a low spine and sometimes one or two spines on its surface, a low cross-furrow separating it from the short, sharp nuchal spine. A sharp spine on the orbital rim under the eye

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[1] A related species, *Sebastodes caurinus*, was described by Richardson from specimens taken at Sitka. It had been since Richardson's time uncertain for which species this description was intended. On our return from Bering Sea in 1896 considerable collections were made by the revenue cutter *Rush*, under our direction, at Sitka, and Richardson's species was found in abundance. Fortunately it is the same one for which we had in 1880 adopted provisionally the name *caurinus*.

We present herewith (Plate XLIX) a figure of a specimen taken just south of the village of Sitka, the original locality of Richardson's collection.

on base of the suborbital stay, three others on the orbital rim before it, and three on the edge of the preorbital. Post-temporal with two or three spinous points, a sharp spine on the postero-temporal and a flat one on humerus. Opercle with two strong spines diverging, each forming a ridge on the bone. Two spines at junction of subopercle and interopercle. Preopercle with five radiating spines, the second longest, 3½ in eye. Space between occipital spines nearly flat. Posterior nostril twice as large as anterior. Lower jaw with four large mucous pores on each side. Scales rather large, rough-ctenoid, deciduous. Rough scales on middle of maxillary and on almost the whole surface of lower jaw. Tip of lower jaw somewhat projecting, the symphysis thickened. Dorsal spines low, slender. Soft dorsal higher. Second anal spine somewhat shorter than third, the soft rays high. Pectoral rather long, not quite reaching vent, but beyond tips of ventrals. Caudal slightly lunate. Color, plain uniform brick-red, the edge of dorsal, anal, caudal, and ventral blackish. Pectoral without dusky

Sebastodes aleutianus (type), Karluk.

shade. Traces of three dusky shades across cheeks and opercles. Inside of mouth and gill opening coppery red. Peritoneum silvery.

The species is here described from four specimens dredged by the *Albatross* on July 20, 1897, in Shelikof Strait, off Kadiak, Alaska, in 120 fathoms. They are from 1½ to 2¼ feet in length.

The species is nearest *Sebastodes miniatus*, but is well separated from all the other American species by the increased number of cranial spines. It needs comparison only with *Sebastodes matzubaræ* (Hilgendorf), a Japanese species described from Yeso, not known to us. It is evident that this is the red species wrongly identified by Pallas as the adult of his *Perca variabilis*, the type of the latter being the *Epinephelus ciliatus* of Tilesius. One of Pallas's specimens from the Aleutian Islands has been examined by Dr. Jordan and described under the probably erroneous name of *Sebastichthys matzubaræ*.

Specimens probably of this species have been taken in stomachs of four seals in in the Gulf of Alaska. It is said that specimens are occasionally taken with *Sebastodes ciliatus* in the salmon nets about Karluk, on Kadiak Island.

59. **Sebastodes ciliatus** (Tilesius).

The only specimens now known in collections are from Kadiak, where it is reported to be abundant.

60. **Sebastodes taczanowskii** (Steindachner).

One specimen, 16 cm. long, from Shana Bay, Iturup Island (one of the Kuriles). Our specimen agrees well with Steindachner's description of the types which came from northern Japan.

Color warm brown above and on sides, paler brown below; obscure shadings of darker brown on upper part of sides; many scales with basil or central area darker. Opercles with a dusky shade; no dark streaks on head. Fins brown, all except the pectorals, and caudal becoming distinctly black on distal portion. Lining of buccal and gill cavities white, but with a narrow dark streak along each side of floor of mouth anteriorly. Peritoneum brownish-black, uniformly and densely pigmented.

Crown and occiput evenly convex, without spines or ridges. Nasal spines low and strong. A rather wide low preocular ridge, ending in a strong depressed spine. Supraocular ridge nearly obsolete, without spine, its posterior portion evenly scaled over. Preorbital sinuate anteriorly, without spines. Preopercular spines short and strong, flattened, the second and third the largest, directed backward, the fifth represented by a slightly projecting lobe. Opercular spines similar to those on preopercle, the lower the largest. Gill rakers long and slender, 10 + 27, the longest half the orbital diameter.

Head, $3\frac{1}{7}$ in length; depth, $2\frac{9}{10}$. Least depth caudal peduncle, $3\frac{1}{5}$ in head. Eye, $3\frac{1}{2}$ in head; interorbital space, $4\frac{1}{2}$; snout, 4; maxillary, 2. D., XII, I, 14; A., III, 7. Pectorals with 16 rays, of which the lower 7 are simple. Forty-five pores in the lateral line.

Spinous dorsal low, with evenly rounded contour, the fourth, fifth, and sixth spines equal, twice the twelfth, $2\frac{1}{3}$ in head. Longest soft ray of dorsal, $2\frac{1}{4}$ in head. Second anal spine longer and much stronger than third, 2 in head. Caudal slightly emarginate. Pectorals reaching beyond vent, $3\frac{2}{5}$ in length. Ventrals slightly overlapping the vent, equaling distance from tip of snout to upper end of preopercle.

Scales strongly ctenoid, except on cheeks, breast, and fins. Top of head scaled forward to nasal spines. Cheeks, opercles, and preorbitals wholly invested, except the anterior extremity of the latter. Maxillary and mandible with partially embedded cycloid scales. Branchiostegal rays naked, or partially invested. Scales on breast and prepectoral area excessively small. Many small accessory scales on back and sides. Basal half to three-fourths of vertical fins densely scaled. Series of fine scales follow pectoral and ventral rays nearly to their tips.

61. **Sebastodes glaucus** (Hilgendorf).

One specimen, 49 cm. long, from Bering Island. Originally described from Yeso.

The identification is made with some doubt, owing to lack of any detailed description of the type, a dried specimen from Yeso, and to some minor discrepancies between the two. Our specimen has 56 (not 49) tubes in the lateral line, the nasal spine is small, but not properly to be called rudimentary, the dorsal notch seems somewhat deeper, and the second anal spine somewhat shorter. Following is a detailed description of our specimen:

Crown and occiput very broad, more convexly arched than in any other species known to us. Nasal spines low, but strong. Ocular ridge low, evident only above front of eye. Occipital ridges barely evident, evenly scaled over. Top of head otherwise without spines, ridges, or furrows, the even convex curve unbroken. Vertical distance from middle of interorbital space to upper edge of orbit equaling half vertical diameter of orbit. Anterior margin of preorbital with two rounded lobes which do not bear spinous points. Preopercular spines very strong, the upper two closely approximate, the others widely separated. All the spines are sharp pointed, the uppermost very wide at base, the second much narrower, the others short and wide. Upper two spines directed backward, the three lower downward and backward. Opercular spines strong, flat, often bifid or trifid. Spines on adjacent angles of subopercle and interopercle sometimes bifid; behind these on margin of subopercle a few short spinous points. Gill rakers very long and slender, 11+29 in number, the anterior one or two of lower arch tubercular; the longest (22 mm.) more than two-thirds diameter of orbit. Mandible very heavy, the symphysis not produced, the two jaws subequal. Vomerine and palatine patches of teeth extremely narrow.

Head, $3\frac{1}{3}$ in length; depth, $2\frac{3}{4}$. Eye, $4\frac{2}{3}$ in head, $1\frac{1}{5}$ in snout. Interorbital width, $3\frac{2}{5}$ in head. D., XIV, 16; A., III, 8. Lateral line with 56 pores. Highest dorsal spine, $2\frac{1}{3}$ in head; thirteenth spine, $4\frac{2}{5}$; fourteenth spine, $3\frac{2}{3}$; second anal spine, $3\frac{4}{5}$; third anal spine, $3\frac{1}{5}$; longest soft ray of dorsal, $1\frac{9}{10}$.

Fins high, the third to seventh dorsal spines subequal. Caudal very slightly emarginate. Anal spines graduated. Pectorals scarcely reaching vertical from vent, the lower 9 simple, the 10 upper forked. Ventral not reaching vent, two-thirds length of head. Caudal scaled to tip on membranes and rays. Soft dorsal and anal with narrow bands of scales following the rays to or nearly to their tips, the membranes of the first three or four rays in each fin wholly scaled on basal third. Spinous dorsal naked. Pectorals scaled on basal half; ventrals naked. Of the head, the maxillary and mandible, the branchiostegal rays, the anterior and upper half of interopercle and all of preorbital except a minute area along its posterior margin are naked. The body is covered with small weakly ctenoid scales, largely covered over by the extraordinarily developed accessory scales. Scales on breast, belly, and prepectoral area smooth. The naked skin covering bones of head is minutely wrinkled or pappilose.

Color in spirits light brownish on body and fins, with darker shades on lips, gill membranes, opercles, and top of head. It may have been reddish in life. Mouth and gill cavity white. Peritoneum jet black.

We prefer at present not to separate this species from *Sebastodes* on the strength of the increased number of dorsal spines.

Family HEXAGRAMMIDÆ.

62. Hexagrammos stelleri Tilesius.

Hexagrammos asper (Steller) Tilesius, Act. Acad. Petrop. II, 340, 1810.
Labrax hexagrammus Pallas, Zoogr. Rosso-Asiat. III, 284, 1811.
Chiropsis nebulosus Girard, U. S. Pac. R. R. Surv., Fishes, 45.
Chirus trigrammus Cope, Proc. Amer. Philos. Soc., Phila., 1873, 29.
Hexagrammos hexagrammus Jordan and Evermann, Checklist, 434.

Two specimens from Petropaulski; several specimens from Unalaska and Karluk. This species seems much less abundant along the shores of Bering Sea than *H. octogrammus* (*ordinatus*). The Petropaulski specimens give the following data: Dorsal XXII, 21; XXIII, 20; anal 23, 24; pectoral, 20. Cheeks scaled above and behind the suborbital stay, naked in front of and including the stay, except for a small patch of scales immediately below the stay, present in one specimen. Interopercle, subopercle, and opercle naked, except for a small patch of scales on upper part of the latter. Upper lateral line ending under second or fourth spine in one specimen, under tenth or twelfth spine in the other. The fourth extends barely to base of ventrals in one specimen, to opposite end of basal fifth of ventrals in the other. There are 7, 8, or 9 scales in an oblique series between second and third lines, counted near middle of body. The lowermost line forks at a point slightly nearer base than tip of ventrals, its distance from ventrals less than half its distance from vent. Ventrals pointed, extending beyond pectorals and more than halfway to front of anal. The caudal fin is strongly emarginate when closed, becoming truncate when spread. It is scaled on basal half only. Color as usual in the species, the light spots on sides numerous, about as large as pupil. Fins bright reddish or orange, especially on basal half.

Dr. Bean records this species from Kadiak, Unalaska, Atka, St. Michael, and Port Clarence, and Stejneger found it on Bering Island and at Petropaulski.

63. Hexagrammos octogrammus (Pallas). (Plate L.)

Chirus ordinatus Cope, Proc. Amer. Phil. Soc., Phila., 1873, 28.

The commonest shore form of the genus in Bering Sea. Specimens were taken at Unalaska, Petropaulski, Robben Island, and Iturup Island. Dr. Bean records it from Unalaska, and Dr. Stejneger found it on Bering Island and at Petropaulski.

This species is currently known as *H. ordinatus.* We make the identification with *octogrammus* for the following reasons: (a) It occurs abundantly at the type locality for *octogrammus*, and so closely resembles *H. asper* as to often require close scrutiny to separate the two species. According to Pallas, *octogrammus* and *asper* are not considered distinct by the natives and were even confounded by Steller. (b) *Octogrammus* is said to be abundant throughout the Kamchatkan region and the Aleutian Islands. Yet, if not *ordinatus*, it is not to be identified with any known species, and must have escaped the notice of all recent collectors. (c) *Octogrammus* is described as having 19 dorsal spines and 24 anal rays. This is the usual formula for *ordinatus*, while no other species is known to have as few as 19 spines. The only important element in the description of *octogrammus* which fails to apply to *ordinatus* is the squamation of the cheeks. *Octogrammus* is said to have the subocular lamella minutely scaled, while in all species except *H. decagrammus* the suborbital ring as well as the suborbital scale are scaleless. The present species shows some variation in the squamation of the opercles. The lower portion of subopercle is usually naked in our specimens, but is in some of them completely scaled. There may be exceptionally a few scales on adjacent edge of interopercle. We append fin counts in 14 specimens:

Dorsal.	Anal.	Pectoral.	Locality.
XIX, 22	23	18	Shana Bay, Iturup Island.
XIX, 23	24	19	Do.
XIX, 23	24	19	Do.
XIX, 23	24	19	Do.
XIX, 23	24	20	Do.
XIX, 23	25	19	Do.
XX, 22	24	19	Do.
XX, 23	24	19	Do.
XIX, 23	24	18	Petropaulski.
XIX, 24	24	18	Do.
XIX, 24	24	19	Do.
XIX, 24	25	18	Do.
XX, 23	23	18	Do.
XX, 23	23	20	Do.

64. Hexagrammos lagocephalus (Pallas). (Plates LI, LII.)

Hexagrammus decagrammus Bean and Bean, Proc. U. S. Nat. Mus., 1896, 383 (Petropaulski); not of Pallas.

Numerous specimens from Robben Island, one specimen each from Bering and Iturup islands. It is not yet known from the American coasts. It is recorded by Bean and Bean from Petropaulski under the erroneous name of *H. decagrammus*. Young specimens up to 20 cm. in length have the scales all rough ctenoid, as in *H. asper* and *H. octogrammus*. Specimens 30 cm. long have most of the scales smooth, a few along middle of sides still ctenoid. In an adult 54 cm. long all the scales are smooth, those on head and nape partially imbedded.

In shape and general appearance this species much resembles *H. octogrammus*. It has a deep caudal peduncle, a convexly rounded caudal fin, and a rather bluntly rounded snout.

Head, $3\frac{3}{5}$ to 4 in length; depth, $3\frac{2}{5}$ to $3\frac{3}{5}$. D., XX to XXII, 22 to 24; A., 22 to 24; P., 20 to 21. Outer row of teeth enlarged in both upper and lower jaws. Teeth on vomer and front of palatines. Maxillary extending to below middle of eye in adults, $2\frac{1}{3}$ in head ($2\frac{4}{5}$ in young). A small flap above eye, fringed along the margin. No tentacles on nape. Fins high, the spinous dorsal deeply notched, the last spine somewhat longer than the one preceding. In the adult the fifth spine is the longest, nearly half length of head, the third and fourth spines nearly equal to the fifth. From the fifth the spines gradually diminish in height to near the end of the fin, when they become rapidly shortened to form the notch.

Caudal very broad at base, convex at its posterior margin even when the fin is closed. Pectorals broadly rounded, rather short, the longest rays $1\frac{1}{4}$ to $1\frac{1}{5}$ in head, not nearly reaching vertical from vent. Ventral fins $1\frac{2}{3}$ to 2 in head, short and rounded in the young, becoming longer and more pointed in adults. The pectoral and ventral rays are very broad, especially toward their tips, and are much branched. The soft rays of dorsal and anal fins are cleft on terminal fifth, as in other species, the two halves not diverging.

There are five lateral lines on each side, as usual, two dorsal, a median, and two ventral. The upper dorsal line is continued to beyond middle of second dorsal fin, usually ending under the fourteenth or sixteenth rays. The lower dorsal line and the median line are extended to base of caudal. The upper ventral line originates below and in front of the pectoral fin, passes immediately above base of ventral, to which it does not send a separate branch, and terminates opposite middle of anal fin. The lower ventral line is single on breast, forks in advance of middle of ventral fins, the branches passing to base of caudal.

In the young the scales are all ctenoid except those in mid-ventral region, breast, prepectoral area, and sides of head. The snout, subocular ring, suborbital stay, interopercle, and usually the lowermost portion of subopercle, scaleless. Basal half or more of caudal, and basal third of soft dorsal, with the membrane densely scaled. Pectoral basis also densely scaled. Scales on breast not greatly reduced; more than half as large as those on middle of sides. Median lateral line with 110 pores. Eight or 9 scales in an oblique series between median line and the one above it.

Color in most of our specimens a nearly uniform warm brown, lighter on under parts, marked only with irregular, small, black spots and lines, which may extend on the dorsal and pectoral fins. The anals and ventrals are black, the thickened tips of the rays in these and the pectoral fins often white. A large, blackish humeral spot in young specimens, often disappearing in adults. One specimen (Iturup Island) has the upper parts, including dorsal and caudal fins, bright reddish, with some dusky blotches and cloudings, the humeral spot conspicuous. The fin rays are as follows in 12 specimens:

Dorsal.	Anal.	Pectoral.	Dorsal.	Anal.	Pectoral.
XX, 24	22	21	XXII, 23	23	21
XXI, 23	23	20	XXII, 23	23	21
XXII, 22	22	21	XXII, 23	23	21
XXII, 23	22	21	XXII, 23	24	21
XXII, 23	23	20	XXII, 24	23	21
XXII, 23	23	21	XXIII, 23	23	21

For convenience we append a short diagnosis of each of the known species of *Hexagrammos*. It will be noted that all of these, except *H. otakii*, were known to Pallas. *H. otakii* has also been long known to collectors, though but recently distinguished from *H. stelleri* (*H. hexagrammus*). It seems probable that all existing species of *Hexagrammos* are now known to us. There are uniformly five lateral lines on each side in all species of *Hexagrammos*. The second, third, and fifth lines are complete in all, while the first and fourth are variously developed, and offer valuable specific characters.

a. Cheeks and opercles fully invested with cycloid scales, including the area overlying suborbital stay; snout, jaws, preorbital, interopercle, and adjacent portion of preopercle scaleless. Breast and prepectoral area with cycloid scales much less than half the size of those on sides; scales elsewhere ctenoid. Ten or 11 scales in an oblique series between lateral line and the one above it. Upper line of pores extending to or beyond middle of soft dorsal, the fourth line unbranched, extending to opposite middle of anal; lower line branching usually behind middle of ventrals. Membranes of soft dorsal and caudal densely scaled for more than half height of fin. *Two pairs of cutaneous flaps on head,* the usual supraocular pair, less than half diameter of pupil, and a much smaller occipital pair which is present in no other species. Dorsal deeply notched. Caudal emarginate when closed, slightly convex when widely spread. Adults brightly colored, the males with large sky-blue spots, the females with smaller red or orange spots. Young sometimes plain brown, with dark plain humeral spot. D., XXI, 24; A., 24. Sitka,[1] to Monterey. .... H. DECAGRAMMUS.

aa. Cheeks not fully scaled, the area, at least, overlying suborbital stay naked. No flap on occiput.

b. Fourth line of pores short, forking in advance of base of ventrals, the lower branch running to base of ventral fin, where it ends, the upper branch usually short, ending opposite middle of ventrals, rarely longer. Second line reaching middle of second dorsal. Scales very roughly ctenoid, except on breast, prepectoral region, and sides of head. Seven or 8 scales in an oblique series between third lateral line and the one above it. Lower line forked in front of middle of ventral fin. Caudal densely covered with comparatively large scales to behind middle of fin, the scales in single series except on middle rays. Supraorbital flap large, coarsely fringed, equaling or exceeding vertical diameter of eye. Eye very small, $5\frac{1}{2}$ in head in adults. Caudal peduncle deep, its depth greater than length of snout, the caudal fin very broad, rounded behind, even when the fin is closed. Dorsals deeply notched. Adults usually deep brown, with blackish mottlings and more or less distinct traces of radiating streaks around the eye, and a round dusky humeral

[1] Recorded by Dr. Bean from Unalaska; but this record needs verification. It is abundant at Sitka, both the large-spotted (*maculoseriatus*) and small-spotted females (*guttatus*) being present, but no males (*constellatus*) were seen.

spot. Younger specimens are often lighter, resembling *H. stelleri,* with small silvery spots on sides and reddish fins, often showing very conspicuously 7 V-shaped or quadrate blackish blotches at base of dorsal fin, and 5 black radii diverging from eye. The anal fin is usually black in adults, but often shows oblique cross bands in the young. D., XIX or XX, 22 to 24; A., 22 to 25. Kurile Islands to Unalaska .... H. OCTOGRAMMUS.

bb. Fourth line of pores simple, long, passing close to ventral fin.

c. Cheeks and opercles largely naked, a patch of scales on upper portions of cheeks and opercles, and a small patch sometimes present on middle of cheeks. First and fourth lateral lines very short, variable, the first rarely extending beyond middle of spinous dorsal, the fourth to middle of ventrals, rarely beyond. Lower line forked in front of middle of ventrals. Caudal fin narrow, emarginate when closed, less densely scaled than in other species, the scales large, in single series. Commonly 9 scales in an oblique series between third lateral line and the one above it. Scales on sides of head, breast, prepectoral area smooth, elsewhere strongly ctenoid. Dorsal fins less deeply notched. Caudal peduncle narrow, the depth less than length of snout. Supraocular flap small, shorter than diameter of pupil. Color in varying shades of gray and brown or light reddish, blotched, marbled or barred with dusky and usually with numerous round silvery spots nearly as large as pupil. In brightly marked specimens there is a series of quadrate dusky blotches along base of dorsal fin, continued on base of fin, much as in *H. octogrammus.* Like the latter there are radiating dark streaks around the eye, of which the two anterior are the most conspicuous and permanent. No humeral spot. D., XXIII (XXII to XXIV), 19 to 21; A., 23 or 24. Size small. Kamchatka to Puget Sound .... H. STELLERI.

cc. Cheeks and opercles largely sealed; the subocular ring, the region overlying the suborbital stay, and the interopercle alone naked.

d. Supraorbital flap long and slender, densely fringed, its length about equaling vertical diameter of orbit. Scales most cycloid, a band of ctenoid scales often present on post-axillary region. A small patch of teeth often present on front of palatines. First and fourth lateral lines long, usually reaching beyond the middle of soft dorsal and anal. Caudal very broad, rounded posteriorly, even when fin is closed; the membranes covered basally with small scales, those on median membranes in several series. Dorsals very deeply notched. Eight or nine scales in an oblique series between second and third rows of pores. Colors usually bright, but varying through green, brown, and bright red, usually dark green with large round red spots, but extremely variable and sometimes finely mottled. D., XX, 23; A., 22. Bering Island (Bean) to Monterey .... H. SUPERCILIOSUS.

dd Supraorbital flap small, little if at all longer than diameter of pupil.

e Caudal very broad, the posterior margin convex even in closed fin. Scales of moderate size, those on breast more than half as large as those on sides of body. Scales all strongly ctenoid in the young, except on breast, prepectoral region, and sides of head, all becoming smooth in adults. First and fourth lines long, extending beyond middle of dorsal and anal. Fifth line forking in front of middle of ventrals. Eight or 9 scales in an oblique series between second and third rows of pores. Eye small, less than one-fifth length of head in a specimen 23 cm. long. Pectoral and ventral rays wide, appearing dilated at tip, concealed in very thick fin membranes. Ventrals short and broad in the young, not pointed. Color, plain brown or reddish, with dusky mottlings on dorsal region; a large round humeral spot. Fins not conspicuously marked. D., XXII (XX to XXIII), 22 to 24; A., 22 to 24. Size large. Kurile Islands to Bering Island........... H. LAGOCEPHALUS.

ee Caudal narrower, the posterior edge emarginate when fin is closed. Scales smaller than in any other species, those on sides of head and breast minute, nearly uniform, less than one-fourth the size of those on sides of body. Eleven or 12 scales in an oblique series between second and third lines. Scales on mid-ventral region, breast, prepectoral area, and sides of head smooth, all others strongly ctenoid throughout life. First lateral line extending beyond middle of second dorsal.

Fourth line short, not reaching tips of ventrals. Fifth line forking behind middle of ventrals. Eye large, $4\frac{1}{2}$ in head. Supraorbital tentacle very small. Anterior teeth in jaws much enlarged, canine-like. Palatines toothless. Fin membranes thin. Dorsals low, less deeply notched than usual. Color brown, blotched and barred with darker, many of the scales each with a silvery spot. No radiating streaks about eye. Black blotches on dorsal fin corresponding to a similar number on back along base of dorsal. D., XX, 23; A., 21. Size small. Known only from Tokio, Japan .... H. OTAKII.[1]

65. **Hexagrammos superciliosus** (Pallas).

Seen by Dr. Jordan at Captains Harbor, Unalaska, where it is abundant. Recorded by Dr. Bean from Kadiak, Unalaska, and Attu; by Dr. Gilbert from Unalaska, Makushin, and Chernofski harbors, and by Stejneger from Bering Island. *Hexagrammos scaber* Bean from Amchitka and Unalaska is evidently the young of *Hexagrammos superciliosus*. We have examined the types.

66. **Pleurogrammus monopterygius** (Pallas). Atka fish.

Obtained by us at St. Paul, where it is rare. It is common about Atka and Attu, and it is said to be occasionally taken as far east as Belkofski. Recorded by Dr. Bean from Unalaska and Attu. Taken by Stejneger at Saranskaya, Bering Island.

Family COTTIDÆ.

67. **Ulca marmorata** (Bean).

Recorded by Dr. Gilbert from about Unalaska; by Dr. Bean from Sitkalidak Island (near Kadiak).

68. **Hemitropterus cavifrons** Lockington.

Recorded from Kadiak.

69. **Icelus spiniger** Gilbert.

Stations 3643 and 3644, off Povorotnaya, Kamchatka, in 100 and 96 fathoms. Originally described from Bristol Bay and about Unalaska.

Females of this species seem more spinous than males. The spines on supraorbital ridge are higher, the suborbital stay is frequently provided with two low spinous points, and the top and sides of head as well as the bases of the dorsal series of spinous plates may be thickly beset with small prickles.

70. **Icelus bicornis** (Reinhardt).

Recorded from Bristol Bay and stations to the westward, as well as from Greenland and the North Atlantic, if the Pacific species is the same, which is doubtful.

71. **Icelus canaliculatus** Gilbert.

Described from near Unalaska.

72. **Icelus vicinalis** Gilbert.

Described from Bristol Bay.

73. **Icelus euryops** Bean.

Described from Trinity Islands.

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[1] The synonomy of *H. otakii* is as follows:

Hexagrammus otakii Jordan and Starks, Proc. Cal. Acad. Sci. 1895, 800.

Labrax hexagrammus Temminck and Schlegel, Fauna Japonica, 1847, p. 53, Pl. XXIII; not of Pallas.

Chirus hexagrammus Günther, Cat. Fishes Brit. Mus., II, 91 (in part).

Hexagrammus asper Steindachner, Beitr. Fische Japans, IV, 10; not of Steller.

74. Rastrinus scutiger (Bean).

Trinity Islands and westward, south of the Alaskan Peninsula.

75. Icelinus borealis Gilbert.

Described from about Unalaska and from Bristol Bay in deep water, with species of Icelus, etc.

76. Artediellus pacificus Gilbert.

Very common. Stations 3637, 3638, and 3639, off St. Paul Island, in 32, 34, and 27 fathoms; 3643 and 3644, off Povorotnaya, Kamchatka, 100 and 96 fathoms; 3647 and 3648, off Robben Island, in 20 fathoms; station 3674, off Karluk, in 31 fathoms.

Recorded by Dr. Gilbert from Bristol Bay and about Sannak and Unalaska.

Some of these specimens are in better state of preservation and show the head with more pores than could be made out in the types. The top of head is thickly studded with these pores, three or four of which are in the interorbital space. A series of very wide slits along under surface of mandible, continued to base of preopercular spine. The wide slits along edge of preorbital and on cheeks are usually six in number.

ARCHISTES Jordan and Gilbert. New genus.

Head and body compressed. Lateral line armed with a series of spinous plates; a series of smaller similar plates along base of dorsal, widening anteriorly so as to fill the space between dorsal and lateral line, but not extending around front of dorsal to connect with band on the other side. Head naked. Gill membranes broadly united, free from the isthmus. No slit or pore behind last gill. No spines above eye or on vertex. A single gently curved preopercular spine, not forked, and without cusps or processes. A large fringed supraorbital flap; smaller flaps and cirri on occiput, sides of head, and along lateral line. Teeth on jaws, vomer, and palatines. Dorsals continuous, notched between spinous and soft portions. Ventrals I, 3, without setæ. Vent far forward, immediately behind base of ventral fins; male with a long anal papilla.

77. Archistes plumarius Jordan and Gilbert. New species. (Plate LIII.)

A single specimen, 72 mm. long, from Ushishir Island, one of the Kurils.

Head, $3\frac{3}{5}$ in length; depth, 4. Dorsal, X, 23; anal, 18; pectoral, 15 or 16. Anterior portion of head compressed and narrow, with vertical sides, the width at angle of mouth little greater than diameter of orbit. From the ocular region the head widens rapidly backward and downward to preopercular spine, leaving the occiput narrow. The greatest width of head and body is near preopercular spine, and is slightly less than depth of head at occiput. The body is compressed, everywhere much deeper than wide.

Mouth slightly oblique, maxillary reaching slightly beyond vertical from front of pupil, $3\frac{1}{5}$ in head. Eye, $3\frac{1}{2}$ in head. Jaws and vomer with rather wide bands of uniform fine teeth; a small patch on front of palatines. Nasal spines strong, fixed. Preopercular spine strong, simple, directed upward and backward, gently curved. Preopercular margin without further spines or prominences. Opercle thin, without rib or spine. Supraocular rim elevated, projecting above profile of head. Interorbital space narrow, deeply channeled, the sides sloping convexly. Occiput depressed behind the eyes and transversely rounded, rendering the profile somewhat concave.

Posteriorly the occiput rises and is laterally angulated, and is somewhat quadrate, therefore, in cross section. The vertex is without ridges or spines. Supraocular flap as long as eye, lanceolate in form, coarsely fringed along the margins. A pair of broad, deeply cleft flaps near middle of occiput, and a second pair at posterior edge of occiput. A long nasal cirrus, a series of short filaments along margin of preopercle, one on suborbital stay, one near tip of maxillary, a cleft filament near opercular angle, and a series of four filaments along middle of lateral line. Anterior nostrils in a short tube. Gill membranes widely joined across the throat, entirely free from isthmus.

Lateral line rising in a high convex curve anteriorly, the curved and straight portions equal. Along its course is a series of 44 plates, with the upper edge free and spinous. They are large along the curved portion of the line, but diminish rapidly in size posteriorly, the free edge becoming smooth or nearly so. A series of much smaller but similar plates lies along base of dorsal, extending halfway along back of caudal peduncle, widening under anterior half of spinous dorsal to form a band which nearly fills the space between dorsal and lateral line. Skin otherwise entirely naked.

Dorsal beginning a pupil's diameter behind occiput. Spines very slender, the anterior ones highest, each crowned with a membranous flap, which is digitately cleft. The third spine is the longest, half length of head; the last spine about two-fifths the the third and one-half the succeeding short ray. Pectoral rays all simple, the lower thickened with incised membranes, the longest rays reaching vertical from third anal ray. Ventrals narrow, reaching front of anal when declined. Vent immediately behind ventral fins, the long anal papilla reaching front of anal fin when declined.

Color in spirits light grayish olive; a series of five irregular quadrate blotches along the back, usually connected at their lower margins. Middle of sides with dusky marblings, from the lower edge of which a series of seven V-shaped black blotches descend toward lower outline. The dusky marking of sides inclose small round spots of ground color. An oblique dark bar on snout, and a black blotch on lower portion of cheeks. Interopercle and upper branchiostegals with cross series of black spots. Pectoral with a large dark blotch and indistinct crossbars on the rays. Anal crossed by oblique dark bars. Caudal indistinctly crossbarred. Dorsals dusky, without definite pattern. Ventrals plain.

78. **Triglops beani** Gilbert.

Generally common, stations 3635, 3637, and 3639, off St. Paul Island, in 24 to 37 fathoms; station 3646, off Robben Island, in 18 fathoms; station 3674, off Karluk, Kadiak, in 31 fathoms. Recorded by Dr. Gilbert from various localities about the Aleutian Islands. Recorded by Dr. Bean (as *Triglops pingeli*) from Plover Bay, Siberia.

79. **Triglops scepticus** Gilbert.

Recorded from deep water about Sannak and Unalaska

80. **Sternias xenostethus** (Gilbert).

Recorded from deep water north of Unalaska.

81. **Elanura forficata** Gilbert.

Recorded from deep water near Sannak and Unimak.

82. **Melletis papilio** Bean.

Described from a rock pool on St. Paul Island; not found by recent collectors.

83. **Astrolytes fenestralis** Jordan and Gilbert. Shumagin Island (U.S.N.M., No. 23936).

Dr. Bean records *Astrolytes notospilotus* from Unalaska. If the locality is correct, the specimen probably belongs to *A. fenestralis.*

84. **Artedius lateralis** Girard. U.S.N.M., No. 23934, from Unalaska.

No. 38985, from Bering Island, small and in bad condition, seems to be the same, according to Mr. B. A. Bean.

STELGISTRUM Jordan and Gilbert. New genus.

Body formed as in *Hemilepidotus*, which it resembles in appearance but with which it is not closely related. Gill-membranes widely joined across the throat, wholly free from the isthmus. Teeth on jaws and vomer; none on palatines. No slit or pore behind last gill. Upper preopercular spine simple, gently upcurved, three short spines below it. No opercular rib or spine. Nasal spines short and strong. Vertex without spines or ridges and without long tentacles. Spinous dorsal without anterior notch, the vertical fins all few-rayed. A series of plates along lateral line, and a band along the back which merges anteriorly into the mass of minute plates covering top and sides of head. Ventrals I, 3, without setæ. Vent immediately before origin of anal.

85. **Stelgistrum steinegeri** Jordan and Gilbert. New species. (Plate LIV.)

One specimen, 52 mm. long, from station 3645, off Robben Island; depth 10 fathoms.

Head, $2\frac{3}{5}$ in length; depth, $3\frac{1}{5}$. Dorsal, IX, 17; anal, 13; pectoral, 16. Caudal with 9 divided rays. Lateral line with 40 plates. Lower series of dorsal band containing 35 or 38 plates.

Head narrowly wedge-shaped, tapering upward; width below eyes equaling length of snout and half eye; width at preopercles equaling depth at occiput. Mouth large, slightly oblique, the wide maxillary reaching vertical behind pupil, equaling length of snout and eye, half length of head. Teeth small, uniform, in narrow bands on jaws and vomer. Palatines toothless. A deep naked transverse groove between nasal spines and front of orbits. Orbital rims moderately elevated, the interorbital space very narrow, channeled. Occiput flat or slightly concave, angulated along lines running backward from orbits, but without spines or ridges. A slender filament above each eye, two minute pairs along sides of occiput, one on suborbital stay, one on maxillary, and a few on plates of lateral line. No nasal cirri, none along edge of preopercle. Upper preopercular spine gently curved upward, without cusps or processes. Below it three short spines, the first directed backward, the second vertically downward, the third, somewhat longer, directed downward and forward. Eyes small, the diameter equaling length of snout, one-fourth length of head measured to end of opercular flap. Interorbital width equaling diameter of pupil.

Straight portion of lateral line longer than the obliquely placed anterior portion, which is not strongly curved. The plates of lateral line are strongly spinous on their upper free edges, and are similar and of nearly equal size throughout. The dorsal band is continued onto back of caudal peduncle, where it is continuous with the band of the opposite side. The lower plates of the band are in a definite lengthwise series, and are as large as those of lateral line or slightly larger. The other plates of the band decrease rapidly in size toward base of fin, where they are minute. They are partially arranged in series running obliquely upward and backward from the lower larger plates to the bases of the dorsal rays, on which they extend for at least half the height of ray. Dorsal spines with minute spinous plates extending almost or quite to their tips. The snout, top of head, nape, suborbital ring, opercles and cheeks above the suborbital stay covered with minute plates similar to the upper part of dorsal band, with which the invested area on top of head is continuous. Sides below lateral line naked, except for a few plates behind axil.

Dorsals divided to the base, the last spine extremely short, its membrane joining extreme base of the first soft ray. Spinous dorsal low, of slender, weak spines, the longest ray one-third length of head; longest soft ray, $2\frac{1}{4}$ in head. Anal beginning under third ray of soft dorsal, ending under its fourteenth ray. Caudal peduncle slender, its least depth one-third its length. Pectorals broad and short, the rays all simple, the lower thickened with moderately incised membranes, the eighth to the tenth rays the longest, extending beyond vertical from origin of anal. Ventrals not reaching vent, $2\frac{1}{6}$ in head.

Ground color light grayish-olive; lower part of sides regularly reticulated with narrow dusky lines. A dusky crossbar from base of posterior dorsal spines and forward to axil. A second much broader bar from front of soft dorsal, ending irregularly below where it merges into the reticulating lines. A third broad bar, less clearly defined, under posterior portion of soft dorsal. A conspicuous, broad, V-shaped blotch at base of caudal, the apex directed forward. A faint dark streak from eye forward to tip of mandible, and a crossbar behind eyes, continued faintly onto cheeks. Spinous dorsal with a small dark spot on anterior and one on posterior spines. Rays of soft dorsal and caudal with dusky markings so arranged as to form fine crossbars. Terminal half of pectorals finely crossbarred, the proximal half plain, with a large dusky blotch on extreme base. Anal very faintly barred. Ventrals unmarked.

86. Hemilepidotus hemilepidotus (Tilesius).

One specimen from Bering Island; also taken at Sitka.

Although much less abundant in Bering Sea than *Hemilepidotus jordani*, this is the only species which came into the hands of the older writers. The *Cottus trachurus* of Pallas, *Blepsias ventricosus* Eschscholtz, *H. tilesii* Cuvier and Valenciennes, and *H. gibbsi* Gill all belong here. In addition to the striking differences in color, *H. hemilepidotus* is distinguished by the much narrower and deeper interorbital space and the more extensive granulations of the bones of the head in adults. The occipital and temporal ridges are more elevated, the granulations finer, extending onto upper portion of opercle, suborbital ring, and bony bridge across cheeks. The opercular rib and the suborbital stay are smooth or faintly striate in *H. jordani*. The vertical fins are constantly shorter and lower than in *H. jordani*, the formula, D., XI, 19, A., 15, being constant in all specimens examined.

The species is recorded by Dr. Bean from Unga, Unalaska, Kyska, Adakh, Atka, Amchitka, and Attu.

87. Hemilepidotus jordani Bean. Irish Lord.

Very abundant; specimens secured at Captains Harbor, Unalaska, at St. Paul Island, Bering Island, Karluk, Unga, and at Station 3635 off St. George Island; depth, 24 fathoms.

This species is recorded by Dr. Bean from Cooks Inlet, Kadiak, Shumagins, Unalaska, and Plover Bay, Siberia. It was taken by Stejneger on Bering Island.

Characterized by its comparatively plain coloration, the pale parts being largely bright yellow in life; by the wider and shallower interorbital space, the smoother side of the head, and the longer dorsal and anal. All specimens examined have dorsal XI, 21, anal 17. At anterior and posterior ends of occipital ridges are centers around which radiate very coarse broken striæ, contrasting with the finer granulation of *H. hemilepidotus*, which are also disposed in radiating lines. The males differ from females in the great development of all the fins, the higher flaps on head, and the presence of more yellow on jaws and branchiostegal region. The ventrals are dusky in the males, yellow or speckled in the females. The general color of body and upper fins is dull olive, mottled with bluish, the sides of belly often obscurely speckled, the upper parts translucent white in spirits, but largely bright yellow in life.

88. Enophrys claviger (Cuvier and Valenciennes). (Plate LV.)

One specimen, 51 mm. long, from Station 3645, off Robben Island; depth, 10 fathoms. The specimen is entirely similar to the one reported from Bristol Bay by Gilbert, Report Commissioner of Fish and Fisheries, 1896, 426. The latter is also 52 mm. long—not 25, as stated in the text.

Preorbital with two strong, spinous projections, which overlap the premaxillary in closed mouth. Interorbital space deeply channeled, the orbital rim raised posteriorly into a blunt spinous tubercle. A small, spinous, occipital tubercle, behind which rises a high, sharp nuchal ridge, which is highest posteriorly and has its upper edge finely toothed. No cirri on top of head. Upper preopercular spine long, simple, reaching beyond head to fourth or fifth plate of lateral line. Below it are three short, strong spines, the lowermost directed downward and forward. The outer surface of the upper spine contains three or four low, finely serrated ridges. Its inner edge is smooth, without accessory cusps or spinules. Opercular ridge high, serrate. Two sharp spines on anterior angle of subopercle. Top and sides of head rough, with minute spinous points. Preopercle and lower jaw with numerous short filaments; a longer one on end of maxillary.

Body entirely covered with minute prickles, which invest also the abdominal region. Those above lateral line are longest and most thickly placed. Lateral line with a series of plates similar to those in *E. bison*, each surmounted by a sharp spine. Lateral line with two curves approaching back most nearly at end of spinous and at end of soft dorsal. Many conspicuous white filaments scattered over sides below lateral line. Dorsals entirely separate, the free interspace as wide as pupil.

Head, $2\frac{2}{3}$ in length; depth, $3\frac{3}{5}$. Eye larger than interorbital width, $4\frac{3}{4}$ in head. D., VIII-14; A., 12 (11 in previously noted specimen); P., 16; Lateral line with 35 plates.

Dusky above, with faint darker crossbars; light below. Two black blotches on cheeks. Some faint dusky V-shaped prolongations of the coloration of the back down toward base of anal fin. Fins indistinctly cross-banded. A dark area at base of pectoral, a narrow oblique dusky crossbar on base of caudal fin.

89. Ceratocottus diceraus (Pallas). (Plate LVI.)

One specimen from Robben Island, collected by Mr. Barrett-Hamilton, and three young specimens from Petropaulski. Recorded by Dr. Gilbert from Herendeen Bay, and taken by Colonel Grebnitzki on Bering Island and at Petropaulski.

The depth of the occipital depression, the height of the different ridges and spines, and the amount of the irregularity in the cusps of the preopercular spine is subject to great individual variation. We find no important differences between this specimen and those from the Alaskan Peninsnla reported on by Gilbert, Report Commissioner of Fish and Fisheries, 1896, 426. The occipital depression is less and the cross ridge behind it much lower in the adult from Robben Island, the occiput comparatively flat and without cross ridge in the young. We do not venture to base any distinctions on these differences, which may be due in part to age and in part to individual variation.

90. Ceratocottus lucasi[1] new species. (Plate LVII.)

Two specimens 135 and 132 mm. long, one taken from the stomach of a cod, the other from a halibut, both of which were captured near St. Paul Island. The skin is digested off from both specimens, so that the details of color can not be determined, but they are otherwise in good condition.

Differing from *C. diceraus* in the deeper, narrower interorbital groove and the smaller size and different armature of the preopercular spines.

Head $2\frac{1}{5}$ in length, measured to end of opercular flap; depth $3\frac{1}{5}$. D., VII–13; A., 12; P., 17 or 18. Measured into the head, the eye is contained $4\frac{3}{4}$ times, the maxillary $2\frac{1}{2}$, the preopercular spine $2\frac{1}{2}$, the pectoral fin $1\frac{1}{5}$.

The maxillary reaches nearly to the vertical from posterior margin of eye. Villiform teeth on jaws and vomer, the outer series in jaws enlarged; no teeth on palatines. Interorbital space very deeply channeled, its least width three-fifths the diameter of eye. The upper edge of orbital rim is sharp and beset with a single series of small teeth. the occiput is abruptly depressed behind the eyes to below the floor of interorbital space, as in *C. diceraus*. It is nearly flat both transversely and longitudinally, the occiput ridges being very low, and the transverse ridge, so conspicuous at back of occiput in adult *C. diceraus*, is here not developed. The nuchal ridges are high, elevated, and compressed into a minutely serrated edge, a very small cusp-like elevation at their base anteriorly. The nasal and preorbital spines are as in *C. diceraus*. The upper preopercular spines are slender and somewhat decurved toward tips. They are minutely roughened on the outer surface, and bear on their upper edge three retrorsely hooked spines, resembling the spines on a rose bush. Below this are three short, strong spines, the first immediately below the upper spine and diverging from it, the second directed nearly vertically downward, the third downward and forward. Two strong diverging spines at anterior angle of subopercle. Opercular ridge elevated. All exposed bones of head roughened with radiating series of lines which are beset with minute prickles. Lateral line with 36 bony plates decreasing in size posteriorly. Each plate bears small slender spines, those on the middle of plate longer than the others and directed backward.

From fragments of skin left on snout and side of head in one specimen, it is evident that this species is colored much as in *C. diceraus*, the ground color light olive, thickly covered with small dusky spots, around which the ground color forms narrow reticulating lines. When taken the bones of the head were a bright vitriol green.

A fine specimen from Avatcha Bay, Kamchatka (U.S.N.M. No. 48859, L. Stejneger coll. 1897), presents the following color markings:

Blackish-brown on back and sides of head and body, the posterior part of body with three dark bars, one on caudal peduncle, one at beginning and one at end of soft

[1] Since this description was written, other specimens of *Ceratocottus* have come to hand, which make it seem possible that *C. lucasi* is based on the young of *C. diceraus*.

dorsal. In these dark markings can be made out small roundish or polygonal spots of of black, separated by reticulating lighter lines. Under side of head and body whitish, the lower lip dusky; breast minutely black speckled; dorsal mottled light and dark, without definite color pattern; anal whitish, with oblique series alternately of small, roundish spots, and of still smaller dots; caudal with a dark crossbar at base, and two or three more or less irregular ones on outer half; pectorals with a large black area at base, the posterior portion with elongate spots forming ill-defined cross series, the lighter area with smaller dark markings of varying shapes; ventrals whitish, with two or three faint dusky crossbars.

Specimen 117 mm. agreeing well with types. The interorbital is narrow and very deep. There is no cross ridge on occiput; the occipital ridges are very high, compressed, knife-like, with serrulate edge. There are three strong hooks on one preopercular spine, two on the other. Each plate of the lateral line has a central, backwardly directed spine. D., VII-14; A., 12; P., 18; plates 35. Lines of plates converging at interspace between dorsal, then again at end of second dorsal.

91. Gymnocanthus pistilliger (Pallas). (Plate LVIII.)

Petropaulski; station 3646, off Robben Island, 18 fathoms. Recorded by Dr. Gilbert from many specimens from Bristol Bay, and by Dr. Bean from Kyska, Point Belcher, and Cape Tchaplin, Siberia. Mr. Scofield found it at Port Clarence, and Dr. Stejneger on Bering Island and at Petropaulski.

No males are included in the number taken. The females differ from those we have examined from Bristol Bay in having the top of head more extensively plated, the rough plates extending onto middle of interorbital space, or in one specimen onto snout. The preorbital ridges are less regular and have lower tubercles. The specimens indicate an approach therefore in this respect to *G. galeatus*. The fin rays are as previously given. In eight specimens they are as follows:

	Dorsal spines.		Dorsal rays.			Anal rays.	
Number of ray	IX	X	14	15	16	16	17
Number of specimens	1	7	1	6	1	3	5

92. Gymnocanthus galeatus Bean (Plate LIX).

Seined in Captains Harbor, recorded by Dr. Bean from the same waters, and by Dr. Gilbert from Chernofsky, all these localities being about the island of Unalaska. Dr. Bean records it from Unalaska and from Cape Sabine in the Arctic, and Mr. Scofield from Point Barrow.

Many very young specimens, about 35 mm. long, were also collected by Mr. William Palmer on St. Paul Island. In these, the preopercular spine is simply furcate at tip, without trace of the upwardly directed processes characteristic of the adult. The roughened plates on head are also undeveloped. Fin rays are: D., XI, 16; A., 19; P., 20 or 21.

93. Argyrocottus zanderi Herzenstein. (Plate LX.)

Three specimens of this beautifully marked cottoid were taken in Shana Bay, Iturup Island. Originally described from Sakhalin Island.

The branchiostegal membranes are widely joined across the throat, narrowly united in front of the middle line of isthmus, with a rather wide free margin behind. The lateral line is without plates. The nasal spines are small, and there are four short spines on preopercular margin.

Our specimens answer well to the detailed description of the type, but are still more ornate in that they possess along the back a number of broad dark bars alternating with lighter bars, the former confluent below with the ground color of the sides. In our largest specimen, 7 cm. long, the ventral fins extend only to base of third anal ray. There are no tubercles on the rays, and the membranes extend nearly to tips of the two outer rays, and two-thirds length of the inner ray. The ventral spine is slender, nearly as long as the inner ray, and is firmly adnate to outer ray. The smaller specimens are respectively 4 cm. and 3.5 cm. long, the ventrals reaching in one to front of anal, in the other to vent. As will be seen from our drawing the fins are finally crossbarred, more variegated than in the type.

94. **Cottus minutus** Pallas.

Described from Talek Island, Okhotsk Sea; not seen by us.

95. **Cottus aleuticus** Gilbert. (*Uranidea microstoma* Lockington; name preoccupied.)

Abundant in the brooks of Unalaska; also recorded from Departure Bay, Vancouver Island. Recorded by Dr. Bean from Kadiak and Unalaska.

96. **Myoxocephalus nivosus** (Herzenstein). (Plates LXI, LXII.)

Cottus nivosus Herzenstein, Mélanges Biologiques du Bull. Acad. Imp. des Sci., St. Petersb., XIII, 113, 1890 (Olga Bay).

One specimen 39 cm. long, from Iturup Island. D., IX, 15; A., 13, P., 17, lat. l., 33 to 35. Coloration very dark on back and sides, white below with traces of blackish crossbars below the dorsal fins. Along lower part of the sides a number of large roundish white spots, which are present also in a band along base of anal, but become smaller posteriorly and toward middle of sides. Sides of head and body, and especially the dorsal, caudal, and pectoral fins, with scattered small spots of pearly white. Spinous dorsal with large roundish transparent spots, the anal margined with white and marked with scattered white spots of various sizes and shapes. The thickened pectoral rays largely white. Ventrals with three dusky crossbars. Lower lip and mandible with white areas surrounded by dusky reticulations.

Head comparatively deep and compressed, with large mouth, narrow deeply concave interorbital space, and depressed concave occiput, which is bounded by strong lateral crests. At the anterior end of these crests they are each accompanied on the outer side by a short ridge, and on the inner side by a still shorter ridge or a small tubercle. The occipital crests converge strongly toward the nape. Temporal ridges are also strong. A short filament above posterior edge of orbit and one at posterior end of occipital crest, each surmounting a very low tubercle.

Upper preopercular spine straight, directed toward opercular flap, scarcely reaching middle of the opercle, its length two-thirds diameter of orbit. The second spine is three eighths length of upper, directed downward and backward. The third points downward and forward, the long interval between it and the second being smooth, without spine or tubercle. The contiguous angles of subopercle and interopercle are provided with prominences which are not spinelike. Opercle and suprascapula each with a strong ridge ending in a spine. No scapular spine. Nasal spines small, not projecting. Top of head, nape, and suborbital ring with small warts, many of which contain openings of the mucous canals. Both pairs of nostrils with short wide tubes. Jaws and vomer with wide bands of cardiform teeth of equal size. A round pore nearly as large as nostril immediately behind last gill. Gill membranes with a short free border mesially.

D., IX, 15; A., 13; P., 17; pores of lateral line 33 or 35. Head (measured to end of opercular flap) $2\frac{1}{4}$ in length; depth about half head. Least interorbital width three-fifths diameter of orbit, which is one-fifth length of head to tip of opercular spine. Greatest width of head $1\frac{1}{5}$ in its length. Mouth large, the lower jaw included, the maxillary reaching the vertical immediately behind the orbit; its length $2\frac{2}{5}$ in head.

Third, fourth, and fifth dorsal spines nearly equal, the fifth strongest, equal to length of snout and half eye. A very short interspace between the two dorsals. Second dorsal very high, the longest rays equaling length of snout and eye. Caudal gently rounded when spread, its length half that of head to end of opercular spine. The ventrals reach halfway to front of anal, equaling height of second dorsal. Pectorals scarcely to vent, the length of the longest rays equaling distance from eye to tip of opercular spine. Vent midway between base of caudal and base of lower pectoral ray. Skin everywhere smooth.

Our specimen agrees well with the description of the much smaller type (185 mm.), apparently differing in the shorter pectorals and more deeply concave interorbital space. The white spots also show no tendency to run together to form streaks either along back or on the bases of the fins.

97. **Myoxocephalus jaok** Cuvier and Valenciennes.

Cottus humilis Bean, Proc. U. S. Nat. Mus. 1881, 149; Chamisso Island, Eschscholtz Bay.

Cottus polyacanthocephalus Kner, Sitzungsb. d. K. Akad. d. Wissen. LVIII, 1868, p. 21; taf. IV, 11. Decastris Bay (not of Pallas).

Cottus tæniopterus Bean and Bean, Proc. U. S. Nat. Mus. 1896, 381 (not of Kner).

In a report on the ichthyological collections of the *Albatross* in Alaska (Report of United States Commissioner of Fish and Fisheries for 1893, p. 421), Dr. Gilbert writes as follows: "*A. humilis* closely resembles the description of *A. jaok*, with which it may well be identical. We do not venture to make this identification as *A. jaok* is said to have but 7 dorsal spines, a number we have not found in *A. humilis*." On further consideration we have decided that the two must be identical. The type of *jaok* was a large dried specimen, the same which had served Pallas for his account of *Cottus scorpius*. In such a dried specimen it would be very difficult to enumerate correctly the low, feeble spines, of which the first two are very closely approximated and the last one often minute and hidden in the membrane. *M. humilis* is abundant along the coast of Kamchatka and agrees with the account of *jaok* in having the upper parts covered with small brown spots, the back with a series of round spinous plates, and the sides below the lateral lines with posteriorly directed spines; it also agrees in reaching a very large size. In the description of *jaok*, the fin formula, except the number of dorsal spines, is that most frequently found in *humilis*.

Specimens are in the present collection from Petropaulski and from stations 3646 and 3648, off Robben Island, in 18 and 20 fathoms. All of these have the supraocular and occipital crests higher and sharper than in those from the eastern portion of Bering Sea, and the preopercular spines are longer, usually reaching in young specimens to or beyond opercular margin. These are, however, characters subject to much variation within the group, in which it will always be unsafe to recognize subspecies unless based on very extensive collections. Our 21 specimens show the following fin formulæ:

	First dorsal.		Second dorsal.		Anal.				Pectoral.	
Rays	IX	X	15	16	12	13	14	15	17	18
Specimens	18	3	10	10	1	1	15	5	7	14

Dr. Bean records this species from St. Michael, Chamisso Island, Eschscholtz Bay, Point Belcher, Arctic Ocean. Mr. Scofield found it at Port Clarence and Grantly Harbor.

98. Myoxocephalus polyacanthocephalus (Pallas). (Plate LXIII.)

Several specimens from Unalaska and one from Robben Island, the latter perfectly typical in all respects and giving us the first Okhotsk Sea record for the species. In the Robben Island specimen the pectoral rays are roughened on their inner surface with horny tubercles, as is usual with adult males of this species. The fin rays are: D., X, 14; A., 12; P., 18.

Seen also at St. Paul and Unga, the species being generally common in Bering Sea. Dr. Bean records it from Sitka, Kadiak, Cooks Inlet, Shumagins, Unalaska, Atka, Amchitka, Port Moller, Cape Lisburne, and Plover Bay. Stejneger found it on Bering and Medni islands and at Petropaulski.

99. Myoxocephalus stelleri Tilesius. (Plate LXIV*a*.)

Myoxocephalus stelleri Tilesius, Mém. Acad. Petersb. 1811, IV, 273.
Cottus decastrensis Kner, Denk. Kais. Akad. Wissen. XXIV, 1865, 2, taf. 2, figs. 1, 1a.
Cottus platycephalus Bean and Bean, Proc. U. S. Nat. Mus. 1896, 240, 384; not of Pallas.
Cottus niger Bean and Bean, Proc. U. S. Nat. Mus. 1896, 240, 384 (in part: Nos. 33899, 33872, 33833, 33850, 33908, 33844, and 33879); not of Bean.
? *Cottus mertensii* Cuvier and Valenciennes, Hist. Nat. Pois. VIII, 496.
? *Cottus marmoratus* Cuvier and Valenciennes, Hist. Nat. Pois. VIII, 497.

This species is now recorded from Bering and Copper islands, Petropaulski, and the mouth of the Amur River. It is evidently abundant in western Bering Sea, but probably does not occur among the Aleutian Islands or on the Alaskan coast. There seems to be no doubt that our specimens are correctly identified with *Myoxocephalus stelleri*, with which they agree in fin rays and in the peculiar and characteristic coloration. They agree also with the description of *C. decastrensis*, the figure of which, however, diverges in several important details. It is highly improbable that *C. mertensii* and *C. marmoratus* can ever be satisfactorily identified, as we have only very brief accounts of them, based on colored drawings.

Following is a detailed description of our specimens: Resembling in shape *M. polyacanthocephalus*, the head less depressed and the snout deeper than in *M. jaok.* Characteristic features are the greatly thickened papillose lips, the presence of a supraocular tentacle, and the peculiar coloration. The skin is naked or with a few scattered small plates in adult males; the interorbital is deeply concave, and the occipital and parietal ridges are heavy and more or less broken or rugose.

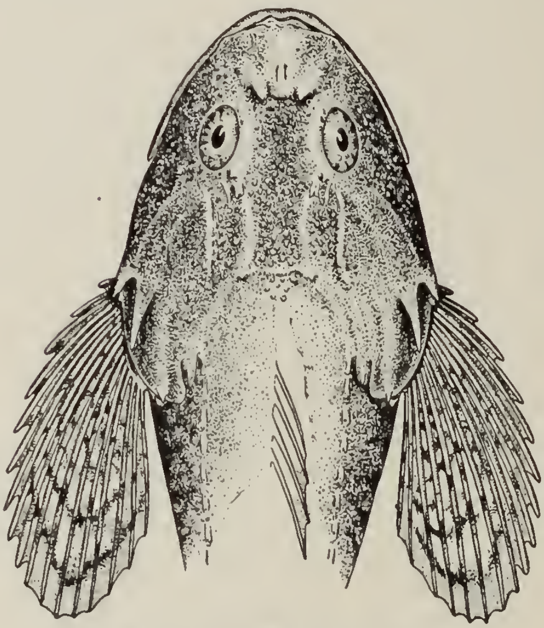
Head $2\frac{2}{7}$ to $2\frac{2}{5}$ in length; depth, 4; least depth of caudal peduncle, $1\frac{1}{2}$ in snout; greatest width of head equaling distance from tip of snout to base of preopercular spine. Depth of head at occiput equaling half its length.

Mouth large, the lower jaw included, but less conspicuously overlapped than in

M. jaok, the maxillary reaching beyond the eye, $2\frac{1}{4}$ in head. Lips very thick and fleshy in adults, the inner margin of each with a dense band of fine papillæ. The lower lip may also bear externally a few papillæ or short filaments. A fleshy slip or filament often present on upper posterior angle of maxilla.

Nasal spines pungent, rather short. Preopercle with two diverging spines at angle and a third remote one below directed downward and forward. The upper spine varies in length but extends usually about half way to tip of opercular spine. Opercle with a strong rib and spine. Humeral and subopercular spines strong.

Interorbital width $5\frac{1}{2}$ to 6 in head, gently concave, its floor usually with traces of two ridges. A definite supraorbital tentacle borne on the anterior end on the occipital ridge, its basal tubercle never conspicuous. A slender occipital tentacle is often present, especially in the young, but is not infrequently absent. The ridges on the occiput are strong, often irregular or partly interrupted, their surface roughened with lengthwise lines or with clusters of granules. Occiput more deeply concave than in *M. polyacanthocephalus*. Usually a cluster of short digitate ridges behind the eye. Top and sides of head with small warty protubreances. A minute pore behind the last gill, to be detected with difficulty in the young.



Myoxocephalus stelleri.—Petropaulski, Kamchatka.

Dorsals with short interspace or none, the membrane from last spine usually joining base of first soft ray. Spinous dorsal very high in adult males, the fifth spine highest, half as long as head. The longest soft ray $2\frac{1}{5}$ in head. The pectorals reach front of anal. The ventrals not to vent. In the young the vertical fins are much lower.

Below are fin-formulæ in 11 specimens:

	Spinous dorsal.		Soft dorsal.		Anal.			Pectoral.	
Rays	VIII	IX	15	16	11	12	13	16	17
Specimens	1	10	10	1	2	8	1	2	9

Skin smooth, without plates or spines in young 7 or 8 inches long; one adult male of 14 inches with scattered, small, subcircular spinous plates, all but a few of which are below the lateral line.

In the young, the maxillary and mandibular membranes are whitish, very conspicuously marked with irregular jet-black spots and blotches. Branchiostegal and gular membranes and the membrane behind the preopercle crossed with narrow, dark streaks; entire underside of head faintly dusky, mottled and maculated with white, "like a frog's belly." Iris with small, black spots and blotches. These colors are fainter in our adult specimen, where the underside of the head is nearly uniform whitish. The maxillary membranes are, however, conspicuously black spotted. The body is brownish, with three light gray saddles, the most conspicuous of which crosses the back of the caudal peduncle immediately behind the dorsal fin. The second is below the dorsal notch, and the third, often obscure or wanting, forms a V-shaped area on top of the head, the two arms diverging from interorbital space toward the base of opercular spine. The dark areas are often lighter centrally, and are variously blotched and mottled with brown or dusky. The dorsals are very irregular in the marking. The anal has usually three or four oblique, dark bars. The caudal has usually a basal translucent bar, followed by varying alternations of translucent and black. The ventrals show two black crossbars. The pectorals have no definite color pattern on their outer face, but are crossed on their inner face with a few irregular black bars. Males show the usual round white spots on sides of abdomen.

Several specimens from Petropaulski and Bering Island.

100. Myoxocephalus mednius, B. A. Bean, new species. (Plate LXIV *b*.)

Head, $3\frac{1}{2}$; depth, $4\frac{1}{2}$; eye, 4 in head. D., VIII, 17; A., 12; V., I, 3; P., 14; C., 14. Profile of head and body gradually ascending from tip of snout to sixth dorsal spine, thence tapering to caudal peduncle; ventral line almost straight, slightly tapering to caudal peduncle; longest dorsal spine almost as long as longest ray, 3 in head including flap. Mouth moderate, maxillary reaching about to vertical through middle of eye. Pectorals large, reaching slightly beyond anal origin, the middle rays being four-fifths as long as the head; ventrals moderately well developed, reaching anal; anal origin under third ray of dorsal, ending under fourteenth ray of that fin. Gill membranes united, forming a fold across the isthmus. Preocular spines moderate; opercular spines but moderately developed; two flattish tubular pores, one on each side of front of eye; numerous pores on head; two rows of pores, one above and one below the raised ridge, running laterally on dorsal half of body. General color dark reddish brown, mottled, barred, and spotted with white; under parts whitish; a wide whitish bar from opercles across nape; posterior part of interorbital space whitish; the dark color on front of snout and under lower jaw relieved by bars and mottlings of whitish; pectorals and ventrals barred; rays of caudal finely mottled; several (5) small white spots on body immediately behind pectoral origin, and several larger white blotches on lower posterior half of body. Bering Sea. A single example, 2 inches long. It is allied to *M. stelleri*, from which it differs greatly in form and coloration. (Type, No. 33863, U.S.N.M. Collected at Medni (Copper) Island, Bering Sea, spring of 1883, by Dr. Leonhard Stejneger.) (B. A. Bean.)

101. Myoxocephalus niger (Bean). Kalog. (Plate LXV.)

Abundant in the rock pools of the Pribilof Islands. Recently reported by Bean and Bean from Bering and Medni Islands (Nos. 33881, 38980, U.S.N.M.; Coll. Stejneger and Grebnitzki) and earlier by Dr. Bean from St. Paul and from Sanborn Harbor, Shumagins.

This strongly marked species can be readily distinguished by its peculiar coloration, by the greatly thickened naked skin, which partly conceals the short nasal and opercular spines, and by the numerous tentacles surmounting the warty tubercles on crown and occiput.

The fins may be uniformly black with a narrow white tip to the soft rays, or may be more or less varigated with white. On the soft dorsal these marks are in the form of white spots which may become confluent to form one or two streaks. In some specimens the caudal membranes are white in their middle portion, the rays remaining black. The under side of the head and maxillary membranes are sometimes marked with large blackish spots with ill-defined edges.

In addition to the minute pores which lie at intervals along the course of the lateral line, the latter gives off pairs of lateral branches each of which opens in three or more small pores. The sides of the head are also thickly studded with pores. Owing to the thickened integument the pectorals and ventrals are more largely adnate to the body than in other species.

The fin rays are as follows in 10 specimens:

	First dorsal.		Second dorsal.			Anal.		Pectoral.	
Rays	IX	X	15	16	17	11	12	16	17
Specimens	6	4	1	8	1	3	7	2	8

Cottus mertensii, Cuvier and Valenciennes, scantily described from a drawing, may be this species.

102. Myoxocephalus verrucosus (Bean). (Plate LXVI.)

Recorded by Dr. Bean from Plover Bay, Siberia, and by Dr. Gilbert from about Unalaska and Bristol Bay. Mr. Scofield found it at Kings Island, Port Clarence, and Grantley Harbor.

Myoxocephalus axillaris, Herendeen Bay, Alaska. Anna L. Brown, del.

103. Myoxocephalus axillaris (Gill). (Plate LXVII *a*.)

Recorded from Bering Straits by Dr. Gill, by Mr. Nelson from St. Michaels, and by Mr. Scofield from Port Clarence, Chignik Bay, and Herendeen Bay. Found on Bering Island by Nicolai Grebnitzki.

104. Porocottus sellaris (Gilbert).

Recorded from Bristol Bay.

105. Porocottus quadrifilis Gill.

Recorded from Bering Straits.

106. Porocottus quadratus, B. A. Bean, new species. (Plate LXVII *b*.)

Head, $2\frac{3}{5}$; depth, $3\frac{3}{4}$; eye, $3\frac{1}{2}$ in head; mandible, $3\frac{1}{3}$; maxillary, 3; interorbital width, 2 in eye. D., VIII, 14; A., 12; V., I, 3; P., 16. Head rather short and broad, quadrangular; the profile from tip of upper jaw ascends almost vertically to end of nasal spine, rounding over orbital ridge, and thence gently sloping upward to origin of dorsal, from which point the body gradually tapers to the tail, the depth of the caudal peduncle being contained about 3½ times in greatest depth of body. The long diameter of the eye equals the length of the mandible, almost that of the maxilla, and is contained 3½ times in the extreme length of the head. Interorbital space narrow, its width one-half length of eye. Gill membranes united and forming a fold across the isthmus. Opercular spines well developed, the lowermost on opercle and that on preopercle being curved downward and forward. Cranial ridges ending in spines of small size. Numerous pores on head, those in front visible to the naked eye; tubular pores on body, especially above anal base, where they appear to the naked eye as raised white specks.

Fins all well developed, large; length of first dorsal base little more than one-half length of second; anal fin beginning under third and fourth rays of second dorsal and ending opposite its last ray; length of longest dorsal spine about three-fourths as long as longest ray, or equal to length of longest anal ray; pectorals large and broad; ventrals reaching past anal origin.

Color reddish brown, relieved by much white; under parts whitish; head above and below brown, flecked with white; lips pale; a broad white half bar on body extending from end of spinous dorsal to fourth ray of second dorsal, another extending from sixth to ninth ray, and a third from last ray to near end of caudal peduncle, which it encircles in connection with a dark bar, the latter extending on the caudal fin; pectorals and caudal barred; ventrals with round black blotches forming rows on the rays. Bering Island; only the type known. (B. A. Bean.) (Type, No. 33875, U.S.N.M., a single example 3 inches long, Bering Island, 1883; collected by Dr. L. Stejneger.)

107. Megalocottus laticeps (Gilbert).

Recorded from the neighborhood of Bristol Bay. Mr. Scofield found it at Port Clarence.

108. Megalocottus platycephalus (Pallas). (*Cottus tæniopterus* Kner.)

Recorded from Kamchatka by Pallas, and from Decastris Bay, near the mouth of the Amur River by Kner.

109. Oncocottus hexacornis (Richardson). (Plate LXVIII.)

Northern part of Bering Sea and northward through the Arctic to Greenland. Very doubtfully distinct from *Oncocottus quadricornis* of Europe. Recorded by Mr. Scofield from Herschel Island and Grantley Harbor, and from Bering Island by Dr. Stejneger.

110. Zesticelus profundorum (Gilbert).

Originally described from three specimens from Bering Sea. A fourth specimen dredged by us off Bogoslof Island, a little larger than the types, has D., VI, 10; A., 8; P., 20. One of the original types has D., VII, 12; A., 10; P., 20; but in all other respects the two specimens agree absolutely and they are no doubt identical.

111. Blennicottus globiceps (Girard).

Recorded by Dr. Bean from Kadiak, Adakh, and Amchitka. These records need verification, as perhaps some other species was mistaken for it.

112. Oxycottus acuticeps (Gilbert).

Originally described from Unalaska; found later by Dr. Gilbert at Departure

Bay, Vancouver Island; by Mr. Arthur W. Greeley in Prince William Sound, and by Dr. Jordan at Sitka and Kadiak. These specimens vary considerably in color and in length of preopercular spine.

This species is the type of a distinct genus or subgenus *Oxycottus*, nearest allied to *Blennicottus*, but differing in the sharper spine of the preopercle and the lateral cleft of the mouth. *Oxycottus embryum* is a second species of the same group, intermediate in form and armature between *Blennicottus globiceps* and *Oxycottus acuticeps*.

113. Dasycottus setiger Bean.

Taken by us off Karluk; recorded by Dr. Gilbert from various localities north and south of Alaska Peninsula, by Dr. Bean from Sitkalidak, and by Mr. Starks from Puget Sound.

114. Malacocottus zonurus Bean.

Recorded from the Trinity Islands, and from about Unalaska and Unimak in deep water.

115. Histiocottus bilobus (Cuvier and Valenciennes).

This species was collected by Stejneger on Bering Island in 1897 (U.S.N.M. No. 48857).

116. Blepsias cirrhosus Cuvier and Valenciennes.

Captain Harbor, Unalaska; Petropaulski; Iturup Island; also recorded by Dr. Gilbert from Unalaska, and by Dr. Bean from Unalaska, Adakh, Kiska, and St. Paul; found by Stejneger on Bering Island. Adults from Unalaska show the following color:

Olive green, of varying shades, the belly bright coppery yellow, the cross blotches on back nearly black, with paler margins; naked patches on sides, white or brassy, thosè on tail colored like body, those on head silvery. First dorsal light olive with 2 translucent patches; second dorsal mottled olive with dark spots and translucent patches. Caudal with 3 blackish and 4 translucent bands. Anal yellowish olive with numerous spots and translucent patches. Radiating blackish bands running out from eye. The upper barbels black, the lower olive.

117. Nautiscus pribilovius Jordan and Gilbert, new species. (Plate LXIX.)

Nautichthys oculofasciatus Gilbert, Report U. S. Fish Commissioner, 1896, 434; not of Girard.

Differing from *Nautichthys oculofasciatus* in the shorter lower fins, the lower cranial ridges and the coloration.

Head, 3 to $3\frac{1}{5}$; depth, $3\frac{2}{5}$; D., VIII, 23; A., 15; V., I, 3; P., 15; eye, $3\frac{1}{4}$ in head; maxillary, $2\frac{2}{3}$; lateral line with 39 spines.

Shape of head and body much as in *N. oculofasciatus*. Head short, the snout rather sharp, the anterior profile steep; nasal spines prominent; a short ocular cirrus, much smaller than in *N. oculofasciatus*, shorter than pupil; interorbital space narrow, about half eye, deeply concave; a blunt triangular ridge above each orbit, with a deep cross furrow behind it which deepens to a pit at the vertex; nuchal ridges lower than in *N. oculofasciatus*, each with a coarse tubercle, lower and larger than in the other species. From the nuchal depression the base of first dorsal spines rises much less abruptly. Preopercle with four blunt prominences, the upper often longer and more spine like. Mouth nearly horizontal, the lower jaw included; a slender filament at end of maxillary; teeth small, a few on vomer and a narrow band on palatines. Gill membranes broadly united to isthmus, the gill opening extending a little below the lower edge of pectoral. Skin covered with close-set villous prickles, among which large ones are frequently seen arranged in rather definite longitudinal series, of which there may be two or three parallel with the back and one running near lower line of tail. No smooth areas on sides. Lateral line conspicuous, the plates with short spines directed backward.

Dorsals separate, the first not notched, comparatively low; the first spine highest, $1\frac{3}{5}$ in head in type; in other specimens $1\frac{1}{4}$ to $1\frac{1}{6}$ in head. Soft dorsal and anal also low, none of the rays reaching base of caudal when depressed. Pectoral longer than head; ventrals $1\frac{1}{2}$ to 2 in head.

Color dull light olivaceous, mottled with darker; three or four dark bands below soft dorsal, one below spinous dorsal; a black band through eyes and across cheeks, extending onto branchiostegal membranes; seven dusky spots along lateral line, a conspicuous pink blotch, rather larger than pupil, between first and second spots. First dorsal dusky; second dorsal, anal, and pectoral dotted and checked; caudal with faint finely checked cross lines, which deepen to form a dark bar at its base and a broader one toward its tip; ventrals pale; belly mottled.

One specimen 6 cm. long, from station 3635, off Zapadni rookery, St. George Island, in 23 fathoms.

Another specimen, barely an inch long, was dredged in 7 fathoms in the harbor of Unalaska. Very numerous specimens were obtained by the *Albatross* in 1890 in Bristol Bay and south of the Alaskan Peninsula. It was at that time incorrectly identified by Dr. Gilbert with *N. oculofasciatus*. In five specimens of those from Bristol Bay the dorsal contains VIII or IX—23 or 24 rays, the anal 16 or 17, the pectoral 15 or 16.

Dr. Bean records *Nautichthys oculofasciatus* from Unalaska, Adakh, Kiska, and St. Paul. Perhaps he had the present species instead of the more southern *Nautichthys oculofasciatus*. The genus *Nautiscus* Jordan and Evermann is closely allied to *Nautichthys*, differing in the low spinous dorsal, the base of which is scarcely raised above the nape. The skin is rougher than in *Nautichthys*, and the anal fin is shorter.

118. Psychrolutes paradoxus Günther.

Psychrolutes zebra Bean, Proc. U. S. Nat. Mus., 1890, X, 3.

Head, $2\frac{4}{5}$; depth, 3. D.,—, 15; A., 13; P., 19; eye, 4 in head; width of mouth from angle to angle, $1\frac{1}{2}$; snout, $3\frac{1}{3}$; interorbital, $3\frac{1}{5}$.

Body short, broad, thick, tadpole shape, the texture soft like that of a *Liparid*, especially about the head; the skin is limp and smooth, covered with little soft dermal warts, that of the head especially lax, the cheeks tumid and translucent. No trace of spines on head, the bones all thin and weak; nostrils each in a short tube; mouth broad, its cleft chiefly anterior, the jaws equal; teeth very minute, none on vomer or palatines; lower jaw with eight large open pores. Gill membranes broadly united to the isthmus, the gill opening extending to slightly below base of pectoral. Lateral line obsolete. Dorsals united, with a slight notch between, the first buried in a ridge of skin, so that its delicate spines can not be counted from without; second dorsal low, similar to anal, both of them free from the caudal. Lower pectoral rays progressively shortened, the longest $1\frac{1}{5}$ in head. Ventrals moderate, I, 3, reaching vent, $2\frac{1}{3}$ in head; caudal rounded.

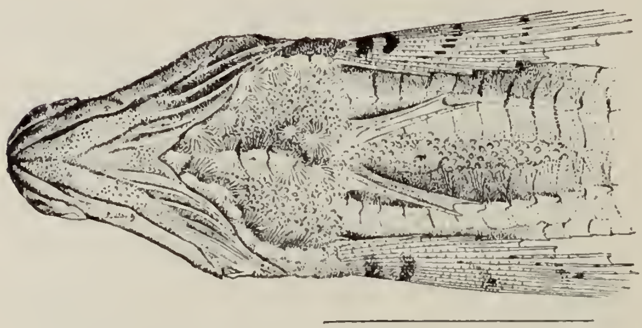
Color creamy white, with blackish cross-bands, irregular in form and broken by whitish patches; five black spots on lower jaw; top of head blackish; a narrow blotch at shoulder; a wider one across first dorsal; a broad one on second dorsal abruptly broadened on body, then narrowed extending across anal; an irregular bar at base of caudal; a narrow bar and some spots and streaks on the fin; pectoral with two curved bars, the inner concave, the outer convex backward, the two inclosing a rounded pinkish area.

One specimen 50 mm. long from station 3640 off St. Paul Island; depth, 26 fathoms. The species is abundant from Puget Sound through Bering Sea to the Kuril Islands. The present collection contains a specimen 16 mm. long from station 3653 off Iturup Island; depth, 18 fathoms. The species was also taken at station 3674, off Karluk. In these specimens the coloration is variable, the bands on the back being sometimes divided. The pectoral fins are orange at base in life, the color varying to bright yellow.

Family AGONIDÆ.

119. Occa dodecaëdron (Tilesius).

Two specimens from Shana Bay, Iturup Island. Recorded by Dr. Gilbert from Bristol Bay. These agree very closely in details of form, structure, and coloration with material from eastern Bering Sea and seem to differ only in the longer, sharper spines with which the plates of the dorsal series are provided. The ridges on the top of the head are also narrower and sharper. This may indicate specific or subspecific separation, but our material is insufficient to indicate that such is the case. From Cuvier's description, based on an individual sent him by Tilesius, our specimens differ in the coloration of the caudal fin, the longer head, and the shorter snout and eye. The caudal is nearly uniformly blackish, not spotted with brown like the pectorals. The head is contained 4¾ times in total length (not 6 times), and the eye and snout are about one-fifth length of head (not one-fourth).



Occa dodecaëdron, Shana Bay, Iturup Island. Anna L. Brown del.

The species is closely allied to *O. verrucosa*, but differs conspicuously in coloration and in numerous structural details. The cheeks are naked below the stay, the stay is without spine, the medial portion of gill membranes are plated, and the investment of the breast is very different. Compare in this respect the accompanying figure with Steindachner's plate of *Agonus barkani* (= *O. verrucosa*) in Ichthy. Beiträge IX, taf. V. Fin rays in our specimens: D., X, 8; A., 14; P., 14 or 15. The two species *verrucosus* and *dodecaëdron* form a minor group or genus, distinguished from *Brachyopsis* (*rostratus*) by the short snout, which is not produced and *Syngnathus*-like. *Siphagonus* Steindachner is identical with *Brachyopsis*. For the group typified by *verrucosus* and *dodecaëdron* Jordan and Evermann have taken the name *Occa* (meaning a harrow).

120. Brachyopsis segaliensis (Tilesius).

Recorded from Sakhalin by Tilesius; not seen by recent writers.

121. Brachyopsis rostratus (Tilesius). (Plate LXX.)

Several specimens from Shana Bay, Iturup Island, show the following characters: Dorsal face wider than in *Occa dodecaëdron* or in *Pallasina barbata* and deeply concave; snout elongate, depressed, its width taken at middle of its length one-half greater than its depth at the same point, and one-half its length, measured from tip of lower jaw; lower jaw much longer than upper, the symphysis entering upper profile of snout, vertically furrowed at tip; maxillary not reaching orbit, 4 in head; preorbital elongate, with a lengthwise ridge which divides anteriorly, the branches not terminating in spines; the edge of preorbital entire; anterior nostril in a short tube. Teeth all minute, present on jaws and vomer, often absent on palatines, sometimes present in a small patch on extreme anterior end. Suborbital stay without spine, forming a gibbous striated protuberance on middle of cheek, between which and the horizontal edge of preopercle is a series of three or four small plates; two strong diverging spines at angle of preopercle; a shorter spine below them; orbital margins elevated superiorly and posteriorly; interorbital space very narrow, grooved, and longitudinally striated, its width equaling one-half diameter of orbit, which is 6 in head; no spines on top of head, the ridges low and rounded. Head $4\frac{3}{5}$ to $4\frac{5}{6}$ in length; width of body $8\frac{1}{5}$ to $8\frac{1}{2}$; length of caudal peduncle $3\frac{1}{2}$ to 4.

Body anteriorly hexagonal, the upper lateral ridge becoming obsolete immediately in front of spinous dorsal; lower lateral ridge also becoming rounded and obsolescent anteriorly; dorsal face widening rapidly from occiput to front of spinous dorsal where its width equals snout; it gradually narrows posteriorly, the dorsal ridges becoming confluent at a point much nearer base of caudal than end of second dorsal; ventral ridges spineless, the lateral ridges with short spinous points, often distinguishable with difficulty; dorsal series anteriorly with stronger spines which rapidly diminish posteriorly; branchiostegal and gular membranes without plates; plates on body without the minute prickles so characteristic of *Occa verrucosa* and *O. dodecaëdron;* breast covered with polygonal plates, a series elevated to form a median ridge, the marginal plates also prominent; prepectoral area wide, with four prominent plates, the uppermost bearing a short spine posteriorly; in the dorsal series of plates, 10 lie in advance of first dorsal, 11 between origins of first and second dorsals, 9 or 10 along base of second dorsal, 6 to 9 between second dorsal and the point of confluence of the dorsal series, and 5 to 7 between the latter point and base of caudal; total number of plates in dorsal series 43 to 45, in 6 specimens examined.

Pectorals long and narrow, $1\frac{1}{4}$ in head; dorsal with 8 (rarely 9) spines and 8 soft rays; anal with 13 (rarely 14) rays; pectoral with 14 rays. Color dusky above, marked with small black spots and lines; white below, growing dusky posteriorly; caudal blackish; ventrals white, anal white, with the last rays dusky; dorsals and pectorals with the rays finely dotted with black.

Recorded by Grebnitzki, from Yeso, Japan.

122. Pallasina barbata (Steindachner).

Two specimens from Shana Bay, Iturup Island, one from Tareinsky Bay, Kamchatka. Recorded by Dr. Gilbert from Bristol Bay, and by Dr. Bean from Yakutat, Unalaska, and Port Clarence. Mr. Scofield found it at Port Clarence and Stejneger at Petropaulski. They show the typical arrangement of plates on the breast, the median series in front of ventrals containing three plates, not two as in *Pallasina aix*. The mandibular barbel is subject to considerable variation in length, and can probably not be relied upon to distinguish the two species.

123. **Podothecus hamlini**, Jordan and Gilbert, new species. (Plate LXXI.)

D., IX to XI, 8; A., 9 or 10; P., 15. Head, $3\frac{3}{4}$ in length; depth, not including spines of dorsal plates, $8\frac{2}{5}$; width at base of pectorals, $7\frac{1}{6}$; length of caudal peduncle, from base of last anal ray, $2\frac{6}{7}$; snout long and slender, depressed, produced beyond the mouth for a distance equaling a little less than half its length, the tip formed of two spines, the space between which is covered with membrane; a pair of strong, nearly erect spines at their base, between which are two or three very small spines on the median line; a second pair of strong spines at posterior end of premaxillary fossa, the ridges bounding which may bear one or more pairs of small prickles; preopercle with a wide, wing-like crest terminating in a bluntish spine; snout long and slender, its lateral profile concave as seen from above or below; suborbital crest with three very strong, backwardly hooked spines; interorbital space very narrow, deeply concave; supraocular ridge strong and much elevated, the interorbital space deeper and narrower than in any other species of this group, its least width $1\frac{1}{7}$ in orbit; post-orbital spine small; ridges on sides of snout minutely serrate; an irregular group of small spines above and behind anterior nostril; lateral ridges of head with three pairs of very strong backwardly directed spines in line with the greatly expanded preopercular ridge; the posterior portion of this ridge produced into a compressed, bluntish process which overlaps the subopercle and reaches margin of gill opening; opercular and temporal ridges low and sharp. Teeth present on jaws in the young, becoming nearly or quite obsolete in adults; in the type, 17 cm. long, a few weak teeth on one side of upper jaw, but none elsewhere; vomer and palatines toothless. A cluster of 14 barbels on each side of lower surface of snout in front of mouth, and a cluster of 14 occupying end of maxillary and angle of mouth; each side of lower lip with two barbels; gill membranes widely joined to the isthmus, without distinct free fold posteriorly.

Plates on body with very strong spines, those of the dorsal series the largest, but decreasing rapidly backward, becoming much smaller than the lateral series under the second dorsal fin; a median series of short, sharp spines still persists along entire back of tail after the confluence of the dorsal series; the lateral series lower anteriorly, the upper row persisting to gill opening, the lower row now becoming obsolete about four plates behind axil; the abdominal series bear short, sharp spines (longer in the young), becoming obsolete along anterior portion of anal fin; of the dorsal series, 4 are in front of the first dorsal, 10 (or $9\frac{1}{2}$) along base of first dorsal, 1 (or $1\frac{1}{2}$) between dorsals, 9 along base of second dorsal, 15 along back of tail, the first of the latter being the plate in which the dorsal series first become confluent; anterior portion of lateral line running along upper lateral series, gradually descending to middle of sides, where it runs on a special row of plates which bear no spines; where the lateral line begins to ascend, three of these plates become confluent with corresponding plates of the upper lateral series; in advance of these, five members of the series again appear distinct, considerably enlarged and bearing spines; 40 pores in the lateral line.

Fins all comparatively short and low; pectorals reaching twelfth plate of upper lateral series, the longest ray equaling length of snout and one-half eye; rays becoming rapidly shortened below, the lower five or six slightly thickened with exserted tips;

ventrals very short, not exceeding length of snout before mouth, not received into longitudinal groove. We consider it very doubtful whether such a groove exists in any of the other species of this group. It has been described as existing in the types of *P. gilberti* (Collett) and *P. peristethus*, Gill. In both cases the type specimens were in a poor state of preservation, and the groove was probably due to a softening of that longitudinal strip of the abdominal wall which includes the anal opening, and extends backward from the base of the ventral fins and is interposed between the firm outer series of ventral plates. That such a softening had occurred in the type of *Podothecus peristethus* is evident from Gill's statement that the ventrals had dropped out. This view is rendered more probable from the fact that *P. peristethus* is apparently identical with the common *P. acipenserinus*, which contains no such groove. We have also examined two of the type specimens of *P. gilberti* without being able to satisfy ourselves of the existence of any special groove. The dorsal fins are closely juxtaposed, the interspace including 1 or 1½ pairs of plates. The base of the last ray of second dorsal is midway between base of caudal and origin of spinous dorsal.

Color dark or brownish above, with irregular spots or dashes of darker, which do not form definite crossbars; a black streak from eye to tip of snout, passing onto lower side of rostral spines; a dark blotch on expanded limb of preopercle; a black spot on base of middle pectoral rays, the fin very obscurely marked with dusky; dorsal spines and rays with linear dark markings, one or two black spots near tip of spinous dorsal anteriorly; under parts, including fins, unmarked.

Two specimens from Albatross station 3653, off Shana Village, Iturup Island, in 18 fathoms. A young individual from Albatross station 3646, off Robben Island, 18 fathoms, seems to belong to the same species, but has the snout less produced and the dorsal VIII, 6; anal 8. (We take great pleasure in naming this species in honor of Hon. Charles Sumner Hamlin, late Assistant Secretary of the Treasury, under whose auspices the investigations described in this memoir were undertaken.)

124. Podothecus thompsoni, Jordan and Gilbert, new species. (Plate LXXII.)

D., VIII or IX-6; A., 6; P., 16. Head rather broadly triangular, its greatest width across preopercular ridges greater than distance from anterior end of preopercular ridge to tip of snout. Lateral ridge on head continuous from tip of snout along suborbital bones to base of preopercular crest, the lateral spines usual in this genus being represented by triangular processes borne on the ridge; preopercular ridge produced posteriorly beyond gill opening, but not spine like; snout terminating anteriorly in two rounded processes, each bearing on its upper surface a vertical crest, and finely serrate along its margins; no terminal pair of strong spines as in other species; under side of snout with an acute median spine directed downward and backward; a pair of strong spines on upper side of snout behind terminal nostril ridge; a pair of coalesced spines behind the nostril groove; a semicircular series of spinelets below the eye; two small tufts of filaments on under side of snout, one on middle of maxillary and one at its tip. A narrow band of sharp teeth in each jaw; vomer and palatines toothless. Gill membranes united to isthmus, without evident free fold. Orbital rim much elevated; interorbital space narrow, deeply concave, its width nine-tenths diameter of orbit; occipital ridges strong, elevated posteriorly, ending in a backwardly directed spine which is much larger than those of the body plates; occipital area narrow, deeply concave, its central portion sunk somewhat below level of interorbital space, from which it is separated by a shallow transverse groove; a similar groove behind occipital spines; area between occipital and temporal ridges also deeply concave; a strong opercular ridge.

All the plates with strong spines, including those of the ventral series; the weakest spines are on the anterior plates of the lateral series; plates on breast with central spine and radiating ridges; dorsal series with fewer plates than in other species; 3 in front of spinous dorsal, 11 (or 12) along base of spinous dorsal, 2 (or 1) between dorsals, 6 at base of soft dorsal, 14 (or 13) unpaired plates on back of caudal peduncle. The unpaired plates have the spine notched at tip. All the plates are marked with strong radiating ridges and have the surface of the spines minutely roughened.

Color, light gray above, white below; top and sides of head with black dots and dashes; back crossed by six narrow black bars. Distinguished from all other species of the genus by the great development of the lateral ridge and spines on head. This gives the head and especially the snout a much broader outline, approaching in this respect *Agonus cataphractus*. The species is represented by several young specimens in rather poor condition, the type being 53 mm. long. The outline and armature of the head are not, however, essentially different in young and adults of such species as are known to us from specimens of different sizes. Off Shana Bay, Iturup Island, Kuril group. (This species is named in honor of Prof. D'Arcy Wentworth Thompson, of the University of Dundee, the commissioner of Great Britain in the fur-seal investigations in Bering Sea in 1896 and 1897.)

125. **Podothecus veternus** Jordan and Starks.

Described from Robben Island.

126. **Podothecus accipiter** Jordan and Starks.

Described from Robben Island.

127. **Podothecus acipenserinus** (Tilesius).

One specimen of this abundant species was taken from the stomach of a codfish at St. Paul Island. It is recorded by Dr. Bean from Kadiak, Unalaska, and Port Clarence, and was found by Stejneger on Bering and Copper islands.

128. **Podothecus gilberti** (Collett).

Described from Petropaulski.

129. **Sarritor frenatus** (Gilbert).

One specimen from station 3643 extends the range of this species to the Kamchatka coast (off Povorotnaya, in 100 fathoms). Anomalous arrangement is shown in the predorsal plates, most of which occur alternately instead of in pairs. The interspace separating the dorsals is longer than in any other specimen we have seen, extending over five pairs of plates. The interspace extends usually over but two or three pairs of plates, four pairs being included in but one of our specimens from eastern Bering Sea. No further differences could be detected. The original localities of this species are about Unalaska and Unimak.

130. **Sarritor leptorhynchus** (Gilbert).

Described from various stations north and south of the peninsula of Alaska.

131. **Xenochirus alascanus** Gilbert.

Dredged by us off Karluk: recorded by Dr. Gilbert from many localities about Unimak Pass.

132. Bathyagonus nigripinnis Gilbert.

Recorded from about Unalaska in deep water.

133. Hypsagonus quadricornis Cuvier and Valenciennes.

Recorded by Dr. Gilbert from about Unalaska and Bristol Bay. Also known from about Kamchatka; found by Col. Nicolas Grebnitzki at Bering Island.

134. Percis japonicus (Pallas).

Known only from the waters about Sakhalin.

135. Aspidophoroides güntheri Bean.

Bering Sea; not taken by us.

136. Aspidophoroides inermis (Günther).

Recorded from about the Aleutian Islands and Unalaska. It was originally described from Unalaska.

137. Aspidophoroides bartoni Gilbert.

Stations 3637 and 3639, off Pribilof Islands, 32 and 27 fathoms, locally abundant; recorded by Dr. Bean from many stations about the Alaskan Peninsula and Unalaska. Found by Stejneger on Medni Island.

Family CYCLOPTERIDÆ.

138. Eumicrotremus orbis (Günther).

One specimen taken from the stomach of a halibut off St. Paul Island. The back was seal brown, the lower parts pinkish, the region about the ventral disk bright pink. Also recorded by Dr. Bean from Unalaska, St. Paul, and Plover Bay. Found on Bering Island by Col. N. Grebnitzki.

139. Lethotremus muticus (Gilbert).

Recorded from near Unimak Pass.

140. Cyclopterichthys ventricosus Pallas. *Miakinka* or soft fish.

Numerous specimens taken at Petropaulski by Prof. D'Arcy W. Thompson, and on St. Paul by Mr. Trevor Kincaid. Found by Stejneger on Bering Island. Recorded from Atka. The species is rare in collections, but seems to be locally abundant.

141. Cyclopteroides gyrinops Garman.

Described from St. Paul. A few very young specimens, apparently of this species, dredged by us in Golinski (Dutch) Harbor, Unalaska.

142. Liparops stelleri (Pallas).

Originally described from Petropaulski; not since seen.

Family LIPARIDIDÆ.

143. Neoliparis callyodon (Pallas).

Specimens were taken at Kamchatka (Mr. Barrett-Hamilton); Captains Harbor, Unalaska; St. Paul, St. George, and Sitka. They vary much in plumpness and somewhat in color, some being plain yellowish olive, others finely spotted with black. The disk varies from $2\frac{1}{6}$ to $2\frac{3}{4}$ times in head. These variations are not correlated, and we are unable to recognize more than one form, though it is not impossible that two species are included among our specimens. Dr. Bean records this species from Unalaska, Adakh, Amchitka, St. Michael, and Plover Bay. Stejneger and Grebnitzki found it on Bering and Medni islands.

144. Neoliparis cyclopus Günther.

Recorded by Dr. Gilbert from Bristol Bay. It ranges southward to Vancouver Island.

145. Liparis pulchellus Ayres.

Recorded by Dr. Gilbert from Bristol Bay, whence it ranges southward to San Francisco. Dr. Bean notes it from Unalaska and Kadiak.

146. Liparis cyclostigma Gilbert. (Plate LXXIII.)

One specimen known, from near Unalaska.

147. Liparis agassizii (Putnam).

Originally described from Sakhalin; generally common in the north of Bering Sea, south to Bristol Bay, whence it was recorded by Dr. Gilbert. Dr. Bean records it (as *Liparis gibbus*) from Unalaska and Petropaulski.

148. Liparis herschelinus Scofield. (Plate LXXIV.)

Northern parts of Bering Sea; described from Herschel Island.

The specimens from Bering Island collected by Grebnitzki, recorded as *Liparis tunicata* by Bean and Bean, Proc. U. S. Nat. Mus. 1896, 243, probably belong to this species.

CRYSTALLICHTHYS Jordan and Gilbert. New genus.

Closely allied to *Liparis*, from which it differs chiefly in the single nostril. A single dorsal fin; a well-developed sucking disk; wide bands of teeth, many of which are trilobate near tip; an inferior mouth, much overhung by the produced conical snout; a single nostril, corresponding to the anterior nostril of other Liparids, the posterior opening being wholly wanting. The typical species, *C. mirabilis*, differs from all known species of Liparis except *L. cyclostigma* in its large size, compressed form, and translucent gelatinous texture.

149. Crystallichthys mirabilis Jordan and Gilbert, new species. (Plates LXXV, LXXVI.)

A large species, soft and gelatinous in texture, the color translucent grayish or purplish, marked on back with many large light circles, which were probably deep red or crimson in life.

Type, a specimen 330 mm. long, from station 3643, off southeast coast of Kamchatka, at a depth of 100 fathoms.

Head 4 in length; depth $2\frac{1}{2}$; snout $2\frac{1}{7}$ in head; eye $3\frac{1}{2}$ in snout. Width of mouth one-half length of head. Length of gill slit, one-half snout, equaling distance from front of eye to front of nostril tube; P., 33.

Head and body compressed, especially along upper profile, which descends in a gentle, nearly even curve to tip of snout. Lower profile less curved, nearly straight and horizontal on anterior third of body. Snout conical, tapering to a sharp tip, its lower profile nearly horizontal, protruding beyond the mouth for a distance (measured axially) equaling two-fifths its length. Mandibular symphysis vertically below nostril tube. Upper jaw strongly arched anteriorly, the mandible much shorter, nearly transverse in position. When the mouth is closed there is exposed the entire width of the thick upper lip, and the anterior portion of the band of fringes which precedes the premaxillary teeth. Teeth slender, shorter than in *L. cyclostigma*, arranged in about 25 oblique series in the half of each jaw. The posterior longer teeth are more or less distinctly three lobed in both jaws, the anterior teeth shorter, simple. A deep cleft on lower side of snout running from its tip to front of premaxillaries, deepening backward, opening into the deep groove above premaxillaries. From base of cleft arises a high free fold, the sharp edge of which nearly reaches the margins of the cleft. A series of three large pores along each side of this cleft, with three more equally spaced on each side and parallel with front of mouth. Belonging to this series, but distant from them and much smaller, we find one on middle of cheeks below eye, and one halfway between eye and middle of gill slit. A pore behind eye and a series of four on each side of nape. No pore in the position of the posterior nasal opening. A second series of six on each side of mandible and preopercle. No other pores on head. Nostril single, in a distinct wide tube, as long as the diameter of pupil. Distance from eye to angle of mouth $3\frac{1}{5}$ in head. Vertical from angle of mouth passing through front of orbit. Gill cleft narrow, reaching base of first pectoral ray, its length $4\frac{3}{5}$ in head. Lateral line rising in an abrupt curve from upper end of gill opening, decurved again behind pectorals to reach middle of sides, on the posterior half of which it becomes obsolete. Anteriorly the lateral line is accompanied above by a second series of pores which is not curved, but runs straight forward from just above the summit of the curve.

The dorsal and anal fins are enveloped anteriorly in thick gelatinous tissue, so that their points of origin and number of fin rays can not be determined. The fins are high, the longest anal ray equaling length of snout and eye. Thirty-two dorsal and 33 anal rays can be distinguished in the posterior transparent portions of the fins, the total number of rays being greater. The last anal ray joins outer caudal ray at middle of length of the latter. Dorsal joined narrowly to base of caudal at end of basal seventh of outer caudal ray. Longest caudal ray $2\frac{1}{2}$ in head. Lower seven pectoral rays thickened, forming a lobe, the distal third of each ray free from the membrane. Longest pectoral ray $1\frac{1}{4}$ in head. Disk of moderate size, anteriorly placed, its posterior margin under the gill slit, its length one-third that of head.

Color translucent, according to Stejneger, beautifully pink flesh color in life, the dorsal region, including dorsal fin, marked with many large round spots, probably deep red or crimson in life, each spot surrounded with a faint darker ring.

Two specimens were taken, one, about 45 mm. long, from station 3638 in 34 fathoms off St. Paul Island, the other, 340 mm. long, from station 3643 in 100 fathoms off southeast coast of Kamchatka. The remarkably beautiful coloration of the smaller example was similar to that of the type specimen of *Liparis cyclostigma*, the body and fins in life being translucent, with large roundish deep red spots, each surrounded by a dark brown ring and this in turn by a light ring. Belly, lower side of head, and lower half of pectoral light yellow. The rings are not always strictly symmetrical on the two sides and do not exactly correspond in different specimens. They soon fade in spirits.

The translucent coloration of this species, extremely beautiful in life, is very different from that of the other Liparids.

150. Careproctus simus Gilbert.

Recorded from near Unalaska in deep water.

151. Careproctus ostentum Gilbert.

Recorded from near Unalaska.

152. Careproctus phasma Gilbert.

From Bristol Bay.

153. Careproctus spectrum Bean.

From near Unga.

154. Careproctus colletti Gilbert.

From waters to the south of Alaska peninsula.

155. Careproctus ectenes Gilbert.

From near Unalaska.

156. Careproctus gelatinosus (Pallas).

Petropaulski; not recognized by recent writers.

157. Prognurus cypselurus Jordan and Gilbert, new genus and species. (Plate LXXVII.)

This species is most nearly related to *Careproctus melanurus*, from which it differs in darker coloration and shorter gill slit. From all known species of *Careproctus* it differs in the very elongate caudal fin, which is forked at the tip. The feature defines the genus *Prognurus*.

Head $4\frac{2}{5}$ in length; depth, $4\frac{9}{10}$; cleft of mouth, $1\frac{3}{4}$ in head, seven-fifths distance from symphysis of lower jaw to angle of mouth; total interorbital width, $2\frac{1}{5}$ in head; eye large, equaling length of snout, $3\frac{3}{4}$ in head; gill opening entirely above base of pectoral, not reaching base of upper ray, its length 3 in head; the opercular lobe broadly rounded.

Snout blunt, broadly rounded, the mouth horizontal along its lower margin, scarcely overlapped by it. Upper lip wide. Teeth acute, without cusps, in about 27 oblique rows in one side of each jaw. Maxilliary reaching the vertical from posterior edge of the pupil. Nostril opening in a wide, low tube.

Front margin of ventral disk very slightly behind angle of mouth, its diameter three-fifths that of eye, about one-seventh length of head.

Pectorals broadly rounded, regularly shortened below, not deeply notched, the lower 7 rays thickened and exserted; the longest free ray about half length of head. Upper portion of fin with 26 rays, the tips only protruding, the longest equaling length of head. Dorsal beginning shortly behind vertical from gill slit, its distance from tip of snout $3\frac{7}{8}$ in length. Dorsal with about 58 rays. Caudal very long and narrow, only its basal third connate with last rays of dorsal and anal. Unlike all other Liparids, the caudal is forked at tip, the terminal notch involving about one-seventh of fin.

Translucent dusky, darker around snout, gill openings, and on the fins, the vertical fins largely jet-black. Mouth and gill cavity dusky, not black.

Type a single specimen, 21 cm. long, dredged at station 3644, off Bogoslof Island, at a depth of 664 fathoms. A second specimen was obtained by the *Albatross* in 1889 at station 3074, off the coast of Washington, in 877 fathoms, but it was too seriously mutilated to admit of description.

158. Rhinoliparis barbulifer Gilbert.

From deep water off Unalaska.

159. Gyrinichthys minytremus Gilbert.

One specimen from deep water off Unalaska.

160. Paraliparis cephalus Gilbert.

Recorded from off Unalaska and off Point Reyes by Dr. Gilbert. Obtained by us in Shelikof Straits off Karluk.

161. Paraliparis ulochir Gilbert.

Recorded from near Unalaska in deep water; the original type from the Gulf of California.

162. Paraliparis holomelas Gilbert.

From near Unalaska in deep water.

Family BATHYMASTERIDÆ.

163. Bathymaster signatus Cope. (Plate LXXVIII.)

Recorded by Dr. Gilbert from about Unimak and Unalaska; taken by us at Sitka. Dr. Bean records the species from Kadiak, Shumagin, and Unalaska. Found by Stejneger and Grebnitzki on Bering and Medni islands.

164. Ronquilus jordani (Gilbert).

Recorded by Gilbert from Bristol Bay. Otherwise known from Seattle and Wrangell.

Family TRICHODONTIDÆ.

165. Arctoscopus japonicus Steindachner.

Two specimens from station 3652, off Iturup Island, depth 14 fathoms. D., X or XI, 13; A., 30 or 31.

Originally described from the Gulf of Strietok, Japan, and recorded, perhaps doubtfully, from Sitka.

166. Trichodon trichodon Tilesius.

Abundant about St. Paul Island, and often cast up by the surf; recorded by Dr. Gilbert from Herendeen Bay and Bristol Bay, and by Dr. Bean from Shumagin Islands, Unalaska, and Nunivak. Recorded by Stejneger from Bering Island.

Family BLENNIIDÆ.

167. Bryostemma polyactocephalum (Pallas).

Blennius polyactocephalus Pallas, Zoogr. Rosso-Asiat., III, 179. (Kamchatka.)
Chirolophus japonicus Herzenstein, Mélanges Biologiques, XIII, 1890, 123.

One specimen, 75 cm. long, from Kamchatka, agrees perfectly with Herzenstein's detailed description above cited. There is no reason to doubt that this is the species described by Pallas as *Blennius polyactocephalus*. We are not wholly satisfied that specimens listed under this name from eastern Bering Sea and Puget Sound (see Bean in Nelson's Report, p. 305, Pl. XV, fig. 2, and Jordan and Starks, Fishes of Puget Sound, 1895, 841) are identical with the Kamchatka form. Alaskan specimens have the posterior pair of supraocular cirri smaller than the anterior and have those of the anterior pair united for often half or more than half their length. We know too little of the variation within the species to warrant specific separation at present.

Recorded by Dr. Gilbert from about the peninsula of Alaska. One specimen obtained by us on St. Paul. Found by Stejneger and Grebnitzki on Bering and Medni islands.

168. Pholidapus dybowskii (Steindachner).

Centronotus dybowskii Steindachner, Ichthy. Beiträge, IX, 1880, 22, northern Japan.
? *Pholidapus grebnitskii* Bean and Bean, Proc. U. S. Nat. Mus., 1896, 390, Yeso, Japan.

Five specimens, the largest 25 cm. long, from Shana Bay, Iturup Island. Steindachner's excellent and detailed description leaves nothing to be desired, and corresponds perfectly with our material except in the character of the scales. A careful examination of these under high magnification fails to show that they are "am hinteren Rande mit kurzen Zähnchen bewaffnet." The posterior border is entire and the scales strongly marked with concentric striæ. Dorsal spines number 62, 63, 63, 64, 64. Dorsal ocelli are present in all our specimens, two of them being faintly visible even in the youngest, 55 mm. long.

Pholidapus grebnitskii may differ in the shorter dorsal fin (57 spines) and in the absence of teeth on the vomer, if these details are correctly reported.

The genus *Pholidapus* is closely related to *Opisthocentrus*, differing in the naked cheeks, the dentition, and in the less differentiation of the posterior dorsal spines.

169. Opisthocentrus ocellatus (Tilesius). (Plate LXXIX.)

Opisthocentrus quinquemaculatus Kner.
Blenniophidium petropauli Boulenger.
? *Opisthocentrus tenuis* Bean and Bean.

Numerous specimens: Tareinsky Bay, Kamchatka; Petropaulski Harbor; Shana Bay, Iturup Island. Recorded by Dr. Bean from Petropaulski.

The number of dorsal ocelli varies from 5 to 9 in our specimens, 6 being the prevailing number. Of 24 specimens whose fins we have examined, 4 have 58 dorsal spines, 10 have 59, 5 have 60, and 5 have 61. In addition, 1 specimen has but 55 spines. The latter is the only male in the collection, and is conspicuous by the absence of distinct dorsal ocelli and the great height of the vertical fins, the longest dorsal spine exceeding the length of the pectoral and contained $1\frac{1}{6}$ times in head. In females the longest spine is $2\frac{1}{5}$ in head.

The anal contains 36 to 39 rays in all our specimens. The dorsal fin is composed exclusively of spines, the anterior flexible ones passing into the strong pungent ones near the posterior end. The stronger spines vary from 7 to 12 in number in our specimens.

Our material answers the description of the type, which had 57 dorsal spines and 36 anal rays. It also agrees with specimens from Petropaulski, reported on by Bean and Bean (Proc. U. S. Nat. Mus., 1896, 391), with dorsal spines 58 in number. *Blenniophidium petropauli* Boulenger (Proc. Zool. Soc. Lond., 1892, 583) has but 52 dorsal spines, but it is otherwise not to be distinguished from *O. quinquemaculatus*. Still more aberrant are 4 specimens from northern Japan reported on by Steindachner (Ichthy. Beiträge, IX, 25), with but 50 to 53 spines and 32 to 34 anal rays.

Opisthocentrus tenuis Bean and Bean, from Yeso, D., 54; A., 38, is probably not a distinct species, although differing from any specimen examined by us. Our first impression on examining the type was that it was a valid species.

170. Pholis fasciatus (Bloch and Schneider).

Blennius tænia, Pallas, Zoogr. Rosso-Asiat., III, 1811, 178. Kuril Islands.
Muraenoides maxillaris Bean, Proc. U. S. Nat. Mus., 1881, 147. (St. Paul.)
Pholis tænia Bean and Bean, Proc. U. S. Nat. Mus., 1896, 388.

Three large specimens from St. Paul Island, the type locality of *P. maxillaris*, have been compared with a number of individuals of *Pholis fasciatus* from Upernavik, Greenland. We can appreciate no differences between the two. The size of the mouth and the length of the head are the same in specimens of equal length, and no difference exists in the development of the ventrals. The agreement seems to be perfect in the fin rays, relative proportions, and coloration.

Pallas's short account of *Blennius tænia* contains nothing distinctive except the number of fin rays and the statement that the body is banded. As both of these items agree with the present species, we may safely follow Bean and Bean in making the identification.

This species has been recorded by Gilbert from Bristol Bay, and by Dr. Bean from Petropaulski and St. Paul.

In a specimen from St. Paul, 29 cm. long, the length of the maxillary is contained $2\frac{2}{5}$ times in distance from tip of snout to origin of dorsal; the mandible equals the length of the pectoral. In a younger specimen, 15 cm. long, from Bristol Bay, the maxillary is contained $3\frac{1}{5}$ in predorsal length; the mandible approximately equals length of pectoral.

171. Pholis ornatus (Girard).

Abundant at Captains Harbor and Iliuliuk, Unalaska. Two specimens, agreeing entirely with the above, taken by Mr. Barrett-Hamilton at Bering Island, D.; LXXVII and LXXIX; A., II, 35 and II, 37.

Dr. Gilbert records the species from Herendeen Bay, and Dr. Bean from Kadiak, Shumagins, Belkofski, Unalaska, Atka, Adakh, Amchitka, Attu, and Port Moller. Stejneger and Grebnitzki found it on Bering and Medni islands.

172. Pholis pictus (Kner). Plate LXXXa.)

Urocentrus pictus Kner, Sitzungsb. d. K. Akad. d. Wissensch., LVIII, 1868, p. 51, taf. VII, fig. 21.

Centronotus pictus Steindachner, Ichth. Beiträge, IX, p. 25.

Numerous specimens from Shana Bay, Iturup Island. As already shown by Steindachner, this is a typical *Pholis*, Kner having been in error in ascribing to it an isolated and channeled first anal spine. The ventral spines are bound down by the integument more closely than usual, but they are in other respects not peculiar. Each is accompanied by two short spinous rays, concealed in the membrane and difficult to detect. The latter are stiff and pungent, and seem to be not articulated. The ventrals of *P. ornatus* show the same structure. Kner gives the anal formula as II, 40. This must be a misprint for II, 49, as the artist figures 51 rays in the fin, not differentiating the two anterior ones.

D., $9\frac{1}{2}$ to $10\frac{1}{2}$ in length to base of caudal. Depth, 8 to 10; D., XCIII or XCIV; A., II, 46 to 48.

173. Pholis dolichogaster (Pallas).

Gunnellus ruberrimus Cuvier and Valenciennes, Hist. Nat. Poiss., XI, 440.

One specimen, 18 cm. long, taken by Mr. Barrett-Hamilton at Bering Island. Also, taken by Stejneger and Grebnitzki on Bering and Medni islands and at Volcano Bay, Yeso.

The color is cherry-red on the body and fins; lighter on belly, lower half of cheeks, and under side of head. Lips blackish anteriorly, a narrow black streak running from them along snout to eye and from eye across cheeks and opercles toward upper edge of pectoral base. This line separates the deep red upper part of the head from the lighter area below. Sides of body with a number of minute scattered black spots. Along middle of sides is a distant series of light spots as large as pupil, the margin of each with 2 to 4 black specks, like those scattered over sides.

The dorsal and anal are more widely joined to the caudal than in other species, the fins being higher posteriorly and without perceptible notch. This does not seem sufficient ground for generic division. The dorsal contains 93 spines; the anal 2 spines and 47 rays; the pectorals 15 rays. Head, $9\frac{1}{2}$ in length; depth, $7\frac{5}{6}$. Eye, 5 in head; maxillary, $3\frac{3}{4}$; pectorals, $2\frac{1}{2}$; caudal, $2\frac{1}{3}$. Ventral spine, $2\frac{1}{5}$ in eye.

Blennius dolichogaster (Pallas) is undoubtedly identical with the present well-known species. They agree in the very long dorsal and anal fins (D., XCIII; A., II, 50 in *dolichogaster*), and in the color. *Dolichogaster* is described as having the color brownish-olive, shaded with greenish and yellowish, spotted with green above the lateral line, belly yellow; anal, caudal, and pectorals yellowish; dorsal and anal dusky, with transverse pale bars. Compare with this details of coloration recently published concerning *P. ruberrimus* by Bean and Bean, (Procs. U. S. Nat. Mus. 1896. 248). "Color olive-brown, with minute black spots; belly yellowish." In another specimen: "Across the spinous dorsal there are 20 narrow, nearly vertical pale streaks. Similar streaks, to the number of 12, cross the anal." The species is evidently not always red in life.

174. Enedrias nebulosus (Schlegel). (Plate LXXXb.)

For comparison we present a figure of this species, which was collected by the *Albatross* in Hakodate Harbor. In 7 specimens the dorsal spines are 78, 79, 80, 80, 81, 81, 81; anal, II, 37; II, 38; II, 38; II, 39; II, 39; II, 39; II, 40. In 4 specimens from Tokio, with which these have been compared, the dorsal spines are 81, 82, 82, 83; the anal, II, 39; II, 39; II, 40; II, 40. The dorsal formula is given by Schlegel as 74, but his artist represents 78 spines.

Pholis nebulosus may be taken as the type of a distinct genus, *Enedrias*, distinguished from *Pholis* by the scaly head.

This species is recorded by Bean and Bean from Yeso, where it was taken by Grebnitzki.

175. Xiphistes chirus (Jordan and Gilbert).

Recorded by Dr. Bean from Adakh and Amchitka.

176. Alectrias alectrolophus (Pallas).

Three small specimens, 75 to 209 mm. long, taken at Tareinsky Bay by Mr. Barrett-Hamilton. Also recorded from Grebnitzki's collection from Petropaulski and Stejneger's from Bering and Copper islands.

They differ from specimens of *Anoplarchus atropurpureus* in the higher crest, the more numerous fin rays, and in having the gill membranes posteriorly free from the isthmus. The latter character will define the new genus *Alectrias* Jordan and Evermann.

Head $6\frac{2}{3}$ in length; depth $7\frac{3}{5}$; D., LXII or LXIII; A., 43. Mouth oblique, maxillary reaching vertical behind pupil, $2\frac{1}{4}$ in head. Teeth in narrow bands on the jaws, the outer series in upper jaw somewhat enlarged; vomer and palatines with narrow bands of teeth. The dentition is similar to that in *Anoplarchus atropurpureus*, which has been erroneously described as having the teeth in the jaws in single series and the vomer and palate toothless. The gill membranes are rather narrowly joined to the isthmus and have a free posterior edge slightly wider than pupil. *A. atropurpureus* has the gill opening somewhat more restricted and the gill membranes without free fold. Large pores on head arranged similarly in the two species.

Spinous dorsal beginning slightly in advance of base of pectoral, its distance from snout less than length of head. Distance from origin of anal to tip of snout $2\frac{2}{5}$ in length to base of caudal. Pectoral short and broad, rounded, $2\frac{1}{6}$ in head.

Scales small, embedded, those on the anterior part of the body concealed by the thickened integument, as in *A. atropurpureus.*

Coloration in our specimens nearly uniform dark olive, with obscure dusky mottlings on the side. In one specimen there is a light bar extending obliquely downward and backward from eye, with a dark bar above and below it, the three separated by narrow light-gray lines. The caudal is narrowly cross-banded with light and dark, as in *atropurpureus*, and the anal is obliquely barred with the same. In the smallest specimen is a series of roundish spots about as large as eye along back just below dorsal fin. Each spot seems to have a narrow dark margin, a light ring, a dusky ring, and a light center. A series of similar but smaller spots along middle of sides posteriorly. The colors were probably brighter and more varied in life.

177. **Anoplarchus atropurpureus** (Kittlitz).

Found at St. Paul Island. Recorded by Dr. Gilbert from Unalaska and by Dr. Bean from Unalaska, Atka, Amchitka, Kiska, and St. Michael.

178. **Stichæus punctatus** (Fabricius).

Recorded from Bristol Bay by Dr. Gilbert, and by Dr. Bean from Kadiak and St. Michael.

179. **Leptoclinus maculatus** (Fries).

Three small specimens from station 3650, off Robben Reef, near the Kamchatka coast; 28 fathoms. No comparison has been made with Atlantic specimens. The lateral line is much more distinct than in our specimens of *Lumpenus medius*, where it can be made out with difficulty on scattered scales along middle of sides. The species was also recorded by Dr. Gilbert from Unimak Pass and Bristol Bay. One specimen was taken by us off Karluk.

180. **Lumpenus anguillaris** (Pallas).

Recorded from Unalaska by Dr. Gilbert, and by Dr. Bean from Unalaska and Point Belcher.

181. **Lumpenus mackayi** Gilbert.

Described from Nushagak River, Alaska.

182. **Lumpenus fabricii** (Reinhardt).

Numerous specimens taken by Dr. Gilbert in Bristol Bay. D., LXIII; A., I, 42. We are unable to distinguish them from others taken at Upernavik and in the Gulf of St. Lawrence.

The Bristol Bay specimens are paler in color, but not otherwise different. *Lumpenus nubilus* Richardson is not distinct from *L. fabricii.* Most specimens have small teeth on the palatines, but in two or three examples, and in the young, these are not appreciable. The specimens from Petropaulski and Plover Bay referred by Bean and Bean to *Lumpenus anguillaris* (Proc. U. S. Nat. Mus., 1896, 386) seem to belong rather to *L. fabricii.* The number of fin rays in the true *anguillaris* are greater.

183. Lumpenus medius (Reinhardt). (Plate LXXXI).

We have had no Atlantic material for comparison, and make this identification on the basis of the current figures and descriptions. The dorsal contains 59 to 61 spines in our specimens; no vomerine teeth are present, and three or four teeth only on the front of each palatine bone. Very young specimens have a series of short dark dashes along middle of body. Adults are nearly uniformly light, with a few very faint roundish dark spots and indistinct blotches or bars on the dorsal fin. The progressive lengthening of the posterior anal rays in this species does not seem to us of sufficient importance to warrant the retention of the genus *Anisarchus*.

184. Poroclinus rothrocki Bean.

Recorded by Dr. Gilbert from near Unalaska.

Family ANARHICHADIDÆ.

185. Anarhichas lepturus Bean.

This species is said to occur in abundance about St. Paul, but we did not find it. Recorded by Dr. Bean from St. Michael and found by Stejneger on Bering Island.

186. Anarhichas orientalis Pallas.

Recorded from Kamchatka; perhaps the same as the preceding. In any event no recent writer has observed it.

Family CRYPTACANTHODIDÆ.

187. Delolepis virgatus Bean.

Found by Dr. Gilbert at Unalaska; originally described from Kingcombe Inlet and Wrangel.

188. Lyconectes aleutensis Gilbert.

Described from north of Unalaska Island.

Family PTILICHTHYIDÆ.

189. Ptilichthys goodei Bean.

Dredged by Dr. Gilbert at Unalaska; originally described from Port Levashef, Unalaska.

Family ZOARCIDÆ.

190. Lyciscus crotalinus (Gilbert).

Sannak Islands.

191. Furcimanus diapterus (Gilbert).

North of Unalaska. The genus *Furcimanus* is well distinguished by its forked pectoral from *Lycenchelys*, which it otherwise resembles.

192. Lycodes concolor Gill and Townsend.

Deep waters of Bering Sea.

193. Lycodes digitatus Gill and Townsend.

Deep waters of Bering Sea. This species may prove to be the adult of *Lycodes palearis*.

194. Lycodes brevipes Bean.

From numerous localities about Unalaska. Dredged by us off Karluk.

195. Lycodes palearis Gilbert.

From Bristol Bay.

196. Lycodalepis turneri Bean.

Described from St. Michael and Plover Bay. Found by Mr. Scofield at Point Barrow. *Lycodes coccineus* Bean, from Big Diomede Island, Bering Strait, is identical with this species, being based on a specimen with some scales on the tail.

197. Bothrocara mollis Bean.

Bothrocara mollis Bean, Proc. U. S. Nat. Mus., 1890, 38.
Maynea brunnea Bean, Proc. U. S. Nat. Mus., 1890, 39.

One adult and two young, the latter 14 and 17 cm. long, from station 3634, off Bogoslof Island, depth 664 fathoms. *Bothrocara mollis* was evidently based on the young of *Maynea brunnea*, in which the vomerine and palatine teeth are absent, or very weakly developed and hidden under the skin. In our young specimens the head is $5\frac{1}{2}$ or $5\frac{1}{3}$ in total length, the depth of body about 10. The eye is $3\frac{1}{2}$ in head. The maxillary reaches nearly to below middle of eye. The large mucous cavities are conspicuous along mandible, subocular ring, and top of head. The length of fins is as described for the type of *B. mollis.*

Our young specimens are especially valuable for comparison with *Bothrocara pusilla*, which apparently does not reach a large size. The differences assigned to distinguish the two species are valid, *B. pusilla* being more elongate and less compressed, with shorter head, much smaller mouth, and with much less development of the mucous cavities. In *B. mollis* the gill openings are wider, with narrower isthmus, the anterior end of the cleft being under the posterior margin of eye, and the width of the isthmus less than half diameter of pupil. In *B. pusilla* the anterior end of gill cleft is under the margin of the preopercle, and the width of isthmus is equal to half the diameter of the orbit, or but slightly less.

As it is doubtful whether either species belongs to the Antarctic genus *Maynea*, we retain for the present the genus *Bothrocara.*

198. Bothrocara pusilla Bean.

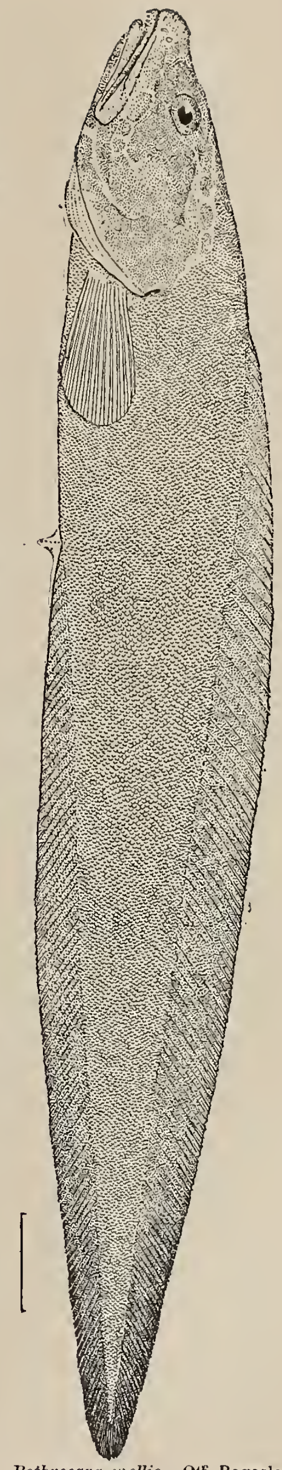
Recorded from north of Unalaska.

199. Gymnelis viridis Fabricius.

Found at Unalaska and Bristol Bay by Dr. Gilbert. Also recorded by Dr. Bean from Shumagin, St. Michael, Unalaska, and Plover Bay. Found by Stejneger on Medni Island.

200. Gymnelis stigma (Lay and Bennett).

One specimen obtained by the *Albatross* at station 3688, near St. Paul Island. Originally described from Kotzebue Bay.



Bothrocara mollis. Off Bogoslof Island. Anna L. Brown del.

This species seems to differ from *Gymnelis viridis* in the more backward insertion of the dorsal, at least an eye's diameter behind the pectoral, and in the presence of a large, jet-black ocellated spot on the dorsal over the vent. The small white spots on anterior part of the body were apparently taken by Dr. Collie, its discoverer, for "very small scales." The species is naked, and this discrepancy led Richardson to redescribe this form as *Gymnelis viridis* var. *unimaculatus*. Richardson's figures of the two forms (Last Arctic Voyage) are excellent. Whether they are really distinct remains to be proved.

Family LYCODAPODIDÆ.

201. **Lycodapus extensus** Gilbert.

From off Unalaska.

202. **Lycodapus parviceps** Gilbert.

From near Unalaska.

Family GADIDÆ.

203. **Lota maculosa** (Le Sueur).

In the Yukon, Nushagak, and other rivers of northern Alaska.

204. **Theragra chalcogramma** (Pallas).

Unalaska, St. Paul, St. George, Bering Island, Petropaulski; station 3651, off Robben Reef, depth 20 fathoms. Everywhere abundant. The following notes are from adult specimens:

Olivaceous above, sides silvery, with two interrupted stripes of dark, brassy olive along sides; these irregular on their edges, each about half width of eye; a trace of a third similar stripe below anteriorly, the stripes very irregular; back mottled Dorsal plain dark olive; pectoral quite dark; lower fins ashy; caudal ashy olive.

D., 12, 14, 18; A., 19, 20. Ventral nearly to vent; pectoral to anal, $1\frac{1}{2}$ in head; eye 5; snout $3\frac{1}{6}$; maxillary $2\frac{1}{2}$. Head 4; depth 6.

The Alaskan pollack seems to be the type of a distinct genus, for which Mr. Lucas suggests the name of *Theragra*. The following is Mr. Lucas's note on the genus:

The Alaskan pollack differs from the Atlantic pollack in having 19 precaudal and 33 caudal vertebræ instead of 23 precaudals and 32 caudals; the bodies of the vertebræ are also slightly longer and more deeply sculptured in the Alaskan fish and the spinous process of the anterior dorsals less elevated.

The greatest differences between the two species, however, are to be found in the gill covers, for the suboperculum of the Alaskan pollack is thick, smooth, and dense, instead of being thin and squamous. The postclavicle is also similar in structure, while its proximal portion is subcircular in the Alaskan species and rhomboidal in the Atlantic. This ivory-like character of the suboperculum and post clavicle is so marked [in the Alaskan form] that it serves to distinguish these bones at a glance, being entirely different from what is found in the corresponding bones of other gadoids.

The vertebral differences between the two fishes are merely differences of degree and of specific value only, but the differences between the subopercula and postclavicula are differences in kind, distinguishing the Alaskan pollack not only from the Atlantic pollack, but from other gadoids. This being the case, it is proposed to establish a distinct genus for the Alaskan pollack, and the name *Theragra* is proposed for this genus. (F. A. L.)

205. **Gadus macrocephalus** Tilesius. Codfish.

Everywhere common; taken at Karluk, Belkofski, Unga, Unalaska, St. Paul, St. George, Bering Island.

206. Boreogadus saida (Lepechin).

Common northward. Recorded by Turner from St. Michaels and by Scofield from Herschel Island, Point Barrow, and Port Clarence.

207. Eleginus navaga (Kölreuter).

Petropaulski; station 3642, in Avatcha Bay, Kamchatka, depth 16 fathoms. Recorded by Dr. Bean from Kadiak, St. Michaels, and Port Clarence, and by Mr. Scofield from Port Clarence; found at Petropaulski and Bering Island by Stejneger and Grebnitzki.

208. Antimora microlepis (Bean).

Originally described from off Queen Charlotte Islands. A specimen taken off Bogoslof, station 3634, 664 fathoms. The filamentous ray of first dorsal is $1\frac{1}{7}$ times in head instead of twice as described by Bean, and the eye is slightly shorter than snout. Our specimen is somewhat larger than the type, however. Recorded by Dr. Gilbert from about St. Paul in deep water.

Family MACROURIDÆ.

209. Macrourus cinereus Gilbert.

Numerous specimens from station 3634, off Bogoslof Island, in 664 fathoms. Originally described from near Unalaska.

210. Macrourus acrolepis Bean. (Plate LXXXII.)

One small specimen taken from station 3634, off Bogoslof Island, in 664 fathoms. It agrees with other specimens from the coast of Oregon. The first dorsal in all has 11 rays.

211. Macrourus lepturus Gill and Townsend.

Deep waters of Bering Sea. *Macrourus dorsalis* Gill and Townsend, is the same species, and it is very close to *M. acrolepis*, but the first dorsal has a greater number of rays.

212. Albatrossia pectoralis (Gilbert).

Two adult specimens dredged by the *Albatross* in 664 fathoms, off Bogoslof Island, station 3634. The species was known heretofore only from off the Oregon coast. *Nematonurus magnus* Gill and Townsend, is the same species. This species is widely different from *Malacocephalus*, and is the type of the genus *Albatrossia*.

The name *Albatrossia* is given in honor of the vessel of the United States Fish Commission, the use of which for purposes of scientific investigation has shed luster on American science and added enormously to the knowledge of the life of the depths of the sea.

213. Bogoslovius clarki Jordan and Gilbert, new species. (Plate LXXXIII.)

The genus *Bogoslovius* Jordan and Evermann differs from *Chalinura* in having the premaxillary teeth in two distinct series (as in *Albatrossia*), those of the inner series small and representing the usual villiform band. The scales are also much more spinous than in the species of *Chalinura*, and the ventral filament is much produced. The type species, *B. clarki*, shows the following characters:

Snout short, slightly exceeding diameter of eye, $3\frac{2}{10}$ in head, median and nasal ridges very little projecting anteriorly, without radiating spines; tip of snout very little projecting beyond the mouth, for a distance not exceeding one-third the interspace between ends of median and nasal ridge. Infraorbital ridge inconspicuous, scarcely extending beyond the eye.

Mouth large, oblique, the lower jaw included, the maxillary nearly reaching vertical from posterior edge of orbit, $2\frac{1}{6}$ in head. Outer premaxillary teeth slender, sharp, unequal, rather distant, not very strong, slightly widened and arrow shaped near tip, becoming very small toward angle of mouth. Within this, and well separated from it, a close-set series of short teeth, directed inward. Mandibular teeth slender, unequal, in a single series corresponding to outer series in upper jaw, slightly widening at symphysis, which is not prominent. Barbel very short, less than half diameter of pupil. Eye of moderate size, equaling distance from tip of snout to middle of anterior nostril, $4\frac{2}{3}$ in head, $1\frac{1}{10}$ in interorbital width. Preopercle broadly rounded, the angle little produced backward, leaving a strip of interopercle exposed along its entire length. Gill membranes joined to the isthmus with a narrow free edge.

Gill rakers very short and thick, $3 + 12$ in number, including rudiments.

Dorsal beginning above base of pectorals, the second spine long, filamentous at tip, $1\frac{2}{5}$ in head, its anterior margin sharply serrate except in basal third. Base of first dorsal $2\frac{1}{5}$ in head. Interspace between dorsals very short, usually less than diameter of pupil. Pectorals very long and slender, equaling or exceeding length of head behind snout, their insertion low, below angle of gill arch. Outer ventral ray excessively produced, twice or more than twice length of head in uninjured adults, reaching base of fiftieth anal ray or beyond. Vent immediately before anal origin.

Scales in a strip along the back firm and very rough, none others preserved in our specimens. Scales with three to five sharp radiating ridges, each ridge with several sharply projecting spines, the posterior of which project beyond the margin of the scale.

Dorsal, 11, 12; pectoral, 19; ventral, 10.

Color very light gray, the vertical fins blackish posteriorly. Mouth and gill cavity and peritoneum jet black.

Four specimens, 24 to 41 cm. long, from station 3634, off Bogoslof Island, in 664 fathoms. The species is named for Mr. George Archibald Clark, secretary of the Fur-Seal Commission.

214. Bogoslovius firmisquamis (Gill and Townsend).

Dredged in Bering Sea by the *Albatross.*

Family PLEURONECTIDÆ.

215. Hippoglossus hippoglossus (Linnaeus).

Generally common. St. Paul, Unalaska, Unga, Karluk.

216. Atheresthes stomias Jordan and Gilbert.

Generally common with the preceding, but reaching a much smaller size. Unalaska, Unga, Karluk.

217. Hippoglossoides elassodon Jordan and Gilbert.

Perfectly typical specimens from stations 3643 and 3644, off Kamchatkan coast, in 100 and 96 fathoms. Also taken by us off Karluk, and recorded by Dr. Gilbert from Aleutian Islands and Bristol Bay. Dr. Bean mentions it from Kadiak, Shumagins, Unalaska, and St. Michael.

Dorsal, 77 to 84; anal, 60 and 61. Pectoral short and broad, less than half length of head. Interorbital ridge sharp, with a single series of scales. Gill rakers, 14 in lower limb of arch.

218. Hippoglossoides robustus Gill and Townsend.

Deep waters of Bering Sea; very close to the next.

219. Hippoglossoides hamiltoni Jordan and Gilbert, new species. (Plate LXXXIV.)

One specimen 17 cm. long, from station 3641, Avatcha Bay, Kamchatka; depth 16 fathoms.

Nearly related to *H. elassodon*, from which it differs in the fewer fin rays and scales, the wider interorbital space, the longer caudal and pectoral fins, and the much smaller symphysial knob. The nasal tubes are larger, the scales rougher, and the anterior part of lateral line more arched. Its relationship with *Hippoglossoides robustus* of the same region is still closer.

Head $3\frac{1}{5}$ in length, depth $2\frac{2}{5}$. Longest diameter of upper eye, $3\frac{1}{2}$ in head; snout (measured from upper eye) 5 in head; maxillary of colored side $2\frac{1}{3}$, of blind side $2\frac{1}{6}$ in head. Depth of caudal peduncle equaling its length, $3\frac{1}{3}$ in head. D., 72; A., 56; P., 11. Pores in lateral line 91.

Upper profile of head continuing the dorsal curve without interruption, there being a slight depression above the eye and an increased convexity on the snout. The mandible is very heavy, and projects anteriorly so that its symphysial profile completes the curve of the snout. A very short prominence at symphysis is directed vertically downward. The gape is strongly curved and the mouth narrowed anteriorly so that the maxillary and premaxillary are almost wholly concealed along the middle of their length by the overarching prefrontal. Teeth acute, in a single series in each jaw, all except the anterior teeth in each jaw short. At the symphysis of lower jaw the teeth are longer and directed inward, while in the anterior end of each premaxillary the teeth are still more enlarged and the series on each side describes a strong curve with its convex side toward the median line. The maxillary reaches the vertical from slightly behind middle of lower eye. Nostril tubes conspicuous, the anterior in closest proximity to the upper lip, which it entirely overhangs. Posterior nostril tube wider and slightly shorter.

Eyes of nearly equal size and opposite, separated by a wider range than in *H. elassodon*, the ridge bearing in its narrowest portion two well-defined rows of strongly spinous scales. A conspicuous series of pores joining lateral line with upper margin of upper eye, and another encircling the lower eye below and behind; a third series along mandible and preopercle; one large pore above posterior nostril. Gill rakers slender, unarmed, 2 above the angle, 11 or 12 below it, the longest $2\frac{3}{4}$ in eye.

Dorsal fin beginning above front of pupil, the longest ray $2\frac{5}{6}$ in head. Anal preceded by a strong spine, its height equaling that of dorsal. Pectoral very long and slender, two-thirds length of head; that of blind side shorter, half length of head.

Ventrals reaching to base of fourth or fifth anal ray. Caudal long, evenly rounded behind, the middle rays not longer than those adjacent, their length equaling distance from tip of snout to preopercular margin.

Scales on colored side strongly ctenoid except in a strip along middle of sides anteriorly. Elsewhere each scale is provided with two to four long spines. On blind side they are smooth except in nape and caudal peduncle. Cheeks, opercles, and interorbital space covered with larger rougher scales than those on sides. Mandible and snout naked. A single series surrounds each eye anteriorly, a series on maxillary of colored side. Blind side of head with maxillary naked, cheeks covered with minute smooth thin scales, the opercles with a few scattered spinous scales, the preopercle naked.

Color nearly uniform brownish, without distinctive markings on body or fins.

The species is named for Mr. Gerald E. H. Barrett-Hamilton, of the British Fur-Seal Commission.

VERASPER Jordan and Gilbert, new genus.

This genus is most nearly allied to *Xystrurys* and *Hippoglossina*, having few short gill rakers, like the former, and strongly ctenoid scales, like the latter. It differs strongly from all its congeners in having premaxillary teeth in two series. The single type is dextral. The teeth are uniformly small, without canines. The dorsal originates above the front of pupil. The lateral line is strongly arched above the root of the pectoral, without recurrent dorsal branch. The scales are extremely spinous. The gill rakers are short, thick, and triangular, few in number. None of the fin rays are notably produced or exserted.

Besides the typical species, *Verasper moseri*, a second species, *Verasper variegatus* (Schlegel), is a common food-fish in the waters of the more southern islands of Japan.

220. Verasper moseri, Jordan and Gilbert, new species. (Plate LXXXV.)

One male specimen, 28 cm. long, from Shana Bay, Iturup Island, is the type of the species; other specimens similar to this were taken in the harbor of Hakodate.

Dorsal, 82; anal, 58; pectoral, 12; pores in lateral line, 84. Head $3\frac{1}{3}$ in length to base of caudal; depth 2; depth of caudal peduncle 4 in greatest depth of body; length of caudal peduncle, measured axially, $1\frac{2}{3}$ in its depth. Head much depressed, with rather wide flat interorbital space, resembling in appearance *Psettichthys melanostictus;* its thickness at interorbital space equaling distance between pupils of upper and lower eyes.

Mouth small, very oblique, the gape strongly arched, the broad maxillary reaching a vertical behind middle of pupil, $2\frac{1}{3}$ in head. Mandible narrowing toward tip, with very rudimentary symphysial knob. Teeth in the upper jaw in two distinct series throughout, those of the outer series increasing slightly in size toward front of jaw, but none of them canine-like. Mandibular teeth in one row, except at symphysis, where a few teeth form a short outer series. Nasal openings of eyed side approximated in front of middle of interorbital space. The anterior has a short tube, the posterior with a raised rim. Eyes small, their anterior margins opposite, the diameter of lower eye equaling distance from tip of snout to posterior nostril, $6\frac{1}{3}$ in head. Interorbital space rather broad and flat, not ridge-like, its total width equaling half the diameter of orbit. Gill rakers short, broad, triangular, minutely toothed on inner margin, one-third diameter of eye; 7 present on horizontal limb of outer arch.

Lateral line with a short, high anterior arch, the chord of which is one-fifth the straight portion. The height of the arch is one-third its length. Behind the arch, the lateral line descends in a gentle curve to middle of sides. The scales are very rough, each possessing several long, sharp spines diverging from median portion of posterior margin. Anterior and posterior portions of dorsal and anal fins naked, the rays of the middle portion each with a series of strongly ctenoid scales. Caudal densely scaled to tip. Pectorals and ventrals naked. Head covered with strongly spinous scales, excepting snout, maxillary, and mandible. On blind side of head the snout, jaws, preopercle, subopercle, lower half of opercle, and all but a central strip on interopercle, scaleless. On blind side the scales are rough on head, ventral area, and along bases of ventral fins; largely smooth elsewhere.

Dorsal beginning above front of pupil, the rays increasing in length to the forty-fifth, which is $2\frac{2}{7}$ in head. Longest anal ray (the seventeenth), $2\frac{1}{7}$ in head. Caudal broadly rounded, $1\frac{2}{5}$ in head. Pectoral short and broad, $2\frac{2}{5}$ in head. Ventrals of nearly equal length, reaching origin of anal, $3\frac{1}{5}$ in head. No anal spine.

Color in spirits: Centers of the scales light gray, the margins dark brown. Fins light or dusky, the vertical fins with conspicuous black bars parallel with the rays. These are most evident on the under side, where the pigment seems to principally occur, and are seen through the fin more faintly on the colored side. Lining of cheeks and gill cover of colored side dusky. Peritoneum gray. The species is named for Jefferson F. Moser, U.S.N., commander of the *Albatross*.

Verasper variegatus (Schlegel), of the same genus, is closely related to *V. moseri*, from which it differs chiefly in the much lower and smaller arch of the lateral line. The fins in this species are spotted with black, but not barred.

221. **Lepidopsetta bilineata** (Ayres).

Abundant everywhere in Bering Sea. Our specimens from St. Paul Island; station 3637, off St. George, 32 fathoms; Unalaska; Bering Island; Medni Island. Dr. Gilbert records the species from Unalaska, Herendeen Bay, Hagemeister Island, and from various localities about the peninsula of Alaska.

222. **Limanda aspera** (Pallas).

Common; taken by us at Petropaulski, Avatcha Bay, Kamchatka; stations 3646 and 3647, off Robben Reef, in 18 and 20 fathoms. Recorded by Dr. Gilbert from Bristol Bay, Herendeen Bay, and many other stations. Dr. Bean mentions it from Sitka, Kadiak, Shumagins, Port Clarence, Plover Bay, and Indian Point.

223. **Limanda proboscidea** Gilbert.

Described from Bristol Bay and Herendeen Bay.

224. **Pleuronectes quadrituberculatus** (Pallas).

Station 3642, Avatcha Bay, 16 fathoms. Station 3647, off Robben Reef, 20 fathoms. Recorded by Dr. Gilbert from Chernofski Harbor, Herendeen Bay, and Bristol Bay, by Dr. Bean from Kadiak, and by Mr. Scofield from Chignik and Port Clarence.

This species is a true *Pleuronectes*, having the lower pharyngeals narrow, separate, with two rows of bluntish teeth. It is an ally of *Pleuronectes platessa*.

225. **Liopsetta glacialis** (Pallas).

Petropaulski. Recorded by Dr. Gilbert from Bristol Bay, by Dr. Bean from Kotzebue Sound, and by Mr. Scofield from Port Clarence.

226. Liopsetta obscura (Herzenstein).

Pleuronectes obscurus Herzenstein, Mélanges Biologiques, 1890, 127.

Two males from Shana Bay, Iturup Island, are referred to this species. The scales on the colored side are everywhere strongly ctenoid and imbricated, while in the types (supposed to be females) they were cycloid. In our specimens the head is somewhat smaller, $3\frac{9}{10}$ in length instead of $3\frac{1}{10}$ to $3\frac{3}{5}$; the depth is greater, $2\frac{1}{5}$ in length instead of $2\frac{3}{7}$ to $2\frac{3}{8}$; the interorbital space is covered with very fine scales, not naked; the curve of the lateral line seems more marked, its chord contained five instead of six times in the straight portion. All of the fins are higher than in the female types, the pectoral of colored side being $1\frac{3}{5}$ in head, the caudal $1\frac{1}{6}$, the ventral half head, and the highest dorsal ray $1\frac{2}{5}$. Some of these differences may well be sexual. The lower pharyngeals are short and broad, 27 and 29 cm. long. The teeth are large and very blunt, like cobblestones, and are arranged in one row along the outer edge, a row of larger teeth along the inner edge, and a short row along the posterior edge of the triangle. The arrangement is very similar to that found in *L. glacialis*, but here a few small teeth, without definite arrangement, are interposed in the middle of the bone, between the three series described.

Dorsal, 59 and 62; anal, 45 and 46; tubes in the lateral line, 79.

Color on eyed side, uniform dark brown on body and fins, the extreme tips of the fin rays white. On blind side the body is yellowish white, with a few irregular scattered dark spots; the dorsal and anal are yellowish at base, becoming more or less mottled with dusky on distal half, the fins marked with broad, dark bars parallel with the rays, about 7 on the anal fin, 10 or 11 on the dorsal; caudal light on basal half more or less blotched with darker, becoming black posteriorly.

With this species we identify also a number of young specimens 9 to 15 cm. long from the same locality (Iturup Island). They are probably young females, but the viscera are in such condition as to prevent positive determination. The scales are perfectly smooth, but in other respects they agree perfectly with the adult males, except in their more varied coloration. The head and body is brownish, profusely spotted in coarser or finer pattern with light gray; also with a few scattered black spots edged with gray. The markings on the fins are as described for adults. In seven specimens the dorsal contains 60, 62, 62, 62, 64, 65, and 66 rays; anal, 45, 45, 45, 46, 47, 47, 48.

227. Platichthys stellatus (Pallas).

Very common; taken by us at St. Paul, Unalaska, Petropaulski, Bering Island, Robben Island, Karluk. Recorded by Dr. Gilbert from Bristol Bay, and by Dr. Bean from Kadiak, Unalaska, and St. Michael. Scofield found it abundant at Port Clarence, and Stejneger on Bering Island.

228. Glyptocephalus zachirus Lockington.

Recorded by Dr. Gilbert from various localities about the peninsula of Alaska.

229. Microstomus pacificus (Lockington).

Recorded by Dr. Gilbert from about Unalaska.

LIST OF FISHES OBTAINED IN THE WATERS OF ARCTIC ALASKA.

By Norman Bishop Scofield.

This report is based on a collection of fishes made in 1896 by the author and Mr. Alvin Seale, under the auspices of the Hopkins Laboratory of the Leland Stanford Junior University.

Through the aid of Mr. Timothy Hopkins and of the late Capt. J. N. Knowles, then president of the Pacific Steam Whaling Company, of San Francisco, the writer, with Mr. Seale, received passage on the vessels of the company from San Francisco to Herschel Island and return, and were afforded every opportunity to make collections at the various ports of call.

Embarking at San Francisco on the *J. D. Peters*, one of the company's sailing vessels, our first stop was at King Island near Bering Strait, where we arrived on the 3d of July.

King Island is about 10 miles in circumference, with precipitous, rocky sides, on which it is possible to obtain a footing at only one place. This is occupied by a small Eskimo village, the summer huts supported on stilts and clinging to the face of the clifflike birds' nests. It was impossible to use a seine at this point. With the hook and line we succeeded in catching only one kind of fish, a sculpin (*Myoxocephalus verrucosus*). We remained in the neighborhood of the island about a week waiting for the harbor of Port Clarence to become clear of ice. The winter just passed had been very severe throughout northern Alaska, and the breaking up of the ice at Port Clarence, which usually occurs in the latter part of June, did not begin until the 11th of July. We succeeded in entering the harbor on the following day. Herring and salmon were already running. The smelt (*Osmerus dentex*) was a little later in arriving, and the capelin (*Mallotus villosus*) did not appear until the 25th, the day of our departure. The lateness of the season retarded the arrival of the anadromous fishes by about two weeks. We learned later that the same was true for that season of the fishes which entered the Mackenzie River.

Port Clarence is situated 40 miles southeast of Bering Strait. The main harbor, which is circular, is about 13 miles across, and is separated from the ocean on the west by a long, low sand spit. The shores are all low, with gravelly beaches, and the water averages about 6 fathoms in depth. The inner harbor, known as Grantley Harbor, is small and separated from the main port by another sand spit. Flowing into Grantley Harbor is a river, about a quarter of a mile in width, which is fed by a large lake some 20 or 30 miles from its mouth. During our stay at Port Clarence we made a two days' trip up this river, and spent the remainder of the two weeks in seining along the beaches of the two harbors.

From Port Clarence we accompanied the steamer *Jeanie* on its annual trip to Herschel Island, stopping on the way at Point Barrow. We stopped at Point Barrow on our return also, but on both occasions the ice was so thick along the beaches that we were able to make only a few hauls with the seine. The open season at Point Barrow is short, extending from the middle of July to the latter part of September, and there are nearly always large quantities of ice in the neighborhood. The shore line here, as is indeed the entire Alaskan coast north of Bering Strait, is very low and monotonous, with gravelly and sandy beaches. The fish are apparently not plentiful, and the natives at Point Barrow depend upon them but little for food.

Herschel Island, 80 miles west of the Mackenzie River, was the next and farthest point reached by us. This island is composed of low clay hills and is about 25 miles in circumference. Here we remained at the whaling company's winter quarters from August 18 until September 5. We were unable to make any extended trips, but did all of our fishing on the shores of the island and on the opposite mainland, 2 miles distant. There were no streams in the immediate neighborhood, so that all the fish taken were from salt water. The herring are usually seen at the island earlier in the season while on their way to the Mackenzie River, but none were seen by us.

On our return trip, after leaving Bering Sea, we made a stop of two days, September 28 and 29, at Chignik Bay, on the mainland opposite Kadiak Island. The coast here is very rocky and the sand beaches are few and small, so we obtained but little. Our collecting during the trip was limited to the four places mentioned: Herschel Island, Point Barrow, Point Clarence, and Chignik Bay; of these, Port Clarence and Herschel Island were the only ones favorable for thorough investigation.

1. **Clupea pallasi**, Cuvier and Valenciennes.

We found this fish abundant at Port Clarence, where it appeared a day or two after the ice went out of the harbor.

2. **Coregonus kennicotti**, Milner.

We obtained one large specimen of this species, which was taken by native fishermen at Barter Island, near the mouth of the Mackenzie River. D., 10; A., 13; scales 11, 86, 11; gill rakers, 8 + 14, 8 + 13.

We have compared it with a specimen obtained by Miss Elizabeth Taylor in Great Bear Lake and find they are the same. A description of the specimen obtained by Miss Taylor has been published by Dr. Gilbert, Bull. U. S. Fish Commission, 1894, 23.

3. **Coregonus nelsoni** Bean.

We found this fish in considerable numbers in the brackish water of Grantley Harbor. Our largest specimen is 13 inches long; the others but little smaller. The backs are not so conspicuously humped as in the type, which is a larger and more mature fish. The distance from snout to nape about twice in distance from nape to origin of dorsal, but it would be more in a more humpbacked individual. We did not find this fish at Herschel Island.

Head.	Eye.	Dorsal.	Anal.	Scales.	Gill rakers.	Locality.
$4\frac{3}{5}$	$4\frac{2}{3}$	12	12	10 80 8	7+13 7+13	Grantley Harbor.
$4\frac{1}{5}$	$4\frac{1}{5}$	12	12	9 80 8	7+12 7+13	Do.
$4\frac{5}{6}$	$4\frac{1}{2}$	12	12	8 88 8	7+13 7+15	Do.
$4\frac{1}{2}$	5	12	12	10 86 8	6+12 7+13	Do.
$4\frac{1}{2}$	5	12	12	9 80 8	6+12 7+13	Do.
$4\frac{2}{3}$	$4\frac{1}{16}$	11	12	....	6+12 7+15	Renideu station, Port Clarence.

4. **Argyrosomus pusillus** (Bean).

This fish we found quite abundant in the river back of Grantley Harbor. We also obtained two large specimens from Barter Island near the mouth of the Mackenzie

River. Our specimens show quite a range of variation in the number of gill rakers and fin rays, given in the accompanying table. One of the specimens from the mouth of the Mackenzie is the only one that shows perfectly the black markings on the dorsal, as given in the figure of a similar sea-run individual from northern Alaska. (Whitefishes of America. Report of U. S. Commissioner of Fish and Fisheries, 1894. Plate 23; also same plate in Cruise of steamer *Corwin.*) In addition to this it has a few small, round black spots on top of the head and four or five similar spots on adipose fin. All of the specimens have the articulation of mandible on a vertical with center of eye. The diameter of eye equals the interorbital width and is greater than length of snout.

Locality.	Length.	Gill rakers on left side.	Gill rakers on right side.	Dorsal.	Anal.	Scales.
	Inches.					
Grantley Harbor	6	16+31	16+32	11	13	92
Do	6	17+32	18+32	11	13	83
Do	6	17+31	17	11	14	93
Do	6	17+31	17+30	10	14	84
Do	6	17+30	17+30	10	13	85
Do	6	17+28	16+28	12	14	90
Do	6	14	14+29	12	12	84
Do	6	16	15+28	11	12	91
Barter Island	$13\frac{1}{2}$	14+27	14+28	10	11	83
Do		17+29	16+28	10	13	*a* 83
Nushagak River, Alaska (*Albatross coll.*)		11+25	12+25	13	12	89
Naknek River, Bristol Bay (*Albatross coll.*)		14+25	14+26	11	12	90

a No. 46.

5. Argyrosomus lucidus (Richardson).

We obtained two specimens of this species in salt water off Herschel Island. They are undoubtedly identical with the species found in Great Bear Lake and River. We have compared them with two specimens from Great Bear River. One of our specimens has a larger number of scales than the other, but it is not a larger variation than may be expected within a species of this family.

Besides the fin formula we give a few measurements not included in Jordan and Evermann's otherwise full description: Longest dorsal ray, $1\frac{1}{2}$ in head; longest anal ray, $2\frac{1}{3}$ in head; pectorals reach less than halfway to origin of ventrals, or $1\frac{1}{2}$ in head; ventrals reach less than halfway to vent, or $1\frac{2}{3}$ in head; ventral scale a little over half length of fin; articulation of mandible with quadrate bone on a vertical with posterior margin of eye. Length of each specimen, 16 inches.

Number.	Dorsal.	Anal.	Ventral.	Gill rakers.	Scales.	Transverse rows of scales below dorsal.
64	13	13	12	16+26	10 87 10	14
67	11	12	12	15+26	10 98 10	16

6. Argyrosomus alascanus Scofield, new species. (Plate XLII.)

Head, $4\frac{1}{4}$; depth, about 4; dorsal, 12; anal, 12; scales, 10, 85, 9. Eye a little shorter than snout, 5 in head, $1\frac{1}{3}$ in interorbital space. Head wedge-shaped, the upper and lower profiles straight and meeting with a sharp angle at the snout. Viewed from above the snout is blunt, almost square, with the narrow, pale, rounded tip of the lower jaw slightly projecting. Mouth oblique; the distance from the tip of the snout to tip of maxillary is equal to the distance from the tip of snout to center of pupil; the maxillary from its anterior articulation is contained $3\frac{1}{2}$ in the head, its width 3 in its length, its upper anterior edge closing under maxillary; mandible, $2\frac{1}{3}$ in head, its articulation with the quadrate bone beneath the posterior edge of the eye; width of supplemental bone a little more than one-half width of maxillary. Preorbital broad, its greatest width equals three-eighths of its length or diameter of pupil; width of supraorbital equals two-sevenths of its length. Gill rakers, 12 to 14 + 21 to 23, long and slender, the longest two-thirds diameter of the eye. The tongue, vomer, and palatine without teeth. Distance from tip of snout to nape equal one-half the distance from the nape to the front of the dorsal, or two-thirds length of head. Adipose fin large; ventral scale one-half length of fin; longest dorsal ray, $1\frac{1}{2}$ in head; longest anal ray, 2 in head; the pectorals reach more than half way to the ventrals; the ventrals reach two-thirds distance to vent; the caudal is forked for a little more than one-half its length. Color dusky above, silvery beneath; the dorsal, adipose fin, tips of caudal rays, and upper side of anterior pectoral rays dusky; fins otherwise pale. The fish appears to be nearest related to *Argyrosomus artedi*, but it differs considerably in number of gill rakers. We obtained but three specimens of this fish—one in salt water at Point Hope, the other two in brackish water at Grantley Harbor. The largest one is $10\frac{1}{2}$ inches in length.

Locality.	Length.	Gill rakers.		Dorsal.	Anal.	Scales.
	Inches.					
Grantley Harbor	$8\frac{1}{2}$	14+23	14+22	12	14	88
Do	9	14+22	12+22	12	12	87
Point Hope, Alaska	11	13+21	12+21	12	12	85

7. Stenodus mackenziei (Richardson).

We obtained three specimens of this fish, one of which was brought to us by the whaling vessel, the other two by native fisherman. All three are from the mouth of the Mackenzie River, and, as far as we could learn, it has never been seen any place else by either natives or white people. The largest specimen is 35 inches in length. This may be the same as the Siberian species *Stenodus leucichthys* (Güldenstadt), but it is impossible to decide as the descriptions of that species are inadequate.

Head, $4\frac{3}{4}$; depth, 5; D., 13; A., 15; scales, 12, 103, 10; gill rakers, 6+16, the longest equaling diameter of eye; branchiostegal rays, 10; eye, $1\frac{6}{10}$ in snout, $1\frac{1}{2}$ in interorbital space, $7\frac{1}{2}$ in head; snout, $4\frac{1}{2}$ in head; maxillary from its articulation, 3 in head; from tip of snout to end of maxillary, $2\frac{2}{4}$ in head, its width contained $4\frac{1}{2}$ times in its length, its end reaching vertical behind eye. Supplemental bone, $4\frac{1}{2}$ in head; its width 4 in its length, its anterior end notched; the point above the notch sharp, the lower point rounded.

Preorbital, $4\frac{2}{3}$ in length of head; its greatest width, $2\frac{1}{2}$ in its length. Mouth large, the lower jaw projecting considerably beyond the upper. Tips of upper and lower jaws, the palatines, vomer, and tongue with bands of short bristle-like teeth.

Distance from tip of snout to nape, $3\frac{1}{2}$ times into distance from tip of snout to front of dorsal; front of dorsal nearer the median caudal rays than tip of snout by width of eye; origin of ventral a width of eye behind the front of the dorsal. Adipose fin large, inserted over the last rays of the anal; its height, 4 in head. The ventrals reach more than halfway to front of anal. The height of the dorsal, $1\frac{7}{8}$ in head; the pectorals are slightly larger than ventrals, $1\frac{1}{2}$ in head; depth of caudal peduncle, $3\frac{1}{2}$ in head.

8. **Oncorhynchus gorbuscha** (Walbaum).

We found this species quite abundant at Port Clarence about the middle of July, at which time it was commencing to run up the river back of the inner harbor. The one specimen obtained by us is 16 inches long; its dorsal, 11; anal, 14; scales, 199 tranverse rows or 162 in lateral line; gill rakers, 13+17; ventral appendage nearly two-thirds length of fin. The natives catch this fish by means of nets about 30 feet long, one edge of which they attach at the edge of the water, shoving the other end out with a pole in such a position that when the salmon strike the net they follow along it toward the shore. When a sufficient number has congregated at the net the outer end is pulled in by means of a rope attached for the purpose.

9. **Oncorhynchus nerka** (Walbaum).

At Chignik Bay we took four of the young of this species—specimens about 3 inches in length. We took six of the young of this species at Grantley Harbor; they are about 5 inches long.

10. **Salvelinus malma** (Walbaum).

Specimens were obtained at Port Clarence, Point Hope, and Herschel Island. The natives of Herschel Island catch this fish through holes in the ice at all times during the winter.

11. **Mallotus villosus** (Müller).

We found this fish only at Port Clarence, where it first appeared on the 24th of July. On this day we observed them in great numbers in the edge of the water near the sandy beach. They ran in small schools and were doubtless spawning. The natives caught great quantities of them with small dip nets. We have compared our specimens with others from Greenland and find no differences.

12. **Osmerus dentex** Steindachner.

We took several specimens at Port Clarence, where they were quite abundant. They agree with Steindachner's description in all except the following: The head is contained a little over 4 times in length of body without caudal, instead of $3\frac{3}{4}$, and there is no spur-like scale between the ventrals. We have compared it with specimens from Kamchatka and can find no differences.

13. **Mesopus olidus** (Pallas).

Head, $4\frac{1}{5}$; eye, $3\frac{3}{4}$; depth, $6\frac{1}{2}$. D., 9; A., 14; P., 11; V., 8; scales, 55 to 60; gill rakers, 9+20, the longest two-thirds of eye; snout slightly shorter than eye; maxillary reaching to center of pupil, or slightly less than 3 in head; least depth of caudal peduncle equaling snout; the longest rays of the dorsal contained 6 or 7 times in the length. The pectorals reach from four-fifths to two-thirds distance to base of ventrals, contained 5 or 6 in the length; the rays of the pectorals and ventrals are slightly enlarged at the base. The color is dusky, silvery below; no very evident silvery band along lateral line. The scales are insecurely attached and rub off easily. We found this fish quite abundant in the river back of Grantley Harbor.

14. Pygosteus pungitius (Linnæus).

We obtained but one small specimen of this fish, which was taken from the throat of a specimen *Osmerus dentex* at Grantley Harbor. The dorsal and anal fin rays are in greater numbers than is usual, being: D., IX, 11; A., I, 10. The ventral spines are almost one-half length of head.

Following are the dorsal and anal formulæ of five specimens from Nushagak, Alaska, collected by the *Albatross:*

Dorsal.	Anal.
IX 9	I 10
X 9	I 9
X 11	I 10
X 11	I 10
XI 9	I 9

In all, the ventral spines are slightly less than one-half of head.

15. Gasterosteus cataphractus (Pallas).

We found this fish abundant in the river at Grantley Harbor. They agree perfectly with specimens from Kamchatka, the type locality. They also agree well with Richardson's description and figure of *Gasterosteus insculptus* from Northumberland Sound. They are more robust than the southern form; the caudal keel is more strongly developed; the pectorals are a little longer and stronger; the spines are heavier, the lateral plates reach farther down on the sides, and their posterior edges are much rougher.

This southern form is *Gasterosteus serratus* Ayers. (Proc. Cal. Ac. Sci., 1855, 47.)

The following is the fin count of our four specimens:

Dorsal.	Anal.	Pectoral.
III 12	I 9	10
III 11	I 8	10
III 12	I 8	10
III 12	I 9	10

16. Ammodytes personatus (Girard).

Type locality: Cape Flattery, Washington.

Measurements of two specimens from Chignik, Alaska: D., 60; A., 28. Head, 4½ in length; depth, 11. Eye, 1½ in snout and 4½ in head. Lateral folds, 140 The pectorals reach past front of dorsal and are a little longer than one-half head. D., 61; A., 30. Head, 4½; depth, 10½. Eye, 1½ in snout and 5 in head; lateral folds 138; pectorals a little longer than one-half head.

Port Clarence: D., 54; A., 28. Head, 4½; depth 11. Eye, 1½ in snout or 4½ in head; lateral folds, 140.

Summer Bay, Unalaska: D., 61; A., 31; Head, 5; depth, 9. Eye, 6¼; lateral folds, 173. Pectoral one-half head.

We have compared these specimens with specimens from the type locality of *Ammodytes personatus*, and we are unable to find any difference between them. The specimens from Neah Bay near Cape Flattery show more rays in the dorsal and anal and less depth to the body than is given by Girard in his original description of *A. alascanus*. There is but little doubt that *A. alascanus* and *A. personatus* are the same.

We can find no difference between our specimens and one specimen from Greenland. All are probably identical with *Ammodytes tobianus* of Europe.

The following shows the number of fin rays and lateral folds of specimens:

From Port Clarence, Alaska.			From Puget Sound.		
Dorsal.	Anal.	Lateral fold.	Dorsal.	Anal.	Lateral fold.
61	29	145	59	30	138
58	28	138	59	30	151
56	28	140	59	31	140
57	28	140	59	28	151
58	29	140	58	30	148
53	26	136	57	29	133
59	29	135	58	30	149
58	28	147	59	29	133
58	27	145	57	29	148
60	30	139	58	29	143

From Upernavik, Greenland: Dorsal, 58; anal, 30; lateral fold, 140.

17. **Myoxocephalus polyacanthocephalus** (Pallas).

We took three specimens of this fish at Chignik Bay, Alaska. They are in no way different from specimens of the same species from Unalaska or Puget Sound. D., X, 14; A., 12. D., X, 15; A., 12. D., X, 15; A., 12.

18. **Myoxocephalus jaok** (Cuvier and Valenciennes).

Specimens of this species were taken at Port Clarence and Grantley Harbor. The number of preopercular spines varies; in the young there are four, in older specimens the third spine from the top may be only a tubercle or entirely wanting. In most of the specimens the caudal has two narrow, vertical wavy bands on its posterior half; in one of the specimens the color on the caudal shows no tendency to form in bands.

Our specimens show the following number of spines and rays:

Dorsal.	Anal.	Pectoral.
IX 15	14	18
X 15	13	18
IX 15	14	17
IX 16	14	18
IX 15	12	18

19. **Myoxocephalus verrucosus** (Bean).

Type locality: Plover Bay, Siberia.

We obtained seven specimens of *A. verrucosus:* four at Kings Island, two at Port Clarence, and one at Grantley Harbor. We have compared them with specimens taken by the *Albatross* on Bristol Bay (Rep. U. S. Fish Comm., 1896, 421), and these have in turn been compared by Dr. Bean with the type of the species. Six of our specimens have eleven dorsal spines; the other, ten. In the sixteen specimens taken by the *Albatross* only one has eleven dorsal spines; the rest have ten. In our specimens the fins are a trifle larger and the maxillary slightly longer.

Dorsal.	Anal.	Locality.
XI 17	13	Kings Island.
XI 17	14	Do.
XI 16	13	Do.
XI 16	13	Do.
XI 16	13	Port Clarence.
XI 16	13	Do.
X 16	13	Grantley Harbor.

20. **Myoxocephalus axillaris** (Gill).

Cottus axillaris, Bean, in Nelson's Rep. Nat. Hist. Coll. Alaska, Pl. XVI, fig. 2.

Head, $2\frac{3}{4}$; horizontal diameter of orbit, 5 in head and $1\frac{1}{5}$ in snout; interorbital space, 6 in head; depth, $4\frac{1}{2}$; maxillary reaches the vertical with posterior edge of eye and is contained $2\frac{1}{3}$ times in the head; dorsal, IX or X, 15 or 16; anal, 11 or 12; pectoral, 15 or 16; caudal, 9 branched rays; lateral line, 40.

Head wide and depressed; mouth horizontal, lower jaw included; nasal spine well developed, but completely covered by the skin. The preopercle has a straight spine at its upper angle, almost covered with skin and equal in length to the vertical diameter of the orbit; a second spine immediately below this, completely covered by the skin and one-half as long as upper spine; at the lower angle of the preopercle there is a tubercle. The opercle has a strong horizontal spine at its upper angle, completely embedded in the membrane and not reaching the edge of the gill flap. At the lower angle of the opercle there is a small downward-directed spine, also completely covered by skin. Suprascapular spine well developed, but completely embedded. Pectoral spine blunt and covered. The occipital ridges are scarcely elevated; four broad, conspicuous tentacles, corresponding to the positions of the supraocular and occipital tubercles. The orbital rims are considerably elevated, having a flat, depressed space between them. Top of the head covered with small wart-like protuberances. Above the lateral line there is a row of osseous plates, smaller and more closely placed beneath the second dorsal; a similar scattered row below the lateral line just beneath the second dorsal. The longest ray of the first dorsal (the fourth or fifth) $2\frac{1}{2}$ times in head; the first six rays about equal in length. The second dorsal is higher and about the same shape as the first; the longest ray $1\frac{9}{10}$ in head. The caudal truncated, the corners about square. The pectorals are large and reach to the second ray of anal. The ventrals scarcely reach the vent.

Color above quite dark, strongly marked with black and white; a saddle of black under the anterior three-fourths of first dorsal; there are two similar but smaller saddle markings over the back below the second dorsal, one beneath the anterior, the other beneath the posterior end; a black blotch on the side of the caudal peduncle, a characteristic marking in several of the members of this genus. The ventral surface of the fish is lighter; the sides with large ovate white spots; four or five bright cream spots at the edge of the black and hidden by the pectorals. The mandibles are mostly black, the lower lip with black mottlings; angle of the mouth light; tip of the maxillaries black; a black blotch at isthmus just back of membrane. The first dorsal is mostly black; a white blotch covering lower half of membranes between fourth and sixth spines; from the upper anterior angle of this blotch the white extends across the fourth spine and runs into the spot at the edge of the membrane and between the third and fourth spines; at the edge of the membrane and between each spine there is a white spot, very small between first and second, but increasing in size posteriorly, and between the seventh, eighth, ninth, and tenth running together, leaving a tip of black at the end of the eighth spine. The second dorsal is black with a few circular white spots, each spot with its center on a fin ray and its edge reaching to the middle of the membrane. These spots are inclined to run together. The caudal mostly black; partially divided by narrow interspace of white into two heavy vertical bands. The anal is colored similar to the second dorsal; the tips of the rays and edge of the membrane are white. The ventrals with several black spots. The pectorals black with oval white spots on the membranes, which join each other imperfectly across the rays to form four or five interrupted vertical bars of black; two white spots at base of rays.

Locality.	Dorsal.	Anal.	Pectoral.	Sex.
Port Clarence	X 15	11	15	♂
Chignik Bay	IX 15	12	16	♀
Herendeen Bay (*Albatross* coll.)	IX 16	12	15	♂
Do	IX 15	11	16	♀

21. Oncocottus hexacornis (Richardson).

D., VIII or IX, 14 or 15; A., 14 or 15; P., 17; V., 1, 3; Br., 6. Head (to end of opercular spine), $3\frac{1}{5}$ in length; eye, 5 in head; snout, $3\frac{1}{2}$; interorbital space, $6\frac{1}{2}$; maxillary, 2.

Body slender, tapering gradually from the rather narrow depressed head to a very slender caudal peduncle. The mouth is large and horizontal, the maxillary reaching past the orbit. The lower jaw shorter than the upper, but not quite included within it. The head smooth and without tubercles or warts. In place of the supraocular and occipital spines there are four large bony elevations, each much resembling the comb of a cock; the upper surface rough and scabrous. In the young these four protuberances are much less developed. The occipital ridges are scarcely elevated and inclose an oblong and slightly concave area, narrowest posteriorly and running into the concave interorbital space anteriorly. The nasal spines are well developed, and in the older fish are inclined to be club-shaped and scabrous. The upper angle of the supraclavicle is prolonged posteriorly into a strong spine, its upper surface scabrous. Just at the base and immediately in front of it is a much smaller spine or tubercle on the posterior end of the post-temporal bone. There is a spine, almost concealed in membrane, just above the base of the pectoral.

The preopercle has four spines; the upper, which equals the orbit in length, extends upward and backward and is in some specimens curved slightly inward. The second spine is immediately at the base of the first and is one-half as long. It is straight and extends outward and backward. The third is curved downward and the fourth, at the lower angle of the preopercle, is directed forward and downward. The opercular spine is rather strong and does not reach the end of the opercular flap. There is a slender sharp spine at the lower angle of the opercle.

The lateral line runs rather high and is composed of elongated rectangular plates, each with a concave depression at either end, thus making a row of elliptical depressions along the lateral line. The plates are not present on the posterior half of the caudal peduncle. Above the lateral line is a row of rough circular osseous plates, beginning on the nape and running to the base of the caudal, gradually becoming smaller and nearer together. Under the second dorsal this row is double. Below the lateral line and beneath the second dorsal there are about three irregular rows of similar but smaller plates.

Adult female.—First dorsal lower than in the male, scarcely rounded posteriorly, but sloping gradually toward the base of the second dorsal; third and fourth spine longest and equal to length of snout. The second dorsal is about twice as high as the first and varies a great deal in shape, the membrane is scarcely incised, and the first three or four rays have rough, prickly edges. The anal is oblong and slightly rounded, with the middle rays longer than snout, and the membrane between the rays not incised. The pectoral scarcely reaches to the front of the second dorsal; the first two or three rays rough on their outer edge; the membrane not incised. The caudal is not rounded, but truncated, with rather sharp corners; ten developed rays; eight of them branched. The ventrals reach two-thirds distance to the vent; the inner ray no longer than the middle one.

Adult male.—The first dorsal is higher than in the female; the third and fourth rays are longest and are equal in length to the distance from the snout to middle of eye; the posterior end of the fin is more rounded. The second dorsal is more than twice as high as the first; the membrane between the rays is deeply incised, the anterior rays projecting for nearly half their length beyond the membrane; the membrane follows around the edge of the projecting rays; the rays are scabrous on their sides. The anal is oblong, but more angular than in female; the longest ray reaches from snout to posterior edge of orbit. The membrane between the first four rays quite deeply incised; the outer edge of the rays scabrous. The ventrals reach four-fifths distance to vent; the inner ray longest.

Color.—In the young the color is gray above and white beneath, a dark saddle marking over the back at the center of the first dorsal; another similar marking under the anterior and another under the posterior end of the second dorsal; a dark spot the size of the eye on top of the caudal peduncle and midway in its length (the young may be distinguished at a glance by this marking on top of the caudal peduncle); a V-shaped marking at the base of the caudal with the angle of the V on the lateral line and directed forward. The caudal is marked by two vertical wavy bands on its posterior half, the first one the wider, the last one at the tips of the rays; these bands are solid, extending across rays and membrane; the pectorals are dark at the base, the distal part marked by three vertical black bars. The first dorsal is slightly dusted with black; the second is slightly mottled with black, but with no bars. The anal has three or four vertical dark bars. In the adults the general appearance of the fish is very much darker, sometimes almost black; the lower parts are light; the markings are not so distinct; the fins except the ventrals are all dark and the markings on the pectorals, caudal, and anal run together into solid black; the lower parts, especially in the males, is brilliantly colored with red.

This fish differs from *Oncocottus quadricornis*, from the Baltic Sea, in having a longer maxillary, longer pectorals, and a square-cut caudal fin.

We can find no good difference between our specimen and one from Arctic Bay, Greenland.

The fish figured by Bean as *Cottus quadricornis* (in Nelson's Report on the Natural History Collections made in Alaska, Pl. XVII, fig. 2) is probably the same as the one here described, though the figure does not agree in all respects.

We found this fish very abundant along the shores of Herschel Island. It was about the only fish to be found where the bottom was muddy. We took a few young at Point Barrow, and at Port Clarence we took specimens of both the young and the old. Three of the young were found in the river back of Grantley Harbor.

Locality.	Dorsal.	Anal.	Head in body.	Eye in head.	Snout in head.	Interorbital in head.	Maxillary in head.	Sex.
Herschel Island	VIII 15	15	$3\frac{2}{5}$	$5\frac{1}{2}$	$3\frac{1}{2}$	7	$1\frac{5}{6}$	♂
Do	IX 15	15	$3\frac{1}{6}$	5	$3\frac{3}{4}$	$6\frac{1}{2}$	$2\frac{1}{10}$	♂
Do	VIII 14	15	$3\frac{1}{20}$	$5\frac{1}{2}$	$3\frac{1}{2}$	$6\frac{2}{3}$	2	♀
Do	IX 15	16	$3\frac{1}{5}$	5	$3\frac{1}{2}$	$6\frac{1}{2}$	2	♂
Do	VIII 14	15	$3\frac{1}{4}$	5	$3\frac{1}{2}$	$6\frac{1}{2}$	2	♂
Do	VIII 14	15	$3\frac{1}{6}$	5	4	$7\frac{1}{2}$	2	♀
Do	IX 13	15	$3\frac{1}{10}$	$4\frac{1}{2}$	$3\frac{1}{3}$	$6\frac{1}{2}$	2	♀
Grantley Harbor	VIII 14	13	$3\frac{1}{20}$	$4\frac{9}{10}$	$3\frac{2}{3}$	$6\frac{2}{3}$	2	♂
Do	IX 14	14	$3\frac{1}{10}$	5	$3\frac{9}{10}$	$6\frac{1}{2}$	$1\frac{7}{8}$	Juv. ♀ ?
Arctic Bay, Greenland	IX 15	16	3	$4\frac{1}{2}$	$3\frac{9}{10}$	7	$2\frac{1}{4}$	Juv. ?

Two very young examples of an unknown species of *Oncocottus* were taken at Point Barrow. The spinous dorsal can not be made out accurately, but the number is between 8 and 11, probably 10; the second dorsal has 14 rays and the anal 13. The species is closely related to *O. hexacornis*, but comparison of specimens of the same age shows numerous differences, which are indicated below.

Young of O. hexacornis from Point Barrow.	*Oncocottus sp. incog. from Point Barrow.*
Head much depressed.	Head compressed.
Occipital tubercles not developed.	Occipital tubercles developed.
Interorbital space about one-half eye.	Interorbital space $1\frac{1}{2}$ times eye.
Caudal peduncle slender and rounded.	Caudal peduncle heavy and much compressed.
Lower jaw even with snout.	Lower jaw projects beyond snout.

23. **Megalocottus laticeps** (Gilbert).

We took four specimens of this species at Port Clarence. They differ from the types slightly in coloration. Our specimens are dark, almost black; below the anterior portion of the second dorsal is a darker saddle-like marking on the body; the caudal is black at the base, and has an undulating dark band on its posterior third; the pectorals vary, being either banded or mottled (one specimen has distinct bands on one pectoral while the others are simply mottled with black). There is no slit behind last gill arch.

Dorsal.	Anal.	Dorsal.	Anal.
IX 15	13	IX 15	12
IX 14	13	IX 14	12

24. **Gymnocanthus pistilliger** (Pallas).

Type locality: Coast of Alaska. Three specimens were taken at Grantley Harbor, Port Clarence, Alaska.

Fin formulæ: ♂, D., X, 14; A., 16; P., 18; C., 9 branched rays; ♂, D., X, 15; A., 17; P., 18; C., 9 branched rays; ♀, D., X, 13; A., 15; P., 17; C., 9 branched rays.

I have compared them with specimens taken by the *Albatross* in southern Bering Sea and find them the same. In the female taken at Port Clarence the crown (not between the eyes), nape, and upper half of opercles are covered with scabrous bony plates. These plates are present in some of the females taken by the *Albatross*, but are not so evident. The female has a few scattered rough prickles back of the origin of the pectorals. The males have the mushroom-like filaments behind the pectorals, and the middle rays of the pectorals have papillæ along their inner edge.

25. Gymnocanthus galeatus Bean.

Type locality: Unalaska. We took one small specimen ($3\frac{1}{2}$ inches) at Point Barrow, Alaska.

Fin formula: ♀, D., X, 15; A., 17; P., 18; V., 3.

H., $3\frac{1}{4}$ or $3\frac{9}{10}$, including caudal; depth, $5\frac{1}{4}$; Eye, $3\frac{1}{2}$ in head, to end of opercular spine; snout, 4; maxillary, $2\frac{1}{4}$ in head, reaching past posterior edge of pupil; interorbital width 2 in length of orbit; lat. line, 43 or 44. Fifth or sixth rays of pectorals longest, reaching to third anal ray. Ventrals reach two-thirds distance to vent. Mouth slightly oblique. Upper preopercular spine with three sharp points on its upper side. No papillæ or sharp points under pectorals.

26. Pallasina barbata (Steindachner).

Siphagonus barbatus Steindachner, Ichthyologische Beiträge, V, 140, Taf. V, Bering Straits and Japan.—Bean, Proc. U. S. Nat. Mus. 1881, 218; Turner, Nat. Hist. Alaska, 94.

Six specimens taken at Port Clarence, Alaska, averaging about 6 inches in length. We have compared them with specimens of *P. barbata* from Bristol Bay, Alaska, and find our specimens have a much longer barbel and slightly longer pectorals. In all other points they appear to be the same. The barbel is one-third distance from tip of lower jaw to edge of gill membrane. The two dorsals vary in their distance from each other. In one specimen they touch, in the others they vary in distance the width of one or two plates. The specimens show a sexual difference. The females have shorter ventrals and a lower, smaller first dorsal than the males. The first dorsal, too, is without color. The males have larger ventral fins and a large darkly colored first dorsal.

Following is the fin formulæ of the specimens:

Dorsal.	Anal.	Pectoral.	Sex.
V 7	10	12	♀
VIII 7	10	12	♂
VI 7	8	12	*a* ♀
VII 7	9	12	♂
VIII 6	10	12	♂
V 6	10	13	♀

a The anal injured.

27. Pallasina aix Starks.

Two small specimens taken at Chignik Bay, Alaska. Fin formula: D., VII, 6; A., 10; P., 12; D., VII, 6; A., 9; P., 12.

We have compared these specimens with the types of *Pallasina aix* and we can find no good differences. One of our specimens has three median plates in the front of the ventrals, the other two. (Our specimens of *P. barbata* have either three or two median plates in front of the ventrals.)

A few of the types have 12 pectoral rays, but the majority have 11.

28. Liparis herschelinus Scofield, new species. (Plate LXXIV.)

Head, $3\frac{1}{2}$ in body; depth, $3\frac{3}{4}$; dorsal, 42 (13 + 19); anal, 33; pectoral, 35; caudal, 10; eye, $4\frac{1}{2}$ in head and $1\frac{1}{2}$ in snout; interorbital space, 3 in head; maxillary, 2 in head.

Body tadpole like; head rounded and very little compressed; abdomen slightly distended; just back of the abdomen the body is suddenly compressed to a width equaling one-third its height, and from this point the body gradually tapers to the caudal, its height and width keeping the same proportions; the height of the base of the caudal equals the diameter of the eye; the maxillary extends to posterior edge of eye, and its end is concealed in the skin of the head; upper jaw slightly longer than lower; teeth tricuspid; interorbital space flat; nape slightly elevated; gill openings small, the width of the slit equaling the interorbital space; the lower edge of the slit even with the first pectoral ray; the posterior nostrils end in very short, compressed tubules, about one-half diameter of eye in front of eye; the anterior nostrils are simple and placed directly in front of the posterior nostrils, separated from them by a distance equal to one-half diameter of eye.

The dorsal begins on a vertical line drawn from posterior edge of gill flap; the anterior rays are short, gradually lengthening till middle of fin is reached, where the rays equal $2\frac{1}{2}$ times the diameter of the eye; the last rays are scarcely shortened and do not form a notch at its junction with the caudal; the last rays encroach on the caudal for one-fourth of its length. The anal is the same shape as the dorsal and of the same height; its last rays encroach on the caudal for one-third its length. The upper lobe of the pectorals is composed of 25 rays; the eleventh and longest ray is contained $1\frac{1}{2}$ times in the head; the length of the twenty-fifth is contained 4 times in the head; the lower lobe is composed of ten rays, of which the third from the last, or twenty-third, is longest, being contained in the head $2\frac{1}{10}$ times; the membrane between the last four rays is incised. The caudal is slender, and rounded behind; its length is contained a little more than twice in head.

The diameter of the ventral disk is contained 8 times in length of body. Skin very loose, attached only at opercle and to the ends of the last rays of the dorsal and anal and to the base of the caudal. The color of the body is dark, due to black punctulations; the belly and the underside of the head is free from markings; the last half of the dorsal is darker than the anterior half; the anal is mottled with black; the caudal has two black vertical bands, the first just back of the tips of the last dorsal and anal rays; the second band is slender and faint and is at the top of the fin.

Several specimens were taken at Herschel Island. The longest specimen is $2\frac{1}{2}$ inches long.

The fish is nearest like *L. tunicatus*, from the coast of Greenland, and appears to be intermediate between it and *L. agassizii.*

29. Lycodalepis turneri (Bean).

We obtained one specimen $8\frac{1}{2}$ inches long of this species at Point Barrow, Alaska. It was washed on the beach during a storm and was found in a dried-up condition, so that the normal width of the head and distance between the eyes can not be determined. It corresponds almost exactly with the figure of the type (Turner's Nat. Hist. Alaska, 93); the light bands across the back and dorsal are not so regular; the third and fourth being slightly broken up. D., 86; A., 67; P., 18, reaching to sixth pectoral ray. The teeth are all strong, with rounded points. The teeth on upper jaw in a single series with no smaller teeth in front about the symphysis. Teeth on lower jaw in a single complete series with another short series around the symphysis in front.

Palatine with a single series. One large tooth on vomer. *L. turneri* and *L. polaris* are possibly the same species.

30. Boreogadus saida (Lepechin).

Head, $3\frac{1}{2}$ in length of body; depth, $5\frac{1}{2}$; eye, 4 in head; snout, $3\frac{1}{5}$; interorbital space $4\frac{2}{3}$; gill rakers, 9 to 13+30 to 32; dorsal, 13, 14, 20; anal, 16, 21; barbel minute.

Body long and slender and but little compressed. The head is rather long and pointed, the lower jaw projecting beyond the upper. The maxillary reaches center of pupil; the mandible is contained twice in the length of the head; its articulation with the quadrate bone is on a vertical midway between pupil and posterior edge of eye. The teeth in the upper jaw in a single series, except in front where there is a double row; the teeth in the lower jaw are in a single row; the teeth are all of about the same size, sharp and not closely set, those on the vomer are few, and of the same size as those in the jaws. The gill rakers are numerous, long, and slender, the longest equal to half the diameter of the eye. The vent is slightly in advance of the front of the second dorsal. The caudal peduncle is slender and rounded, its depth scarcely more than one-half eye. The pectoral fins reach the vent and are contained $1\frac{1}{2}$ in head; the ventrals are contained $1\frac{1}{3}$ in head, their second ray produced for two-fifths its length. The space between the first and second dorsals is but very little shorter than the space between the second and third dorsals; first dorsal highest; the front of second dorsal midway between the tip of snout and the base of middle caudal rays. The caudal is forked a distance equal to two-thirds the eye; the tips rounded.

Color plain brownish, light silvery below, the body covered with minute black or brown punctulations which are most numerous above. The dorsal and caudal dusky, becoming black toward the ends of the rays and narrowly edged with white. The pectorals are uniform dusky with an edge of white. The ventrals are partly dusky. The two anals are dusky; the basal half colorless; the edge of the fin white, as in the others. Peritoneum dusky. We have compared our specimens with the Greenland form and can find no differences.

This fish appeared to be quite abundant north of Bering Straits. It was especially brought to our notice by its habit of hiding in small holes in the floating ice, from which they were dislodged by our steamer striking and turning over the blocks of ice. This floating ice was usually in 7 fathoms of water and 1 or 2 miles from the coast. At Herschel Island we took it with the seine in shallow water along the beach. Turner reports it from St. Michael, where he took it through the ice in February, and was told by the natives that it appeared there only in the winter. According to Richardson it spawns in Greenland in February, laying its eggs in the seaweeds along the shore under the ice.

Dorsal.			Anal.		Locality.	Dorsal.			Anal.		Locality.
13	12	18	15	21	Point Barrow.	13	15	21	17	22	Herschel Island.
a 10	13	20	16	21	Port Clarence.	15	14	21	15	20	Davis Strait, Greenland.
14	14	20	17	20	Herschel Island.	14	13	22	16	21	Do.
12	15	21	16	22	Do.	12	15	19	16	20	Melville Bay, Greenland.
13	14	20	17	20	Do.	14	15	20	17	21	Do.
13	14	20	18	20	Do.	12	13	21	15	20	Do.

a First dorsal mutilated.

31. Theragra chalcogramma (Pallas).

We took but one specimen of this species at Chignik Bay, where it is not abundant. Out of 150 codfish taken with the hand lines only two were of this species, the rest *Gadus macrocephalus*. Our specimen differs from the average, but we have little doubt it belongs to this species. Its dorsal rays are 11, 16, 17; the anal 18, 17; the ventrals reach three-fifths to vent; the interorbital space is wider than the diameter of the eye; the coloration is dark. In the few rays and shorter ventral and wide interorbital space it agrees with *Theragra fucensis* (J. & G.) from Puget Sound, but in coloration, high ventral fin, and in slender body it is like the Alaskan form. Below we give noncomparative fin count:

Dorsal.	Anal.	Locality.	Remarks.
13 15 20	19 20	Kamchatka	From original description.
13 15 20	19 21	Unalaska	18 inches long.
14 19 23	24 22	Pribilof Islands	Young.
14 16 21	21 23	do	Do.
14 17 18	23 21	St. Paul Island	Do.
13 15 19	21 22	do	Do.
14 17 19	21 20	do	Do.
14 17 18	22 20	Kamchatka	Do.
11 16 17	19 17	Chignik Bay	Large specimen.
10 15 17	18 16	Puget Sound	Type of *Theragra fucensis* (J. & G.).
11 15 16	19 18	do	
10 14 16	16 19	do	
12 13 17	19 19	do	

32. Eleginus navaga (Kölreuter).

Head, $3\frac{4}{5}$ in length; depth, 6; eye, $5\frac{3}{4}$ in head; snout, 3; interorbital space, $4\frac{1}{2}$; gill rakers, 20 or 21 in all; barbel small, equal to pupil; dorsals, 12 to 14, 18 to 20, 18 to 22; anals, 20 to 23, 20 to 23; scales small, 157 transverse rows above lateral line from gill opening to first rudimentary caudal rays.

Body slender and rounded, with a rather long head; the snout viewed from above is rounded, but runs to a rather sharp point when viewed from the side; the lower jaw is included; the fleshy snout projects beyond the maxillary, its length slightly greater than that of the snout; the tip of the maxillary is on a vertical with the front of the pupil; the articulation of the mandible with the quadrate bone is on a vertical running midway between pupil and posterior edge of eye; the teeth are all slender and curved backward, those in the upper jaw in several irregular rows, the outer row regular and with slightly larger teeth; the teeth in the lower jaw are in a single row, except in the front, where they are in a double row; the teeth on the vomer are few and about the size of the smaller teeth in the upper jaw; the gill rakers are moderate, the longest not quite equal to the diameter of the pupil; the caudal peduncle is compressed, its depth equal to diameter of eye; vent under front of second dorsal. The pectoral fins do not reach the vent; their length contained $1\frac{3}{4}$ times in the head. The ventrals reach halfway to vent; the second ray moderately produced. The first dorsal is highest; the distance between the second and third dorsals twice the distance between the first and second. The caudal fin is very slightly concave. The third ray of second dorsal is midway between tip of snout and base of middle caudal rays. Our largest specimen 11 inches long, which is about the average.

Color somewhat mottled, grayish brown above, light silvery below; the three dorsals and the caudal dusky and edged with white; the pectorals are uniform dusky; the ventrals but slightly dusted with black; the anals have a few punctulations at their anterior ends; the peritoneum is pale.

Dorsal.			Anal.		Locality.	Remarks.
14	18	18	22	20	Grantley Harbor	
14	20	20	23	21	do	
14	21	20	20	21	Port Clarence	
12	18	19	22	20	do	
14	18	20	20	21	Petropaulski, Kamchatka	Albatross collection.
15	20	19	21	21	do	Albatross collection.
14	19	20	22	21	do	Albatross collection.
13	19	22	20	23	do	Albatross collection.
12	18	21	20	23	do	Albatross collection.
13	19	19	21	22	do	Albatross collection.
13	18	20	20	21	do	Albatross collection.
12	18	21	21	22	do	Albatross collection.

We have compared the skeleton of this with the skeleton of *Microgadus proximus* (San Francisco) and find but very little difference in the skulls. There is no difference in the character of the neural spines of the vertebræ, but there is a difference in the character of the transverse processes. In *M. proximus* they are flattish and plate-like, while in *E. navaga* they are club shaped, narrow where they leave the centrum, but expanding into a round, hollow bulb at the distal end.

We obtained this fish only at Port Clarence, where it was abundant, the natives catching great numbers of them with their crude hooks and lines. According to Turner, "the Eskimos assert that these fish spawn in February among the pebbles at the bottom of the deeper portion of the bay."

32. Gadus macrocephalus Tilesius.

We found this fish at Chignik Bay, where it is abundant. We preserved five young specimens, whose fin rays are as follows:

Dorsal.			Anal.		Locality.	Remarks.
11	16	17	21	19	Chignik Bay	Young.
12	15	18	21	18	do	Do.
12	15	17	20	18	do	Do.
12	15	17	20	18	do	Do.
12	14	16	20	17	do	Do.
15	18	17	20	17	Unalaska	Large specimen, L. S. Jr. U. collection.
15	18	17	18	16	do	Do.

33. Atheresthes stomias (Jordan and Gilbert).

Quite common at Chignik Bay, where we obtained a large specimen in 18 fathoms of water.

34. Hippoglossus hippoglossus (Linnæus).

Obtained one specimen at Chignik Bay, where it is abundant.

35. Lepidopsetta bilineata (Ayres).

We found this fish quite common along sandy beaches in Chignik Bay. They are in no way different from specimens of the same species from Puget Sound.

36. Pleuronectes quadrituberculatus Pallas.

Two specimens of this species were taken at Grantley Harbor, where it was not rare. It appears to be common at Chignik Bay, where we obtained one specimen.

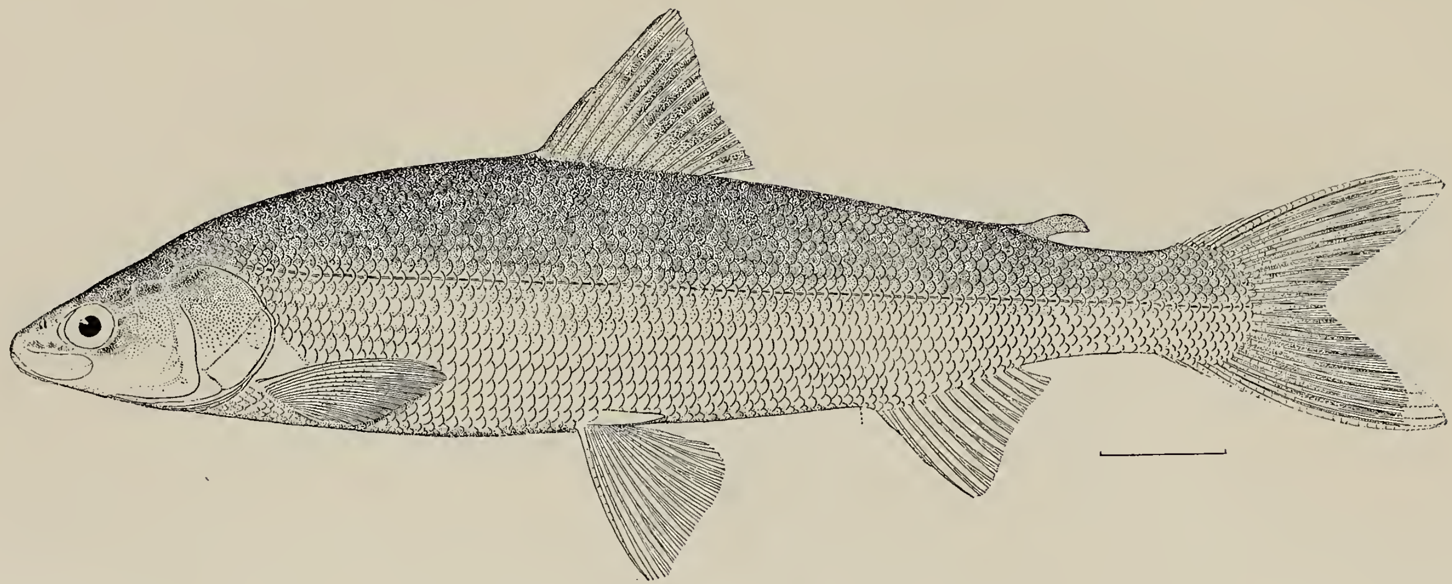
37. Liopsetta glacialis (Pallas).

This species was found at Port Clarence, in company with *P. quadrituberculatus* and equally abundant.

38. Platichthys stellatus (Pallas).

Abundant at Port Clarence. In the four specimens obtained the fin rays are as follows: dorsal, 53; anal, 38; dorsal, 50; anal 38; dorsal, 53; anal, 38; dorsal, 49; anal, 35.

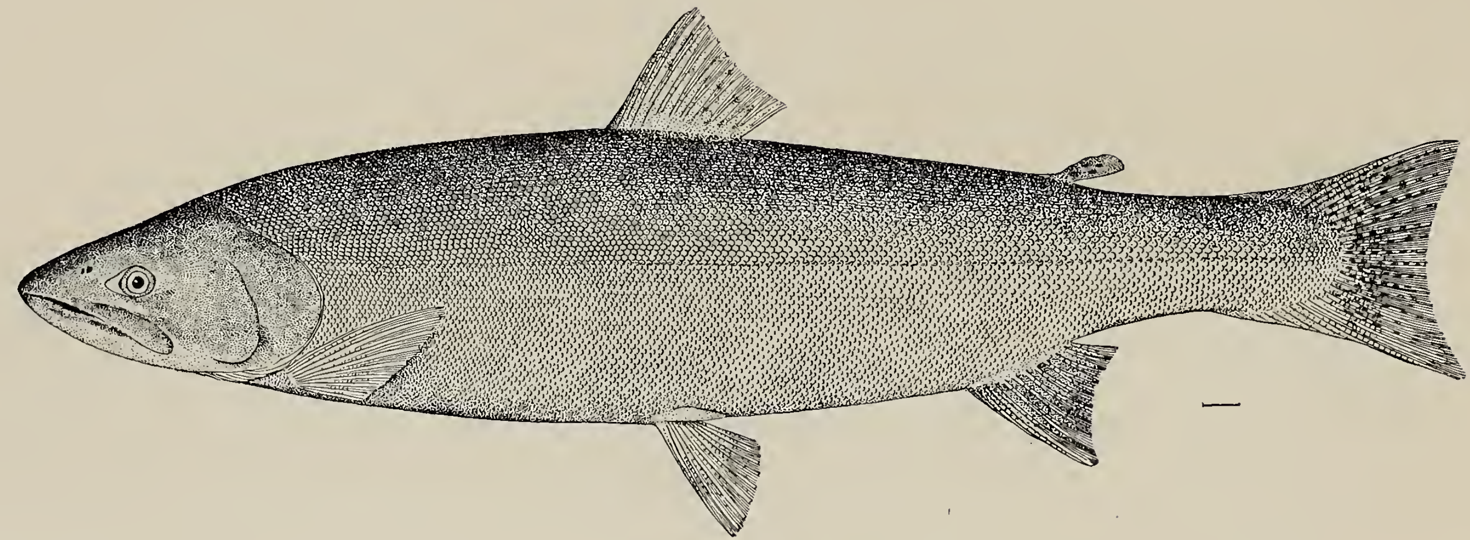
The stellate scales large, much more jagged, and in fewer numbers than in the Californian form. The four specimens are sinistral.



ARGYROSOMUS ALASCANUS (type).

Point Hope, Alaska.

Drawn by Anna L. Brown.

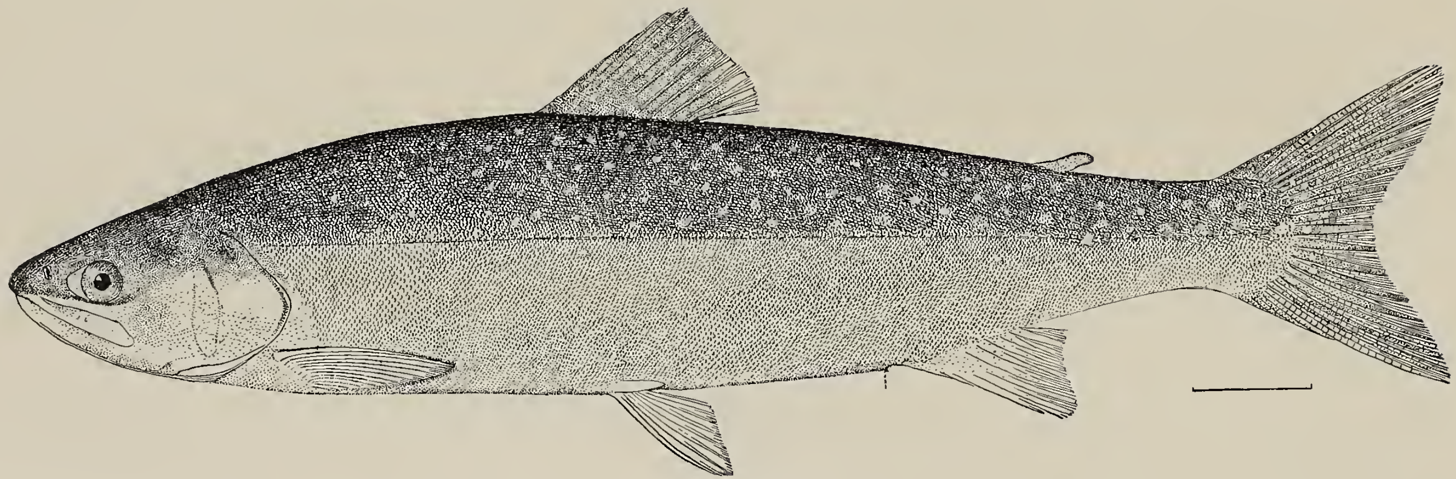


SALMO MYKISS.

Kalakhtyrka River, Kamchatka.

Drawn by Anna L. Brown.

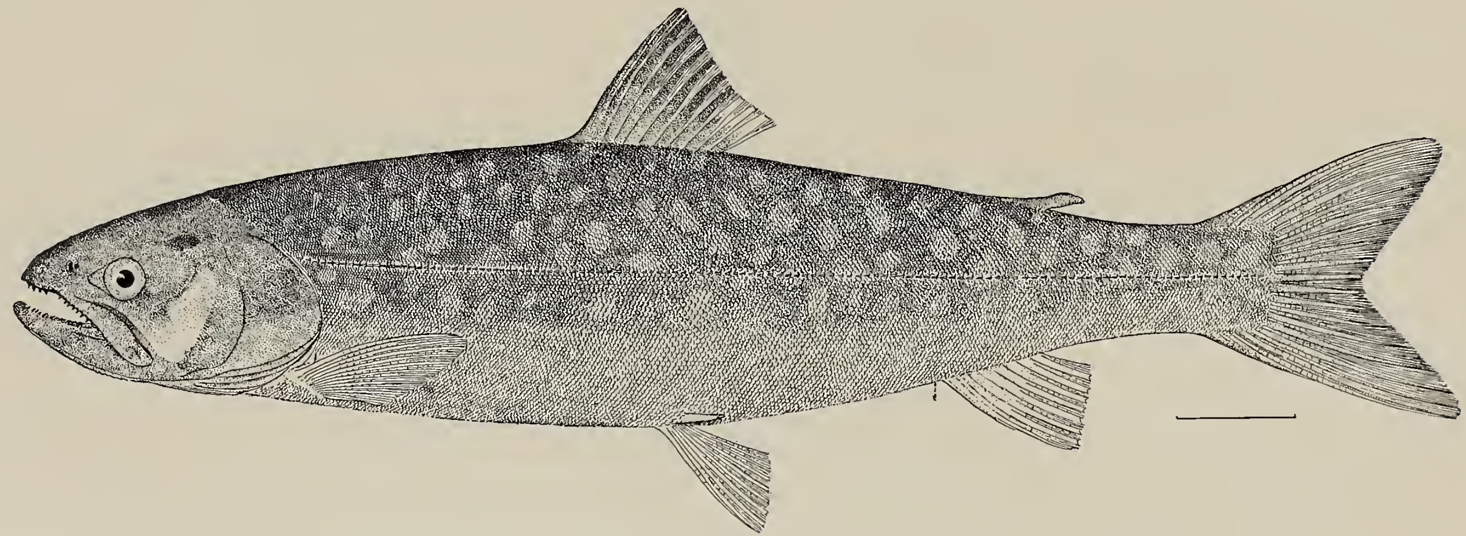
PLATE XLIV.



SALVELINUS MALMA.

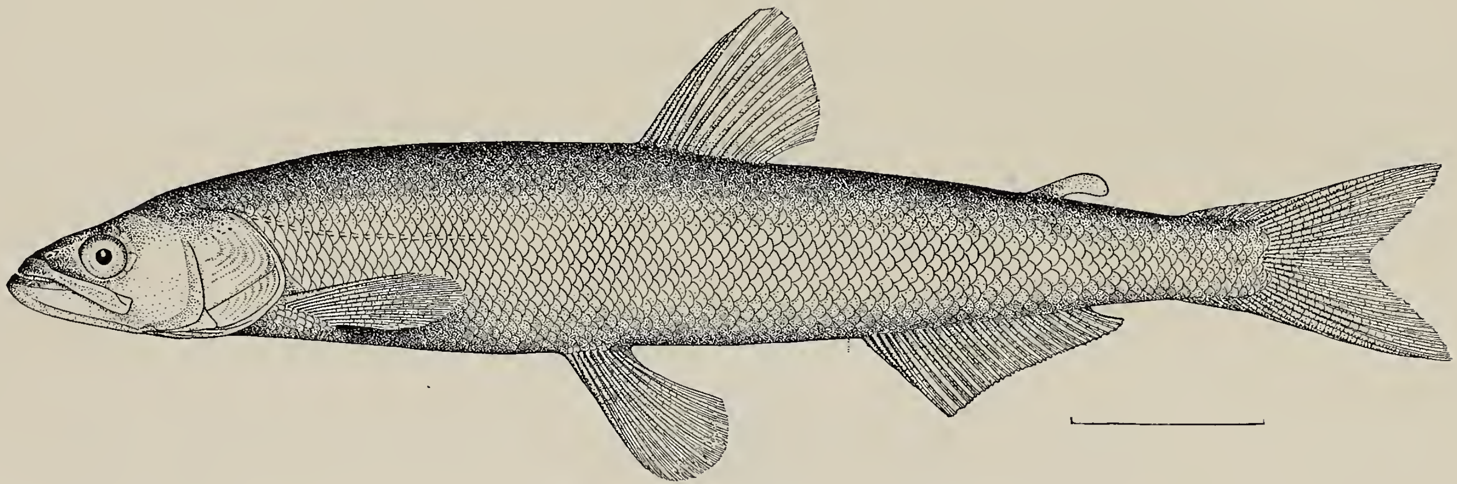
Unalaska.

Drawn by Anna L. Brown.

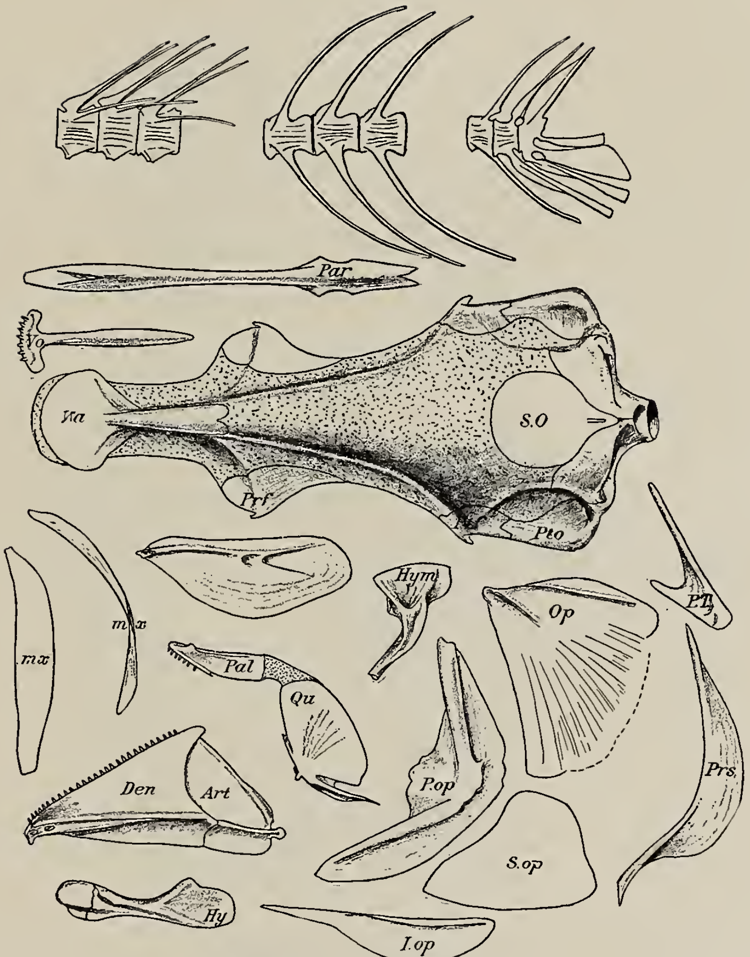


SALVELINUS KUNDSCHA.
Tareinsky Bay, Kamchatka.
Drawn by Anna L. Brown.

PLATE XLVI.



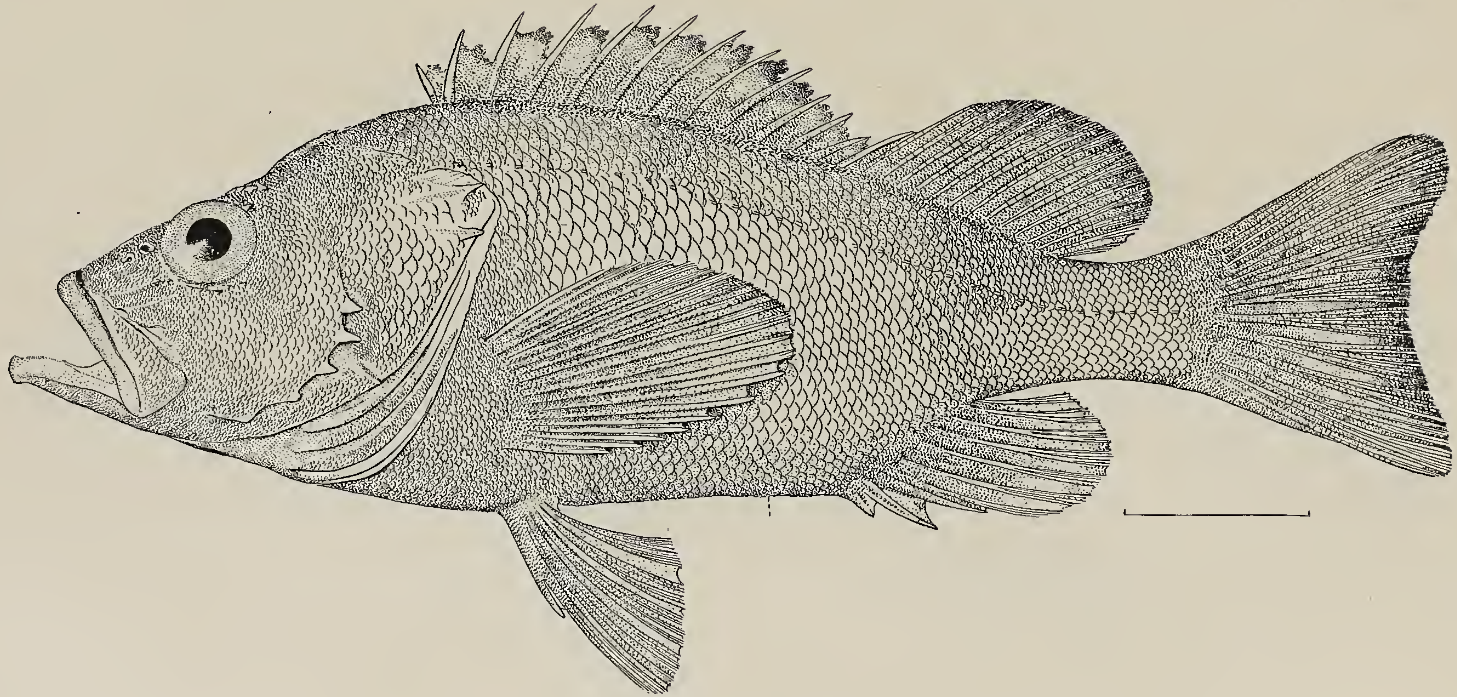
OSMERUS ALBATROSSIS (type).
Shelikof Straits, near Karluk.
Drawn by Chloe Lesley Starks.



THEROBROMUS CALLORHINI (type). ×3½.

(Drawn by F. A. Lucas, from specimens found in stomach of fur seal.)

PLATE XLVIII.

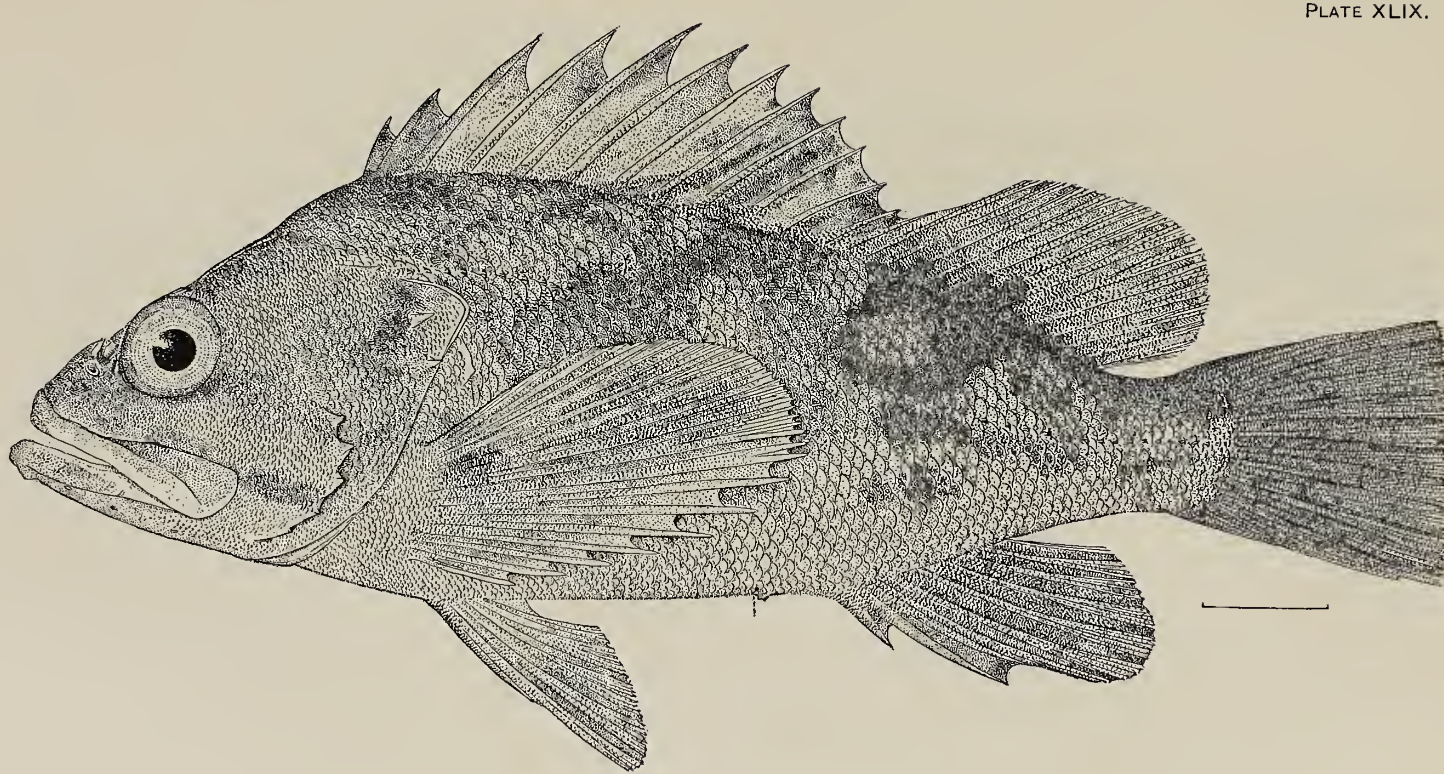


SEBASTODES ALEUTIANUS (type).

Off Karluk, Kadiak Island.

Drawn by Anna L. Brown.

PLATE XLIX.

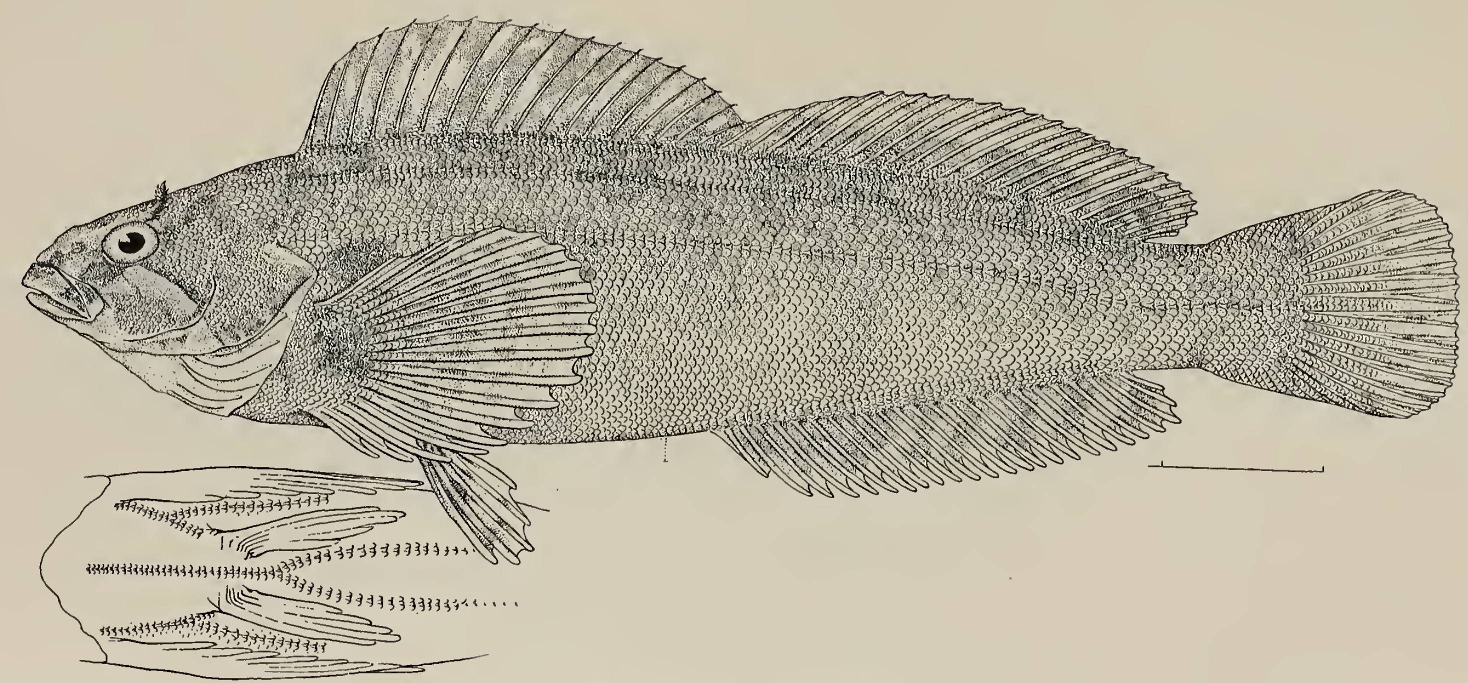


SEBASTODES CAURINUS.

Sitka, Alaska.

Drawn by Anna L. Brown.

PLATE L.

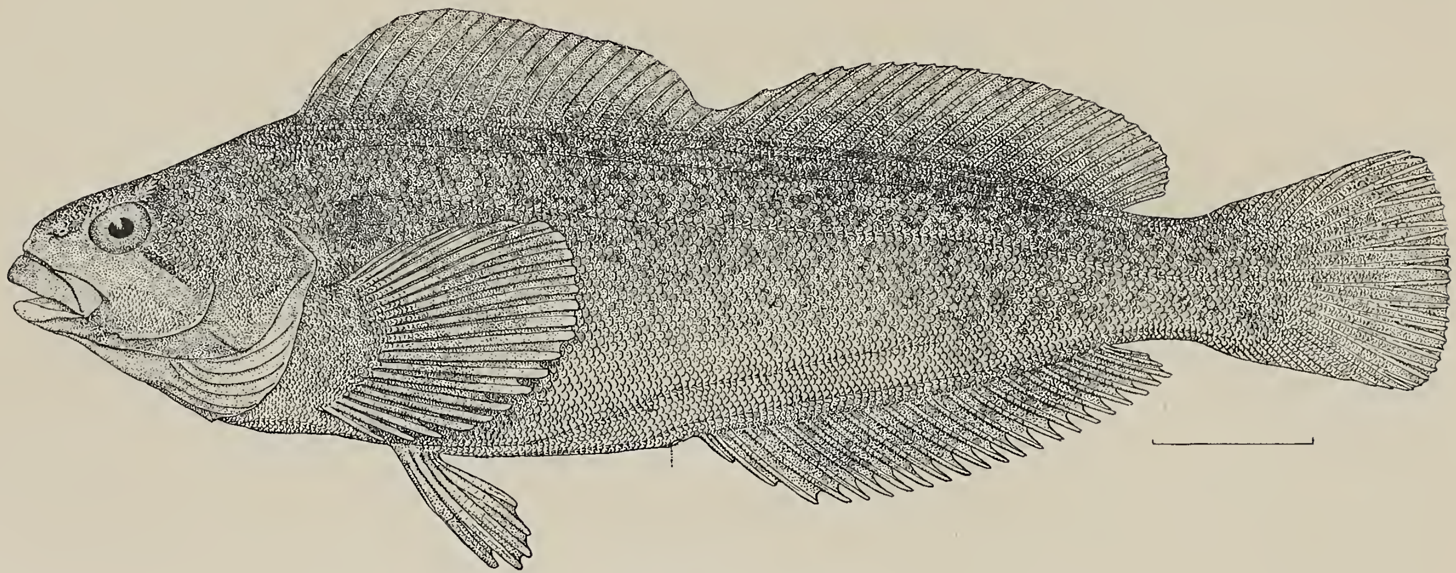


HEXAGRAMMOS OCTOGRAMMUS.

Unalaska.

Drawn by Chloe Lesley Starks.

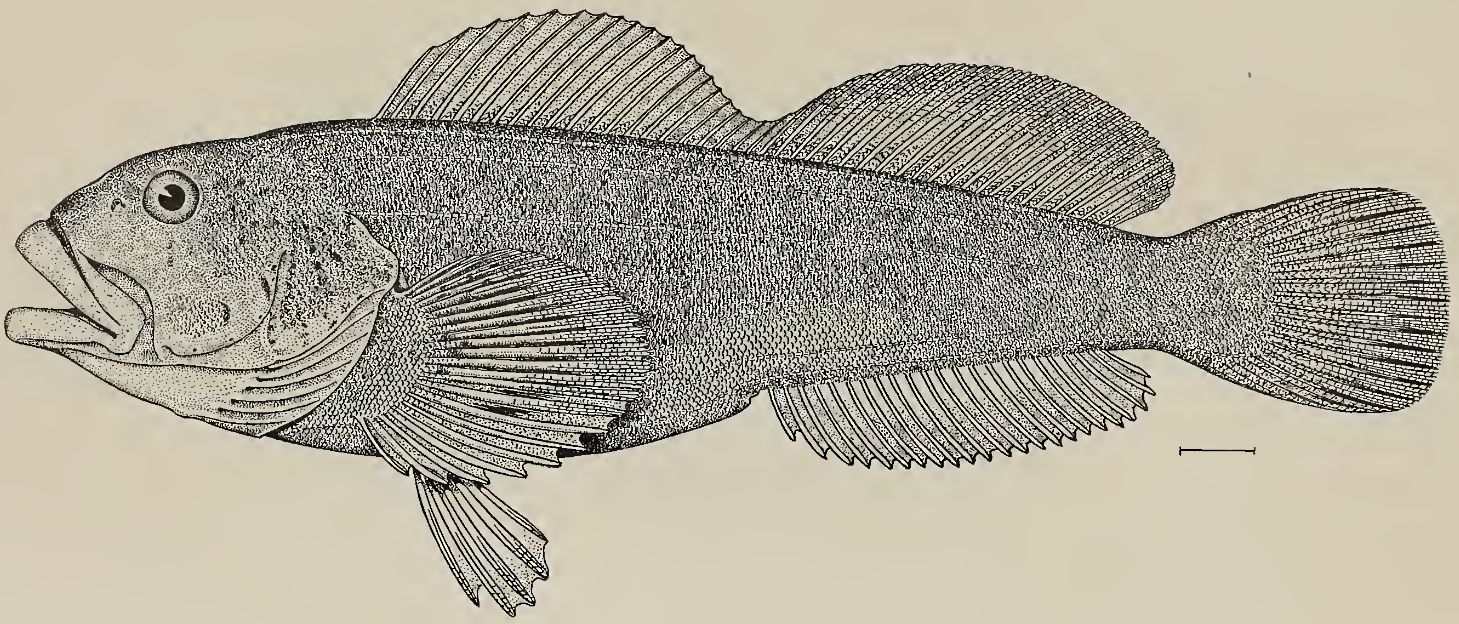
Plate LI.



HEXAGRAMMOS LAGOCEPHALUS.

Robben Island.

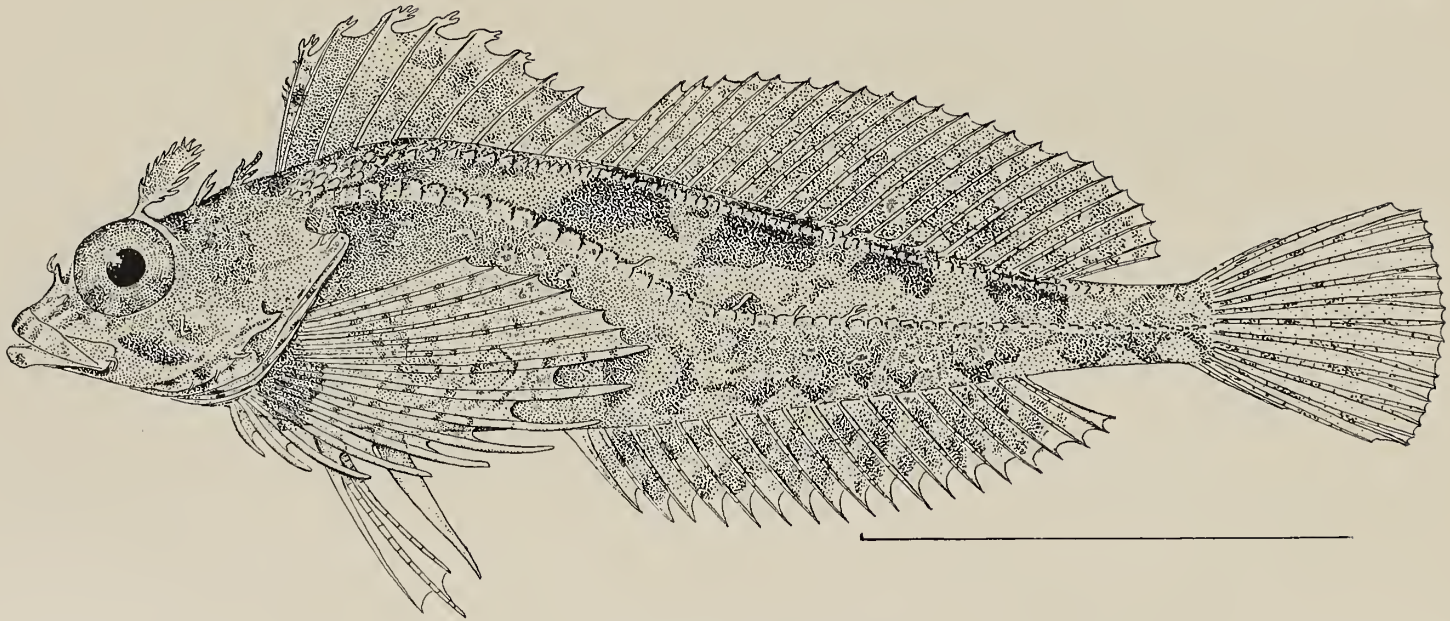
Drawn by Chloe Lesley Starks.



HEXAGRAMMOS LAGOCEPHALUS.

Petropaulski, Kamchatka.

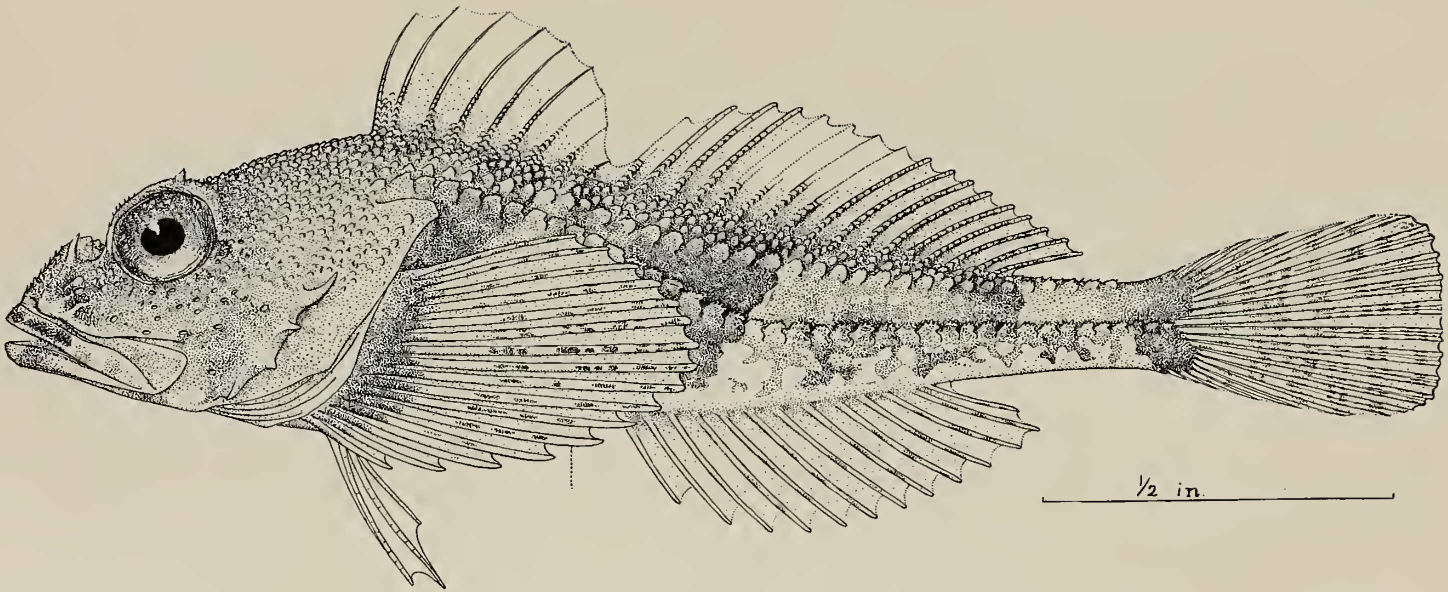
Drawn by A. H. Baldwin.



ARCHISTES PLUMARIUS (type).

Ushishir Island, Kuril Group.

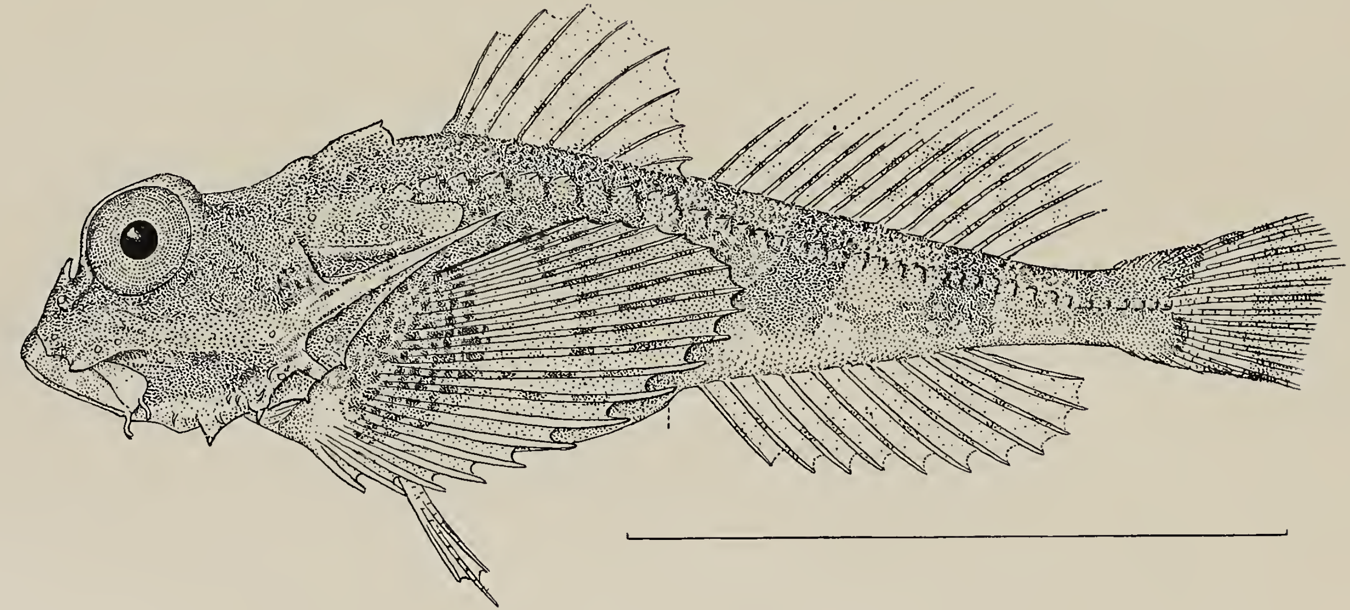
Drawn by Anna L. Brown.



STELGISTRUM STEINEGERI (type).

Albatross Station 3645, off Robben Island.

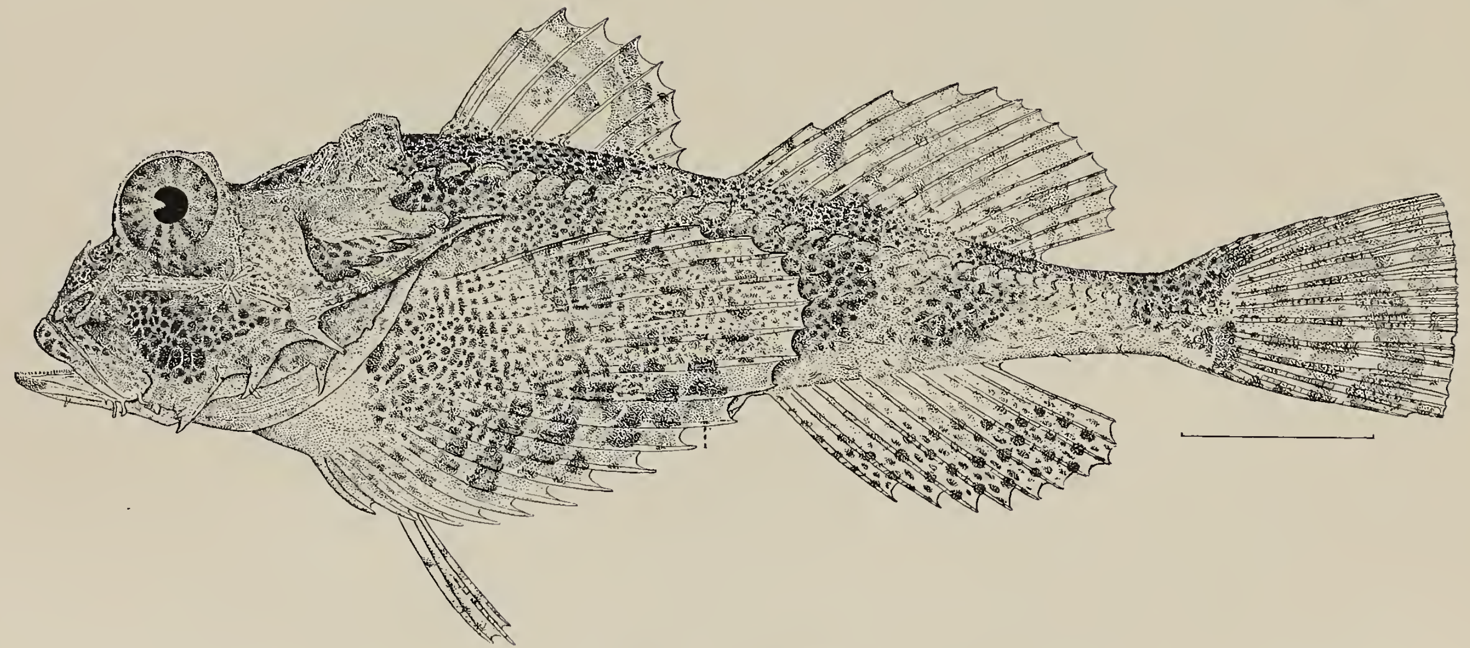
Drawn by Chloe Lesley Starks.



ENOPHRYS CLAVIGER.

Off Robben Island.

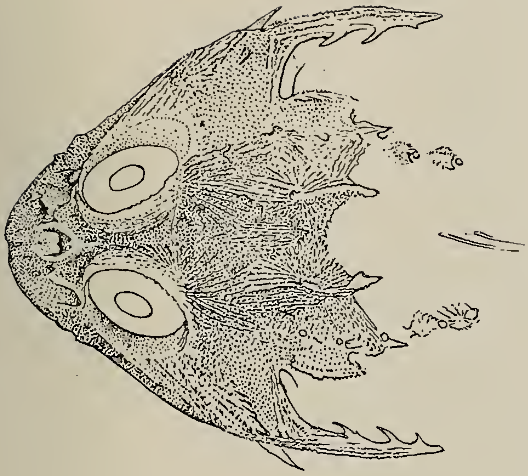
Drawn by Anna L. Brown.

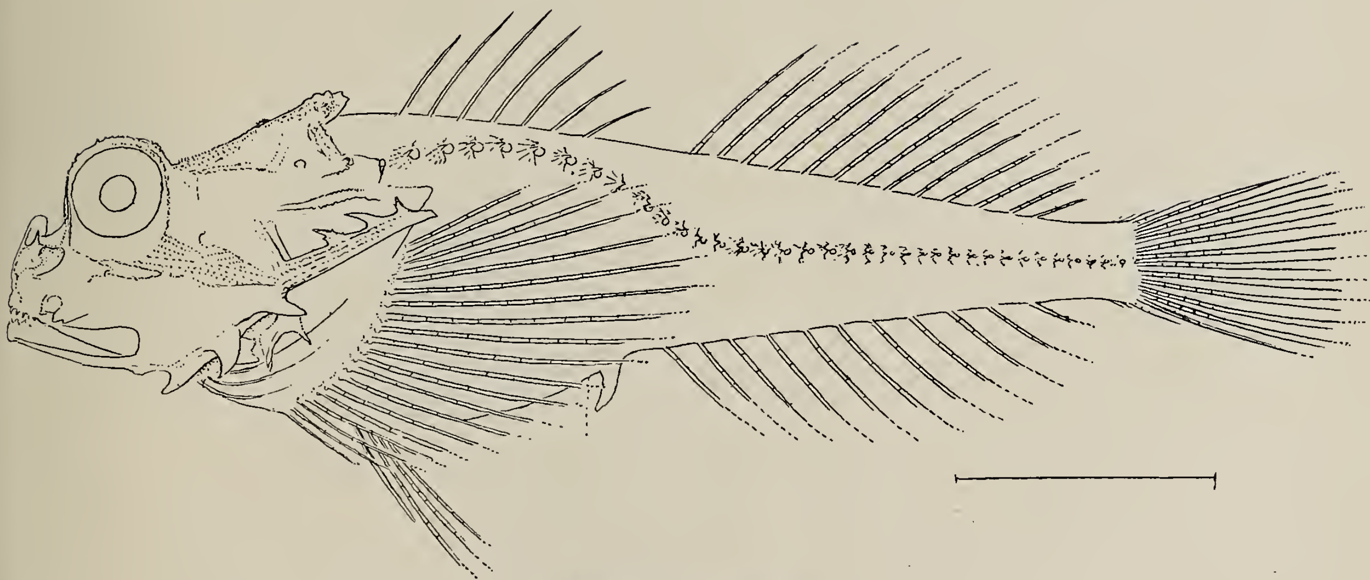


CERATOCOTTUS DICERAUS.

Herendeen Bay, Alaska.

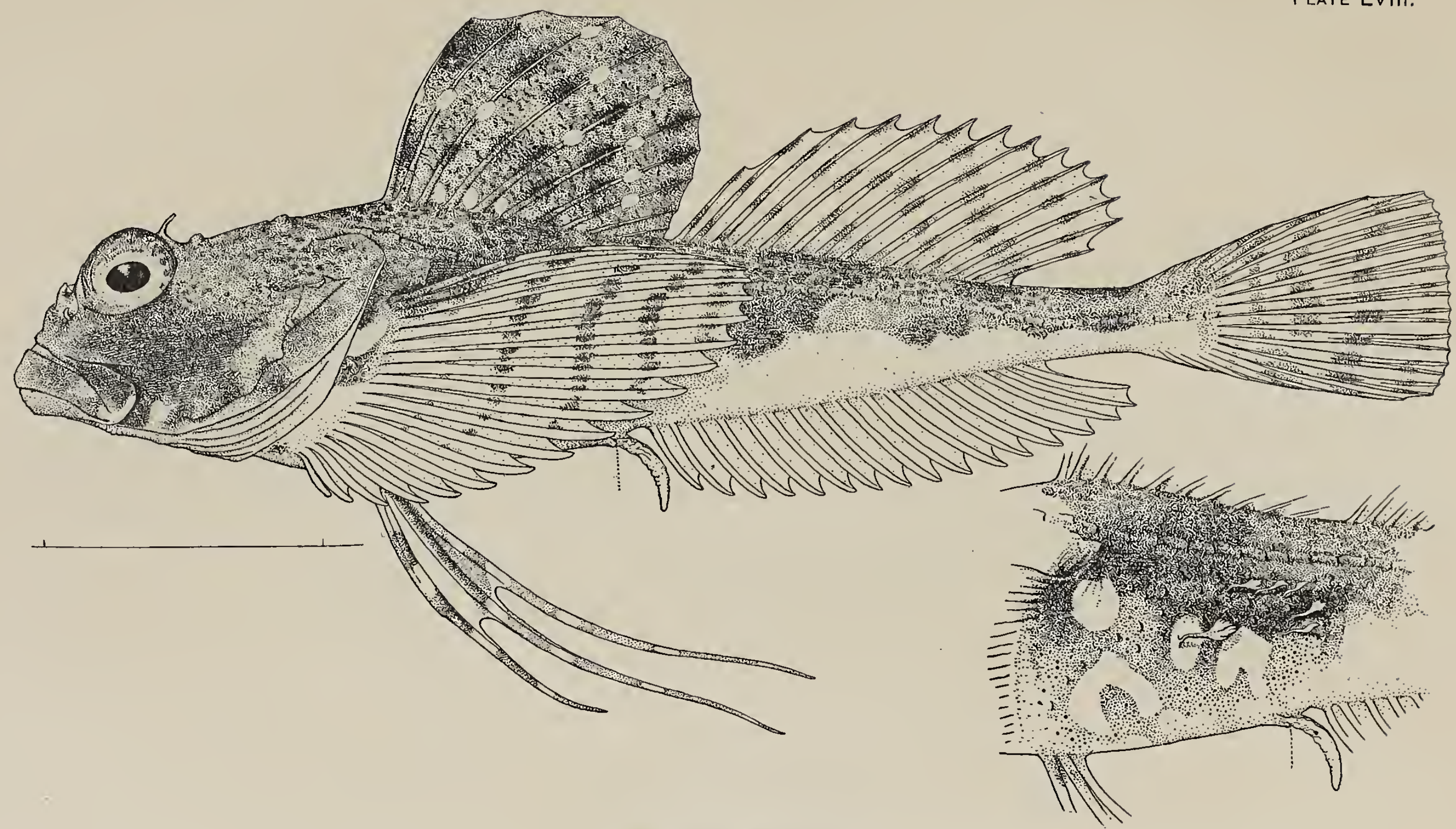
Drawn by Anna L. Brown.





CERATOCOTTUS LUCASI (type).
Near St. Paul Island.
Drawn by Anna L. Brown.

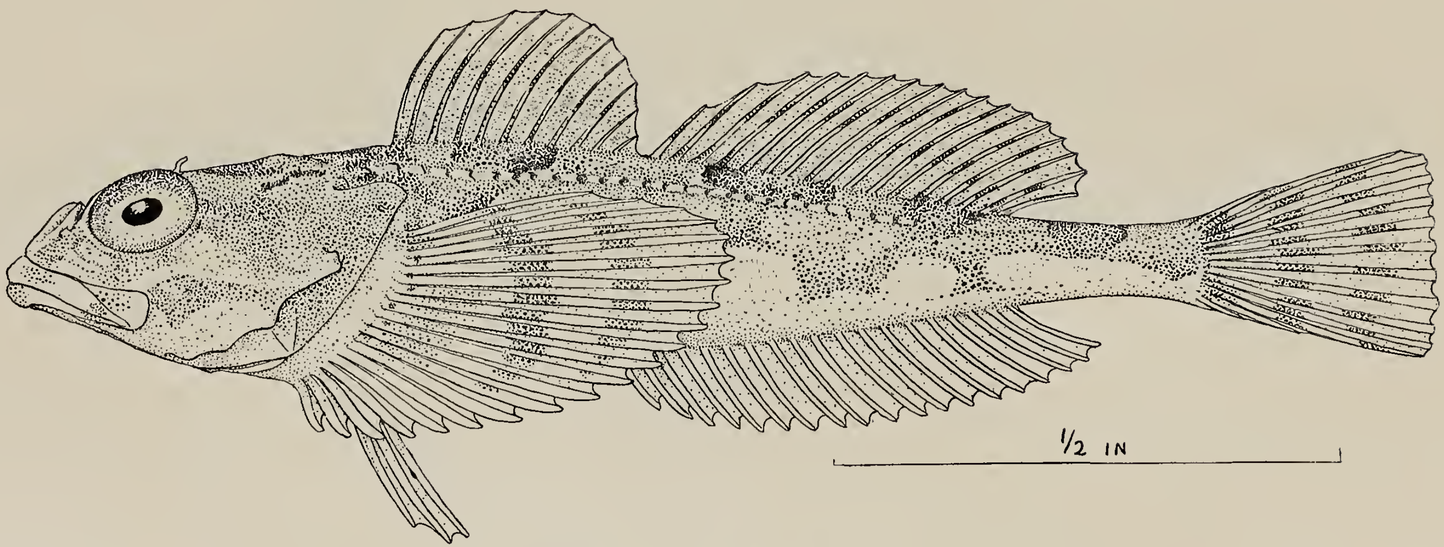
Plate LVIII.



GYMNOCANTHUS PISTILLIGER.

Petropaulski Harbor, Kamchatka.

Drawn by Chloe Lesley Starks.

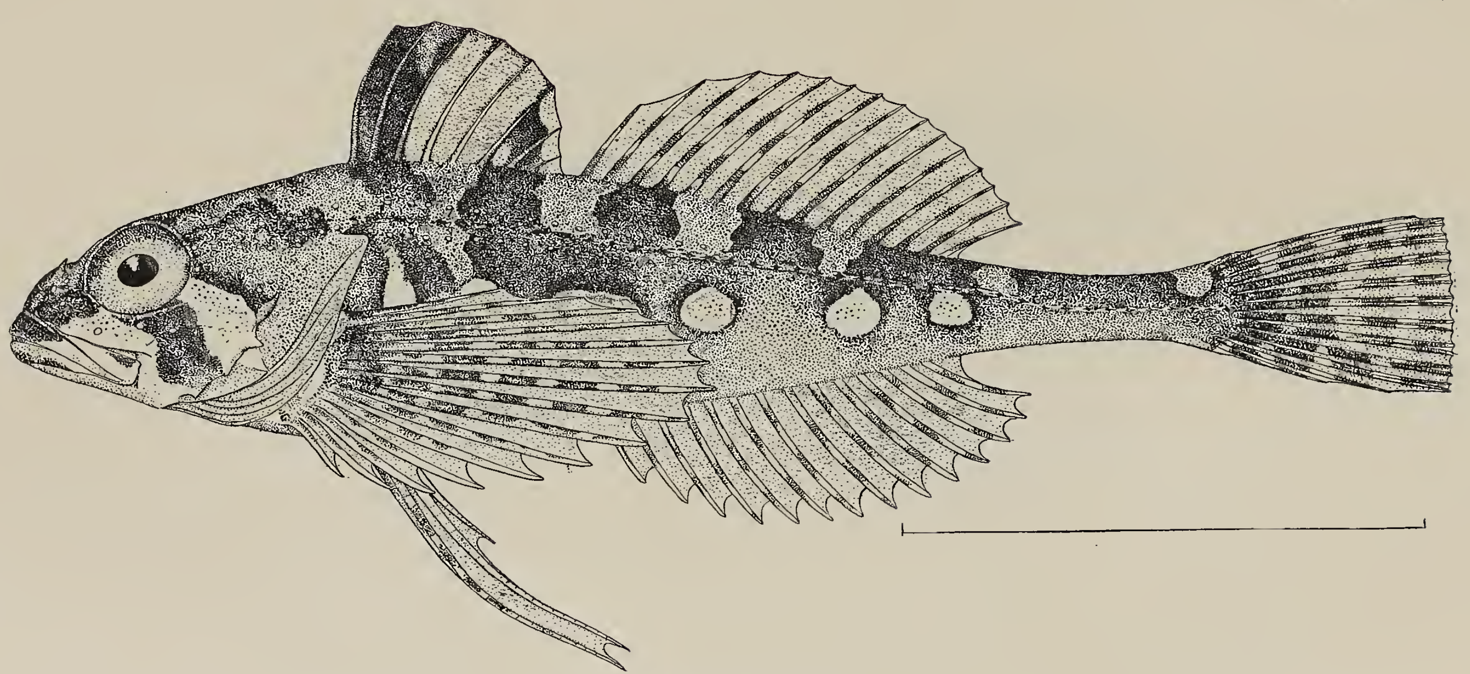


GYMNOCANTHUS GALEATUS (very young)

Salt Lagoon, St. Paul Island.

Drawn by Chloe Lesley Starks.

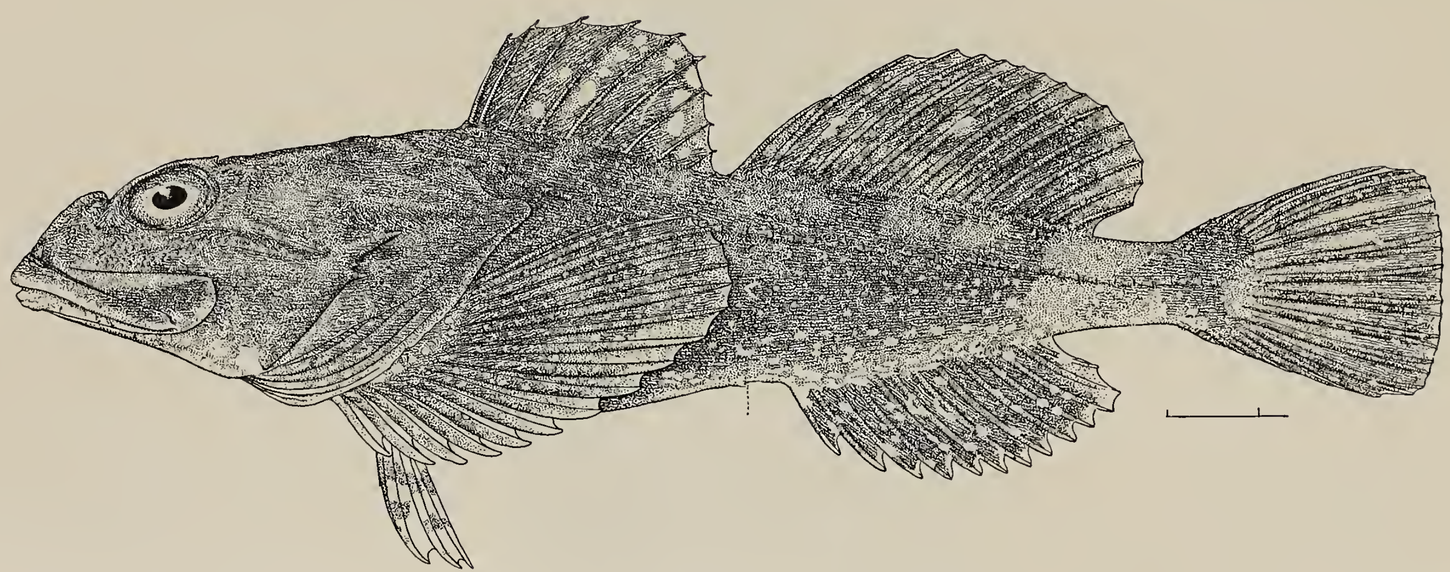
PLATE LX.



ARGYROCOTTUS ZANDERI.

Shana Bay, Iturup Island, Kurils.

Drawn by Chloe Lesley Starks.

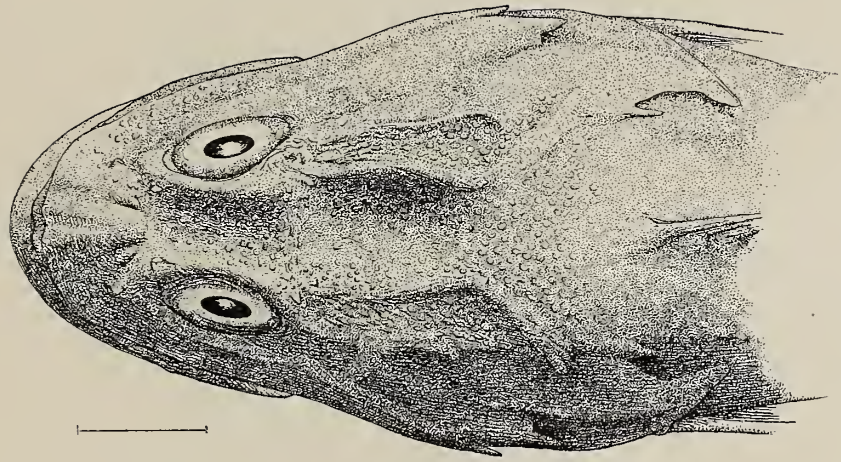


MYOXOCEPHALUS NIVOSUS.

Iturup Island, Kurils.

Drawn by Chloe Lesley Starks.

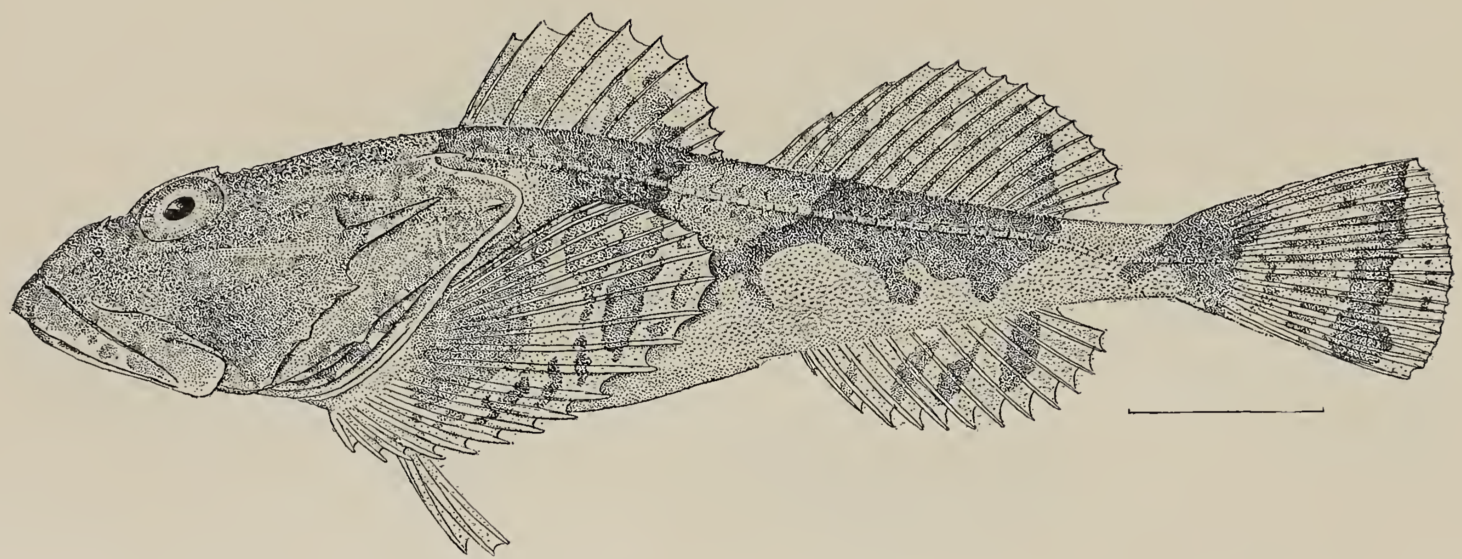
PLATE LXII.



MYOXOCEPHALUS NIVOSUS.

Iturup Island, Kurils.

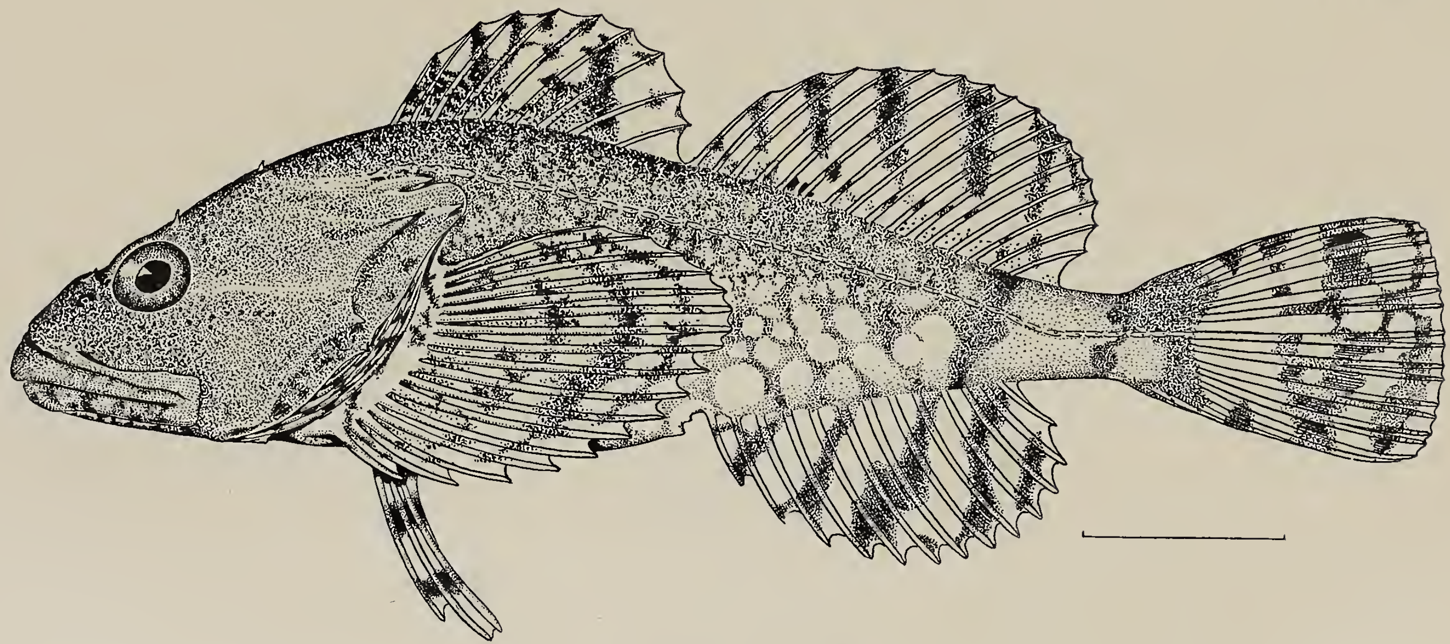
Drawn by Chloe Lesley Starks.



MYOXOCEPHALUS POLYACANTHOCEPHALUS

Unalaska.

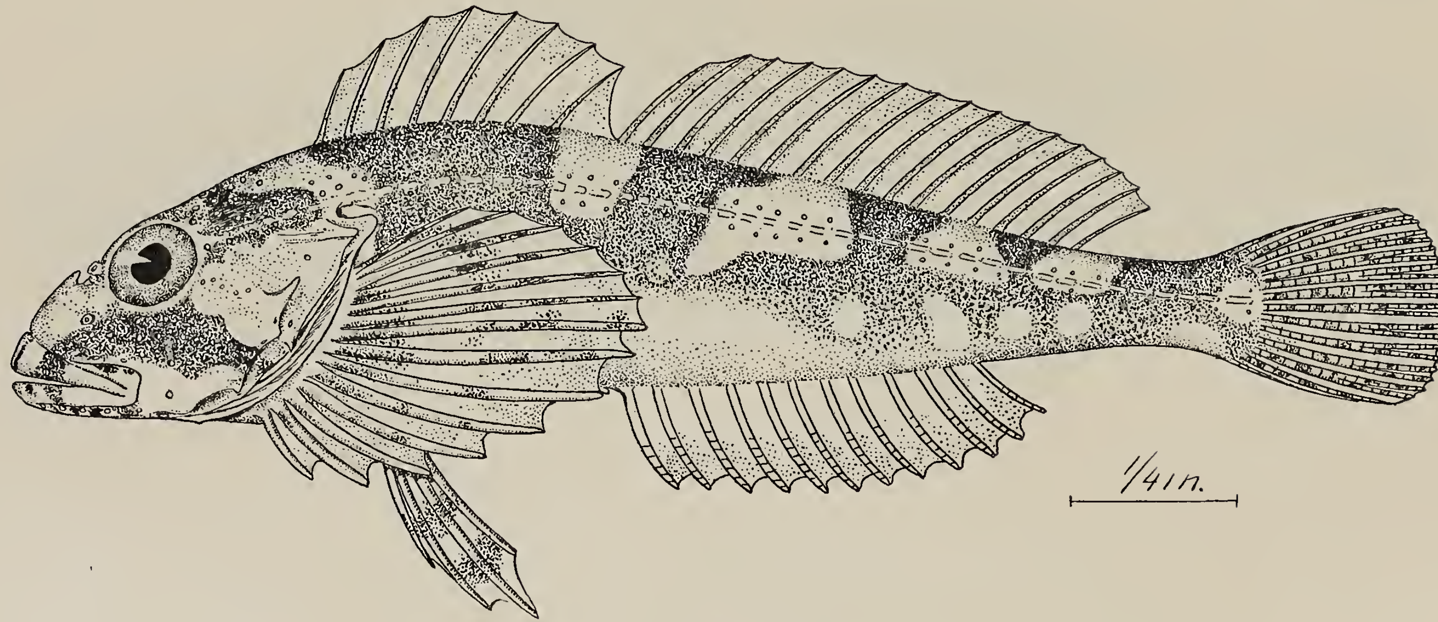
Drawn by Anna L. Brown.



MYOXOCEPHALUS STELLERI.

Petropaulski, Kamchatka.

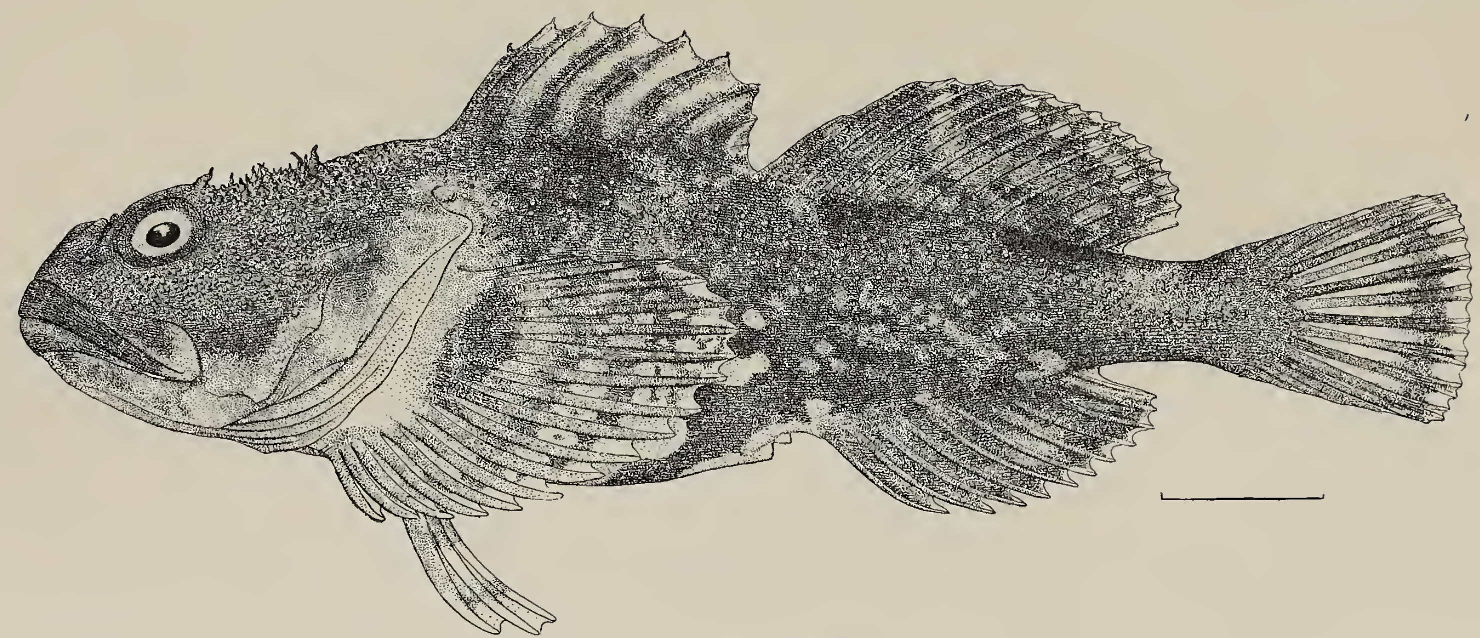
Drawn by A. H. Baldwin.



MYOXOCEPHALUS MEDNIUS.

Copper Island.

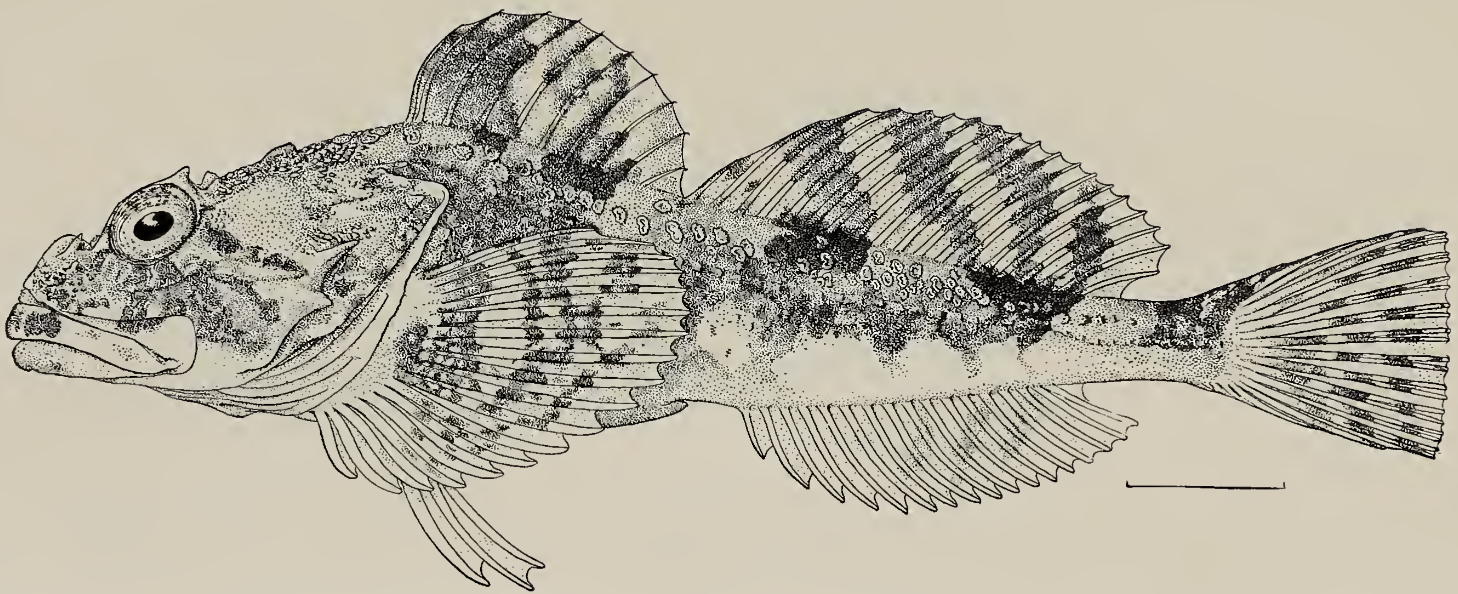
Drawn by A. H. Baldwin.



MYOXOCEPHALUS NIGER.

St. Paul Island.

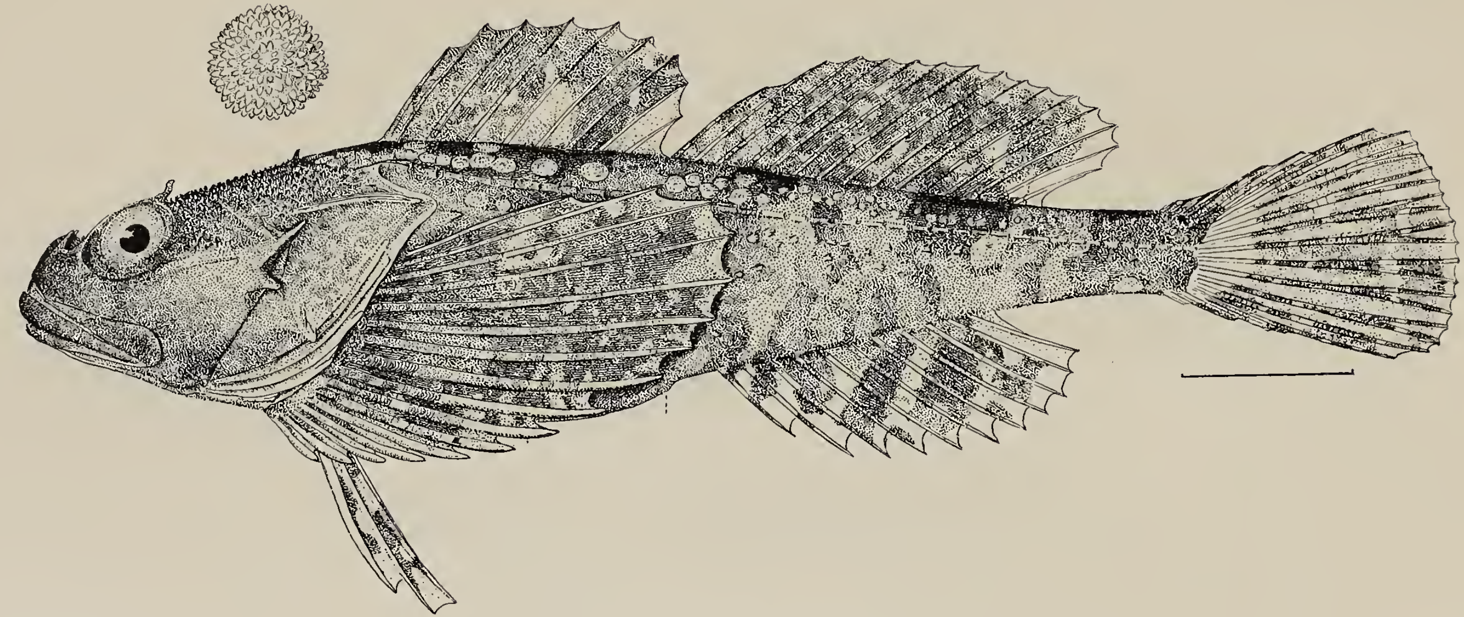
Drawn by Chloe Lesley Starks.



MYOXOCEPHALUS VERRUCOSUS.

Albatross Station 3232, Bering Sea.

Drawn by Chloe Lesley Starks.

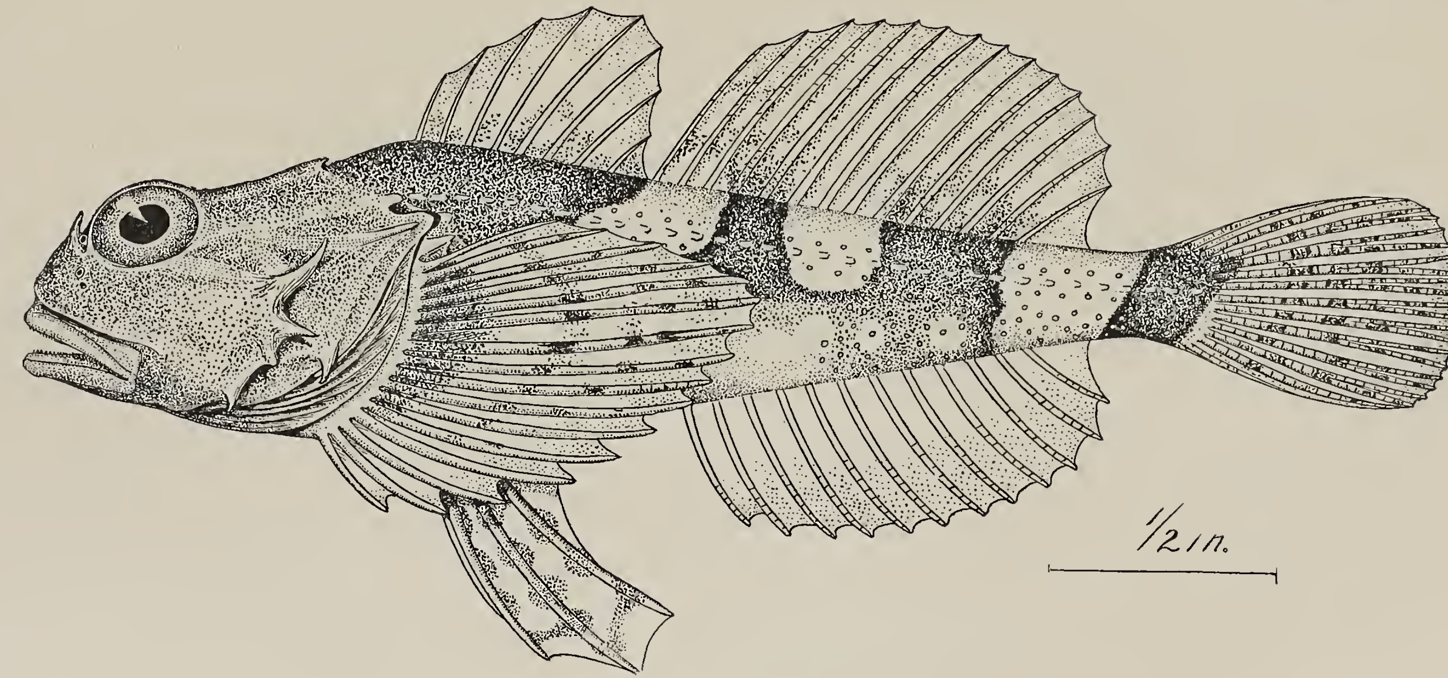


MYOXOCEPHALUS AXILLARIS.

Herendeen Bay, Alaska.

Drawn by Anna L. Brown.

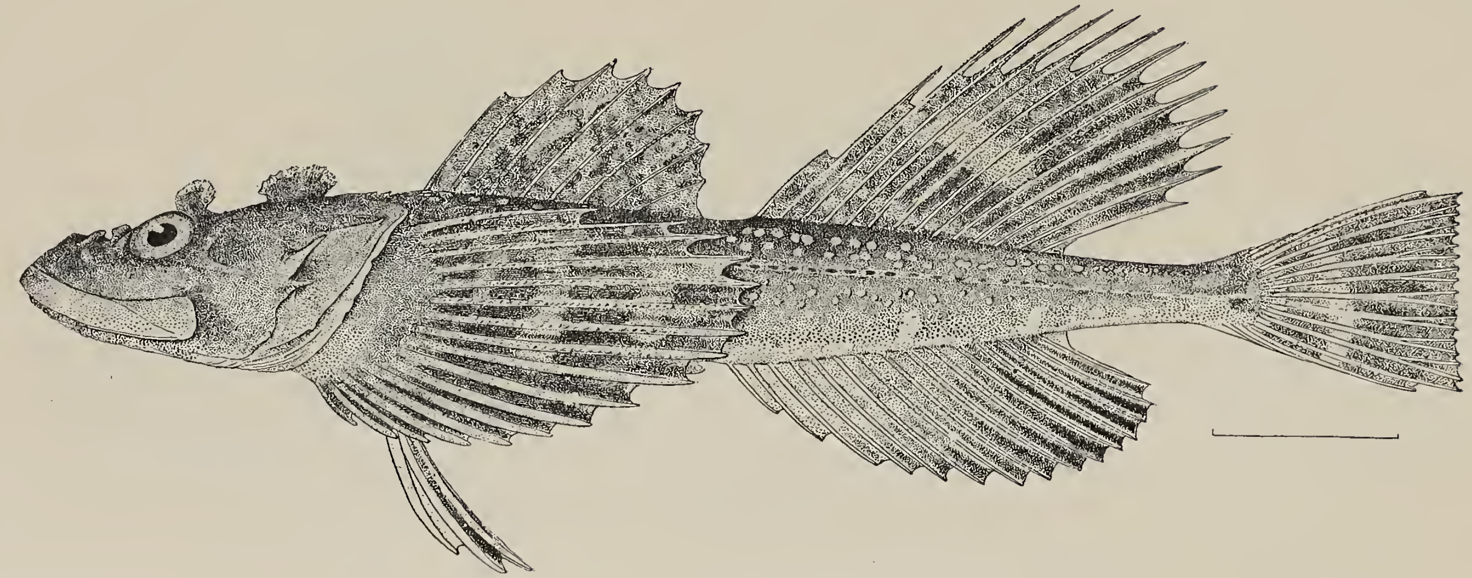
PLATE LXVIIb.



POROCOTTUS QUADRATUS.

Bering Island.

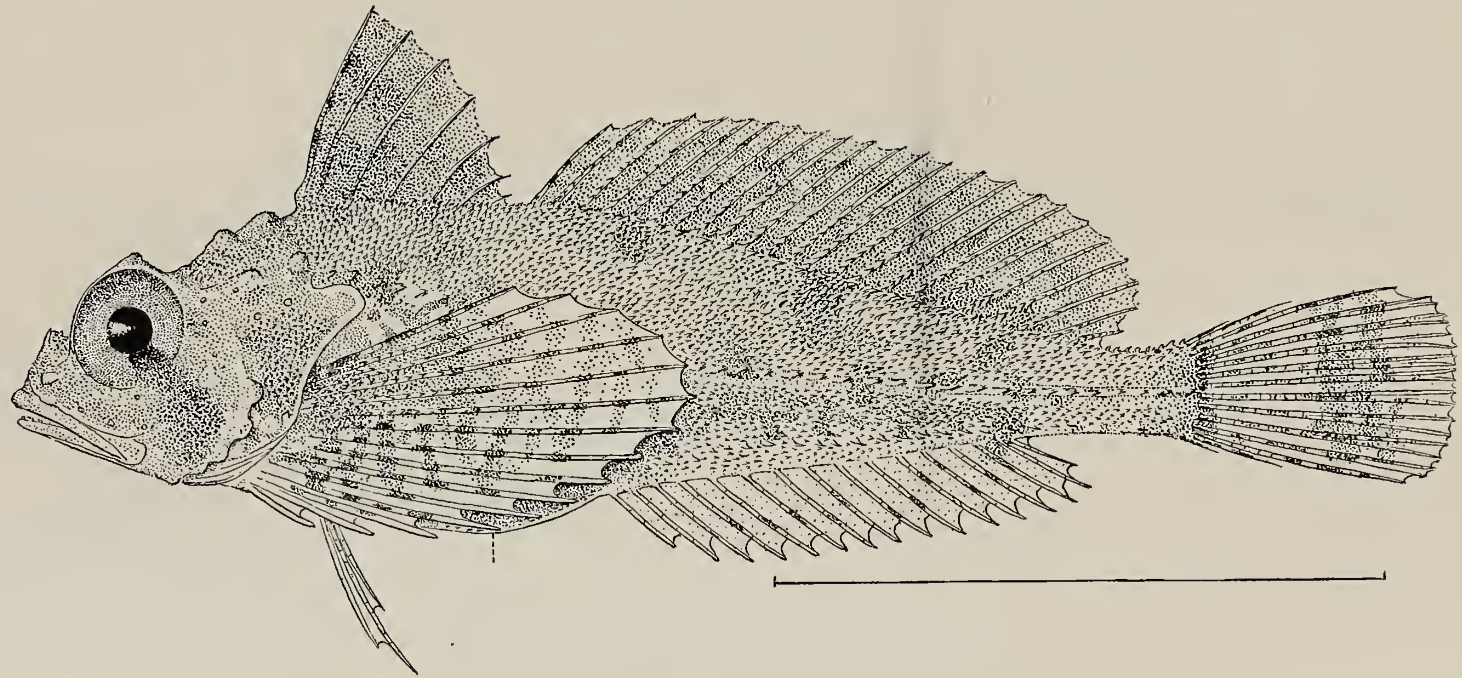
Drawn by A. H. Baldwin.



ONCOCOTTUS HEXACORNIS.

Herschel Island, Arctic Ocean.

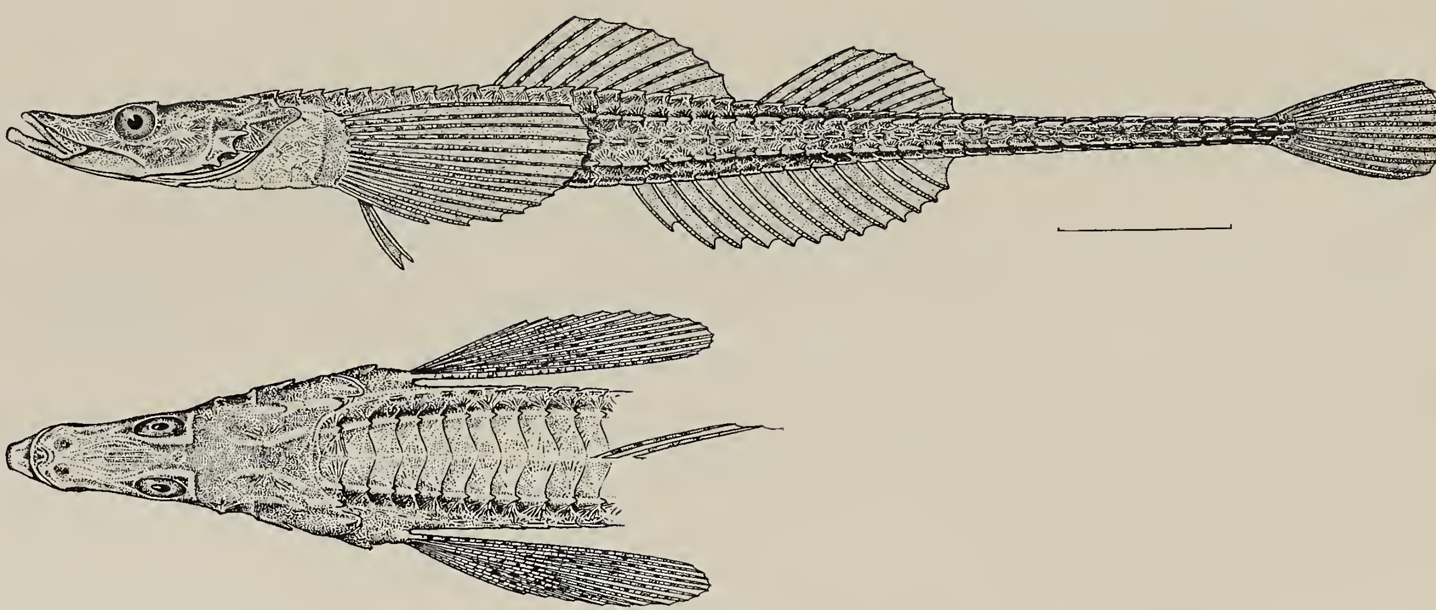
Drawn by Anna L. Brown.



NAUTISCUS PRIBILOVIUS (type).

Off Zapadni Mys, St. Paul.

Drawn by Anna L. Brown.

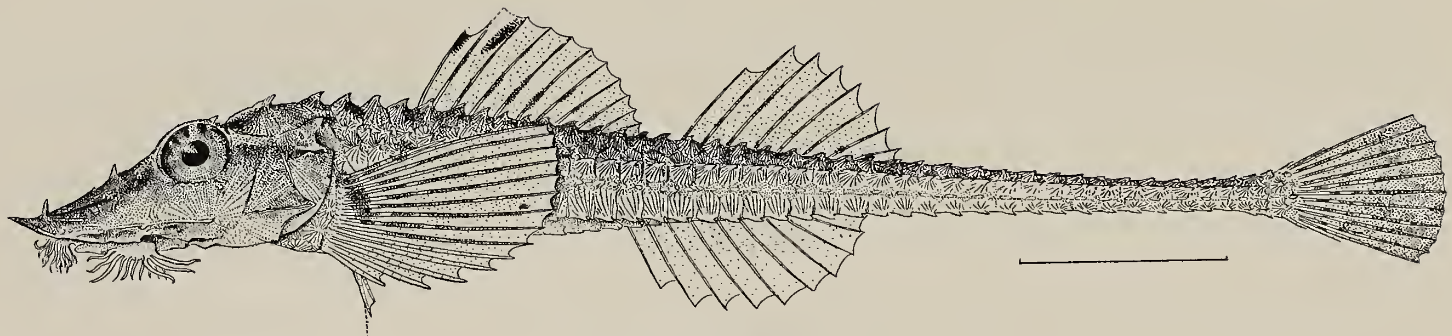


BRACHYOPSIS ROSTRATUS.

Yeso, Japan.

Drawn by A. H. Baldwin.

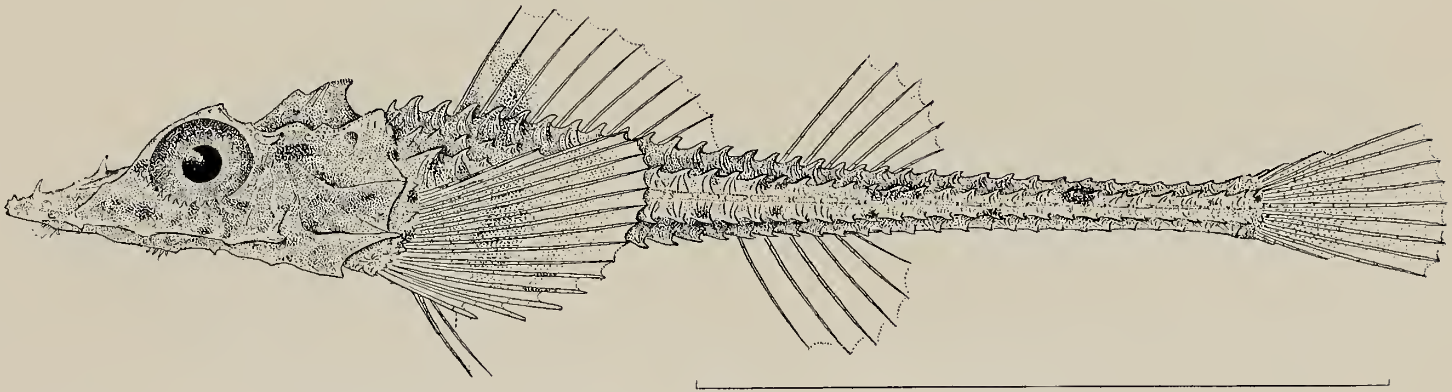
Plate LXXI.



PODOTHECUS HAMLINI (type).

Albatross Station 3652, Kuril Islands.

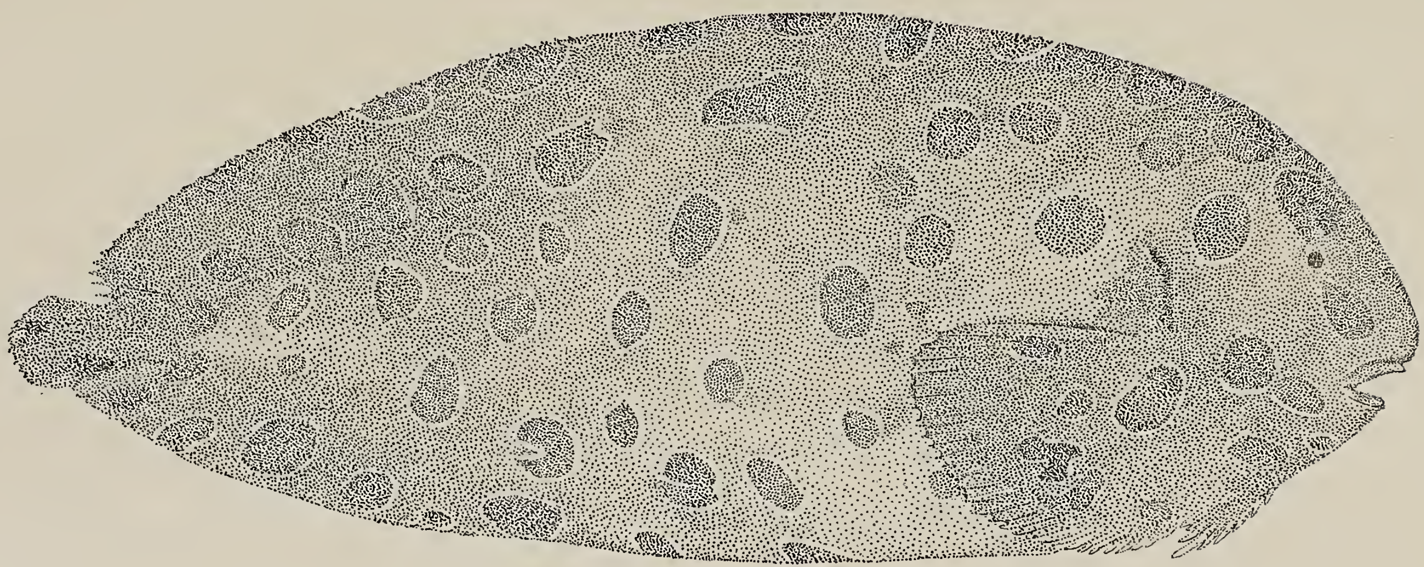
Drawn by Anna L. Brown.



PODOTHECUS THOMPSONI (type).

Albatross Station 3653, Kuril Islands.

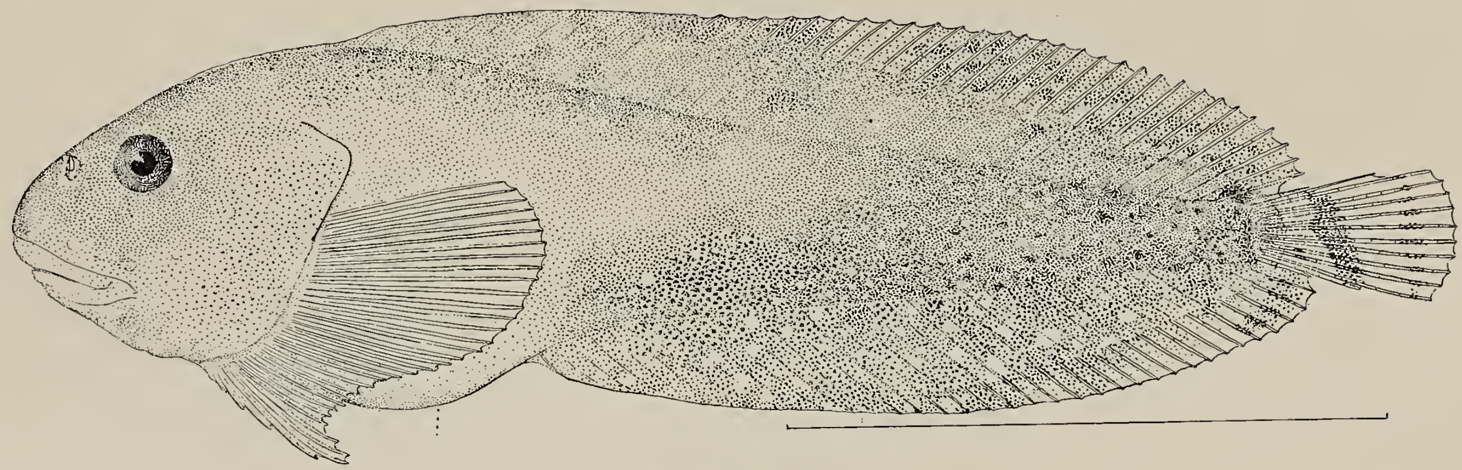
Drawn by Anna L Brown.



LIPARIS CYCLOSTIGMA (from a photograph of the type .

Albatross Station 3252, off Unalaska.

Drawn by Anna L. Brown.

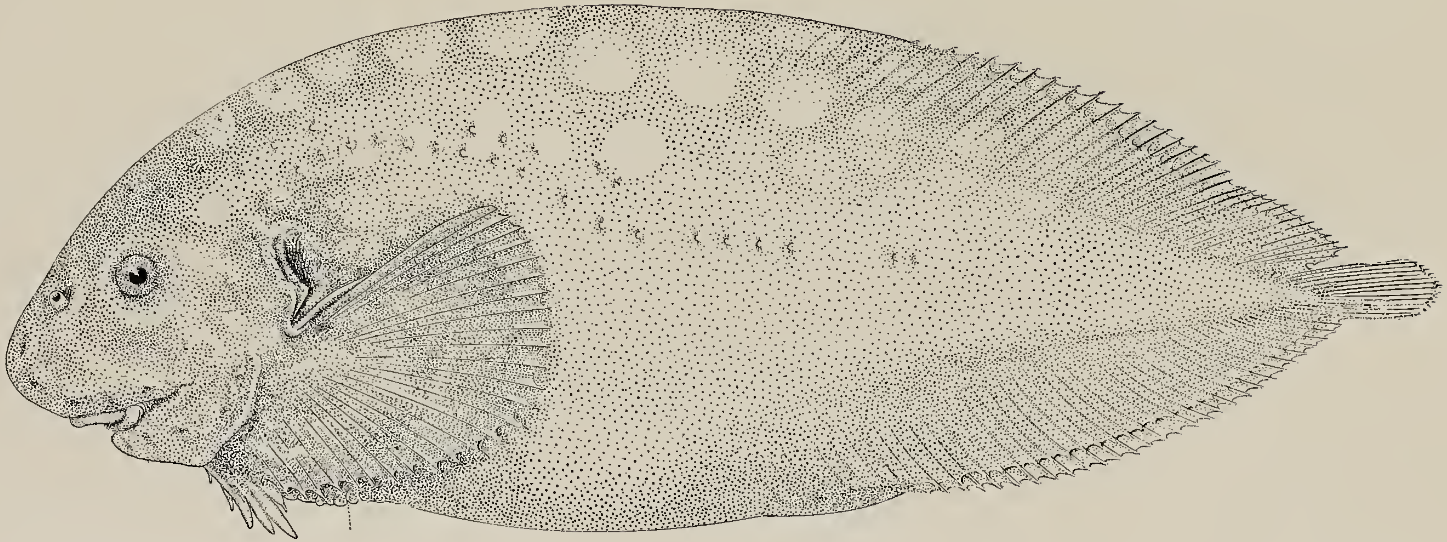


LIPARIS HERSCHELINUS (type).

Herschel Island, Arctic Ocean.

Drawn by Anna L. Brown.

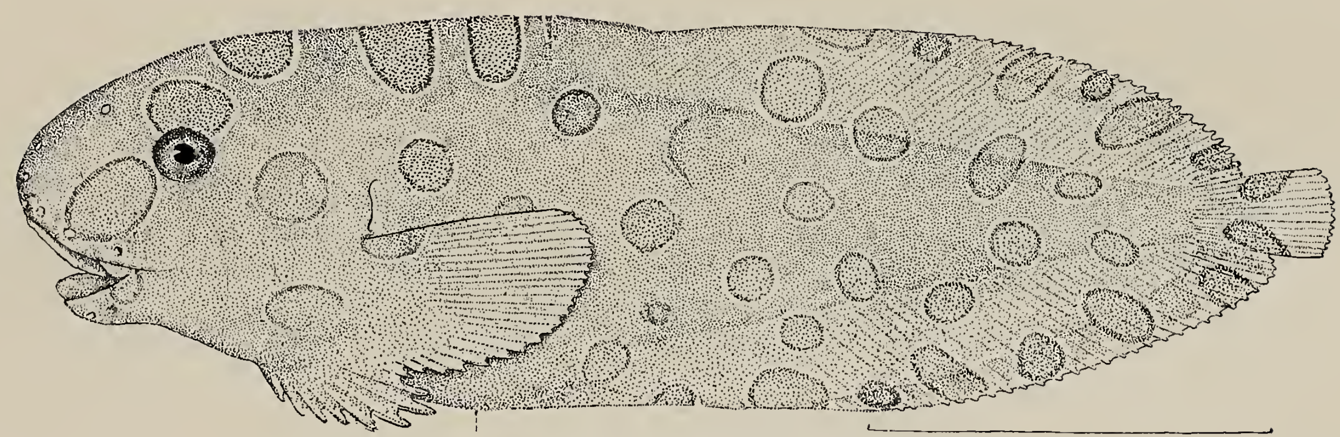
Plate LXXV.



CRYSTALLICHTHYS MIRABILIS (type).

Off Povorotnaya, Kamchatka.

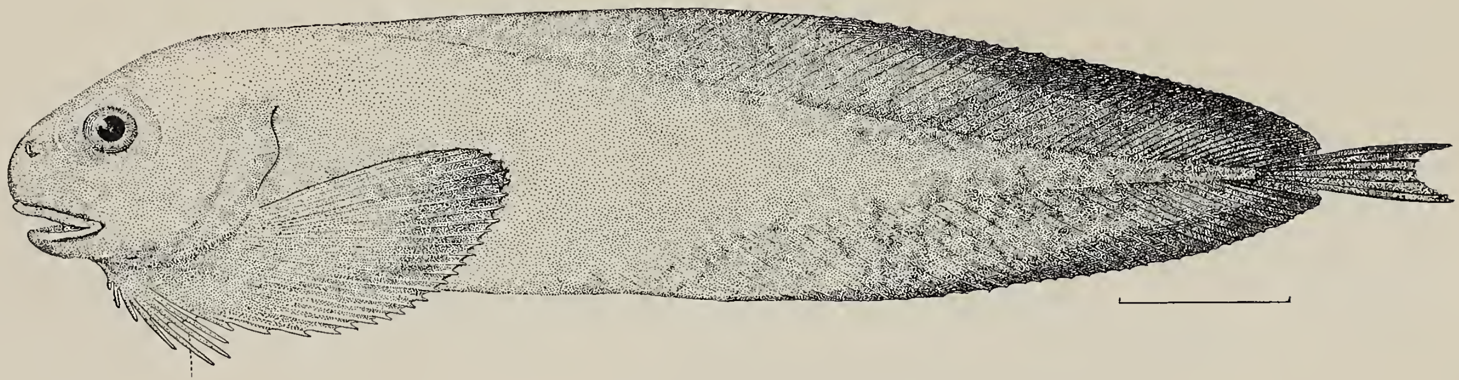
Drawn by W. S. Atkinson.



CRYSTALLICHTHYS MIRABILIS (young).

Off Zapadni Mys, St. Paul Island.

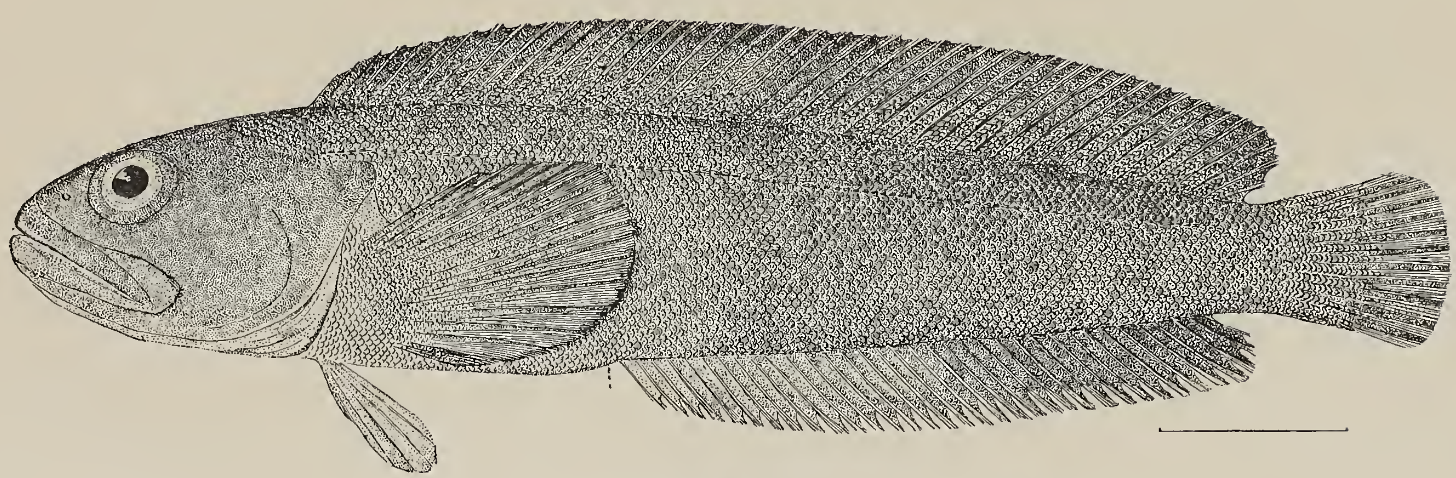
Drawn by Anna L. Brown.



PROGNURUS CYPSELURUS (type).

Off Bogoslof Island.

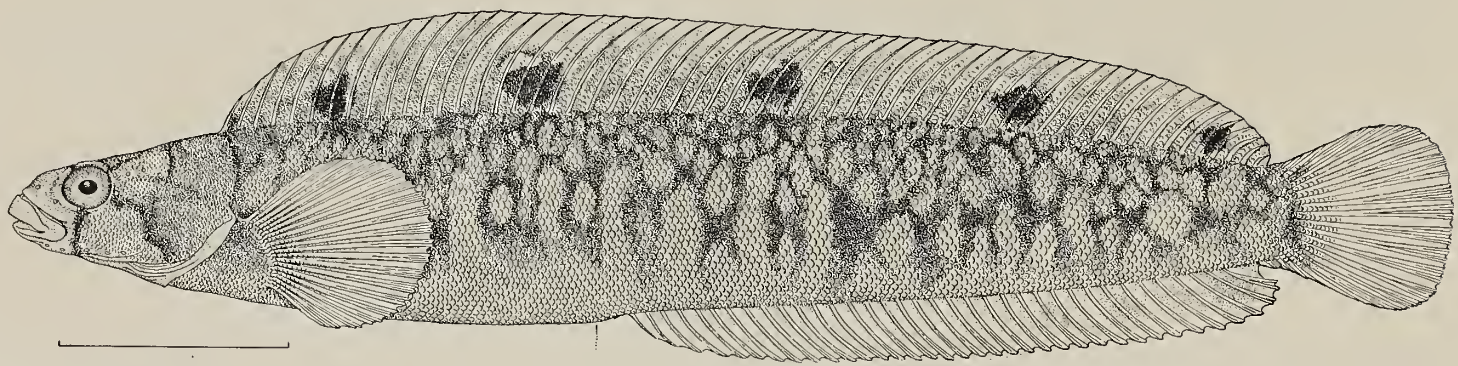
Drawn by Anna L. Brown.



BATHYMASTER SIGNATUS.

Sitka, Alaska.

Drawn by Anna L. Brown.

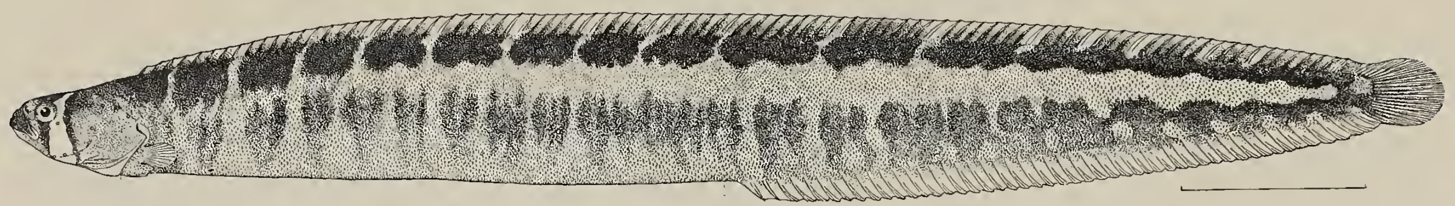


OPISTHOCENTRUS OCELLATUS.

Petropaulski Harbor, Kamchatka.

Drawn by Chloe Lesley Starks.

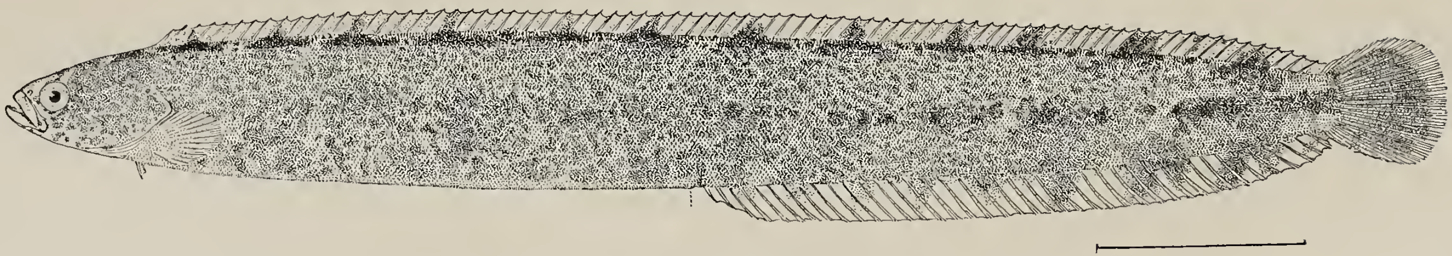
Plate LXXX.



PHOLIS PICTUS.

Shana Bay, Iturup Island, Kurils.

Drawn by Chloe Lesley Starks.

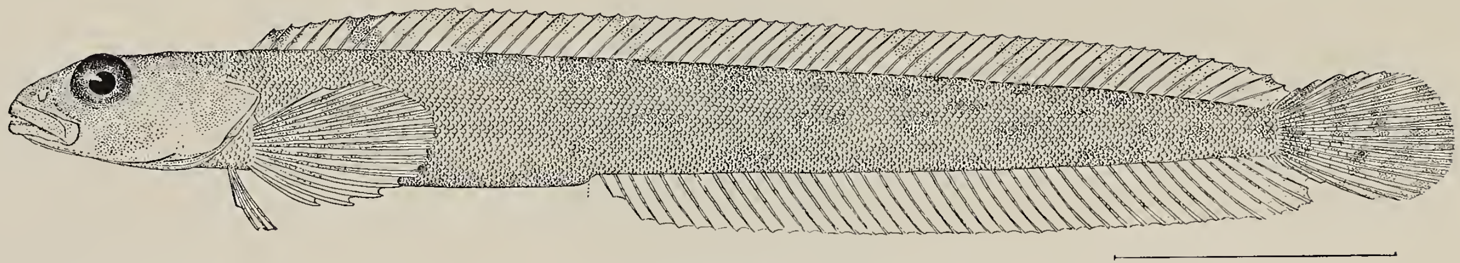


ENEDRIAS NEBULOSUS.

Hakodate, Japan.

Drawn by Anna L. Brown.

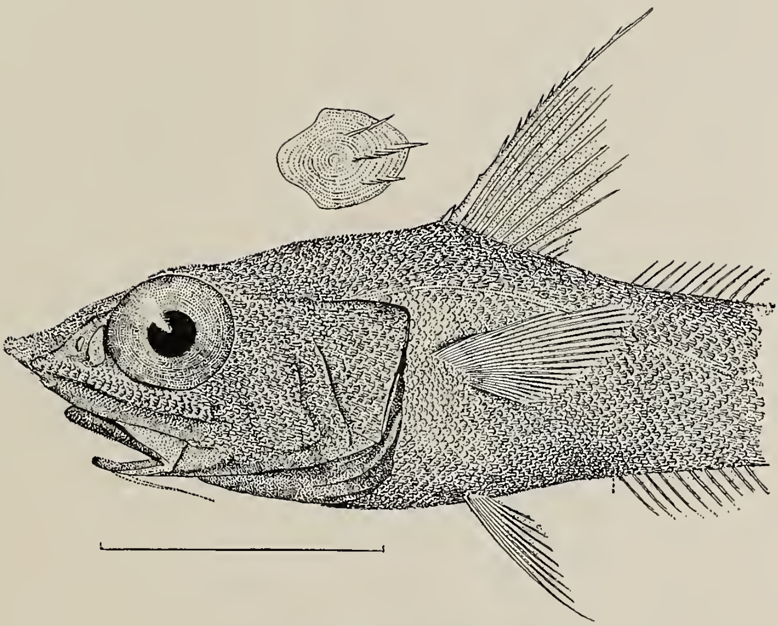
PLATE LXXXI.



LUMPENUS MEDIUS.

Off Avatcha Bay, Kamchatka.

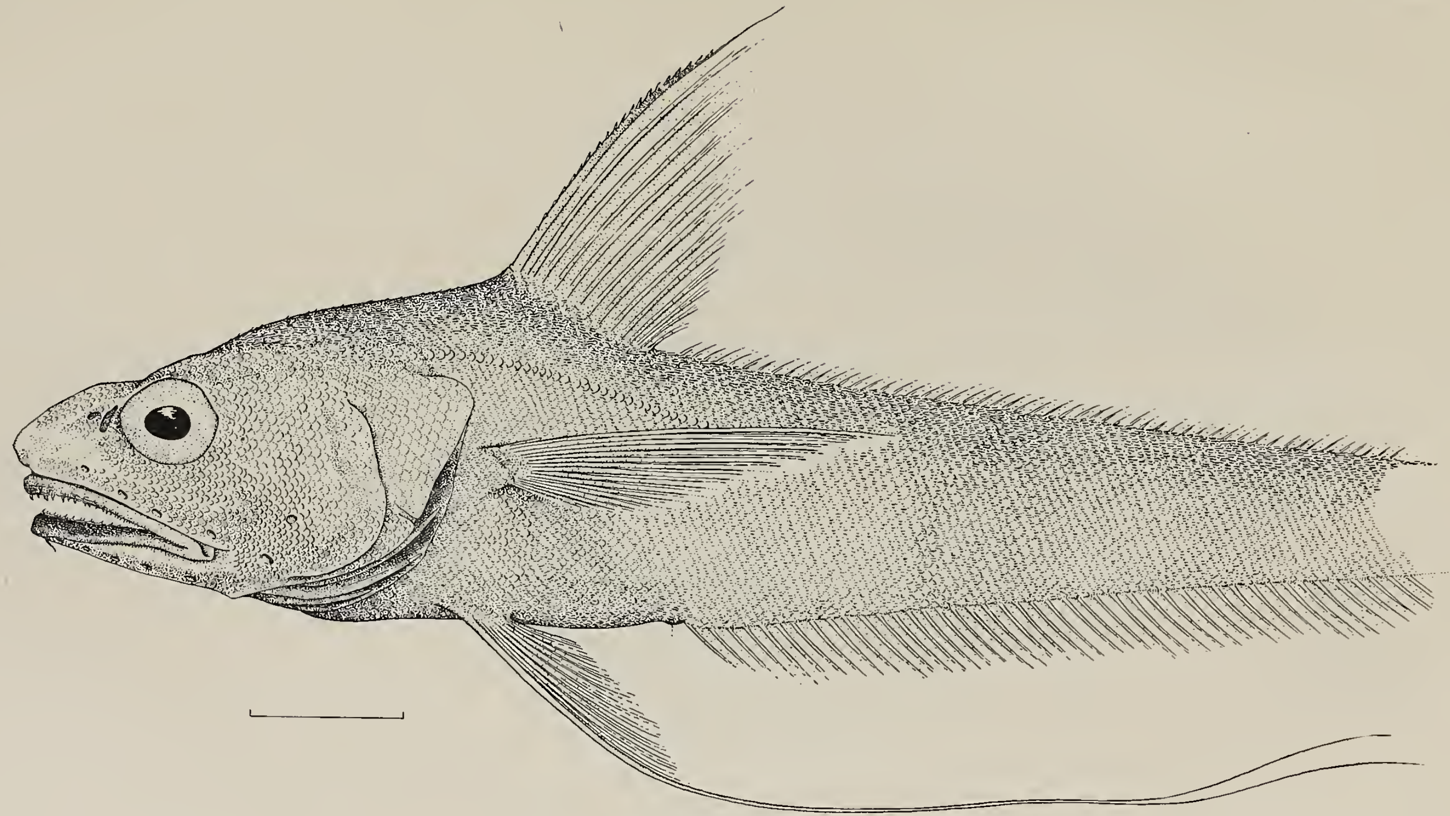
Drawn by Anna L. Brown.



MACROURUS ACROLEPIS.

Off Bogoslof Island.

Drawn by Anna L. Brown.

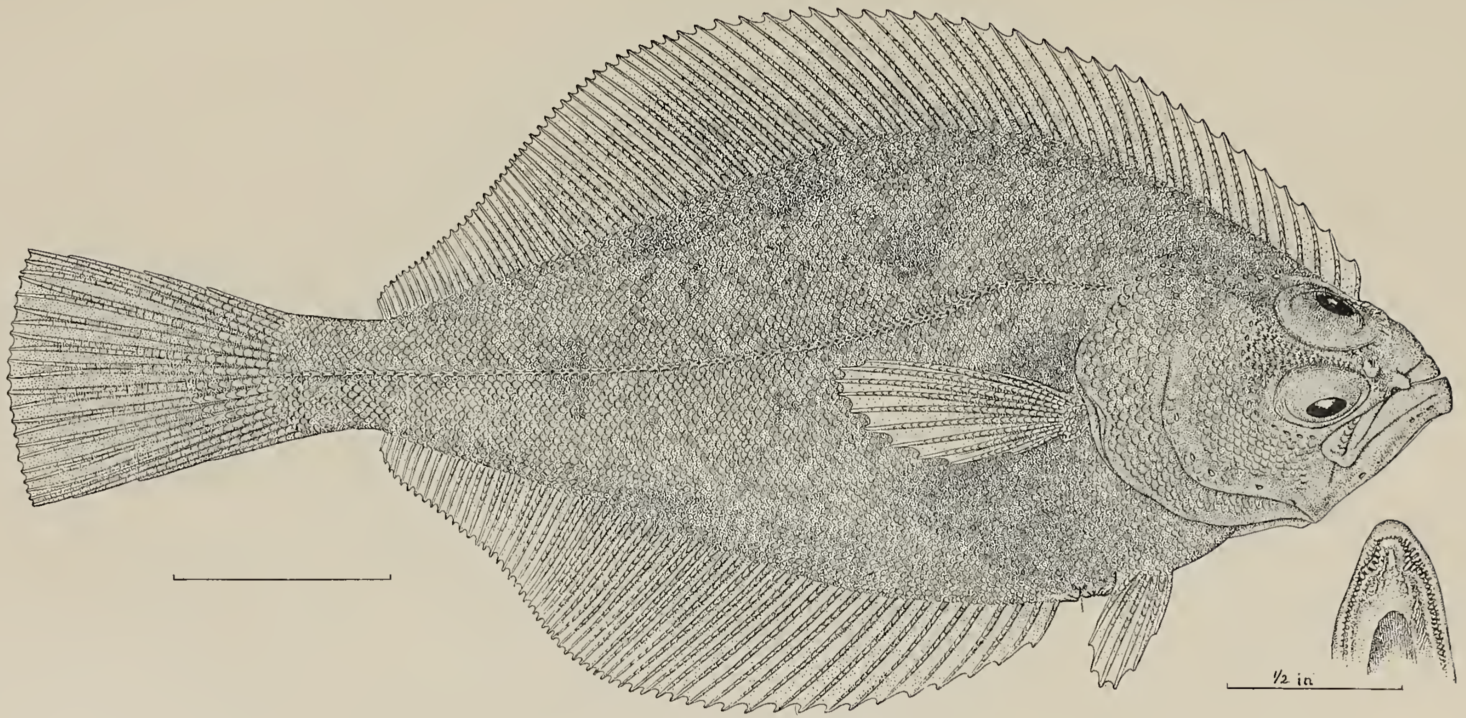


BOGOSLOVIUS CLARKI (type).

Bogoslof Island.

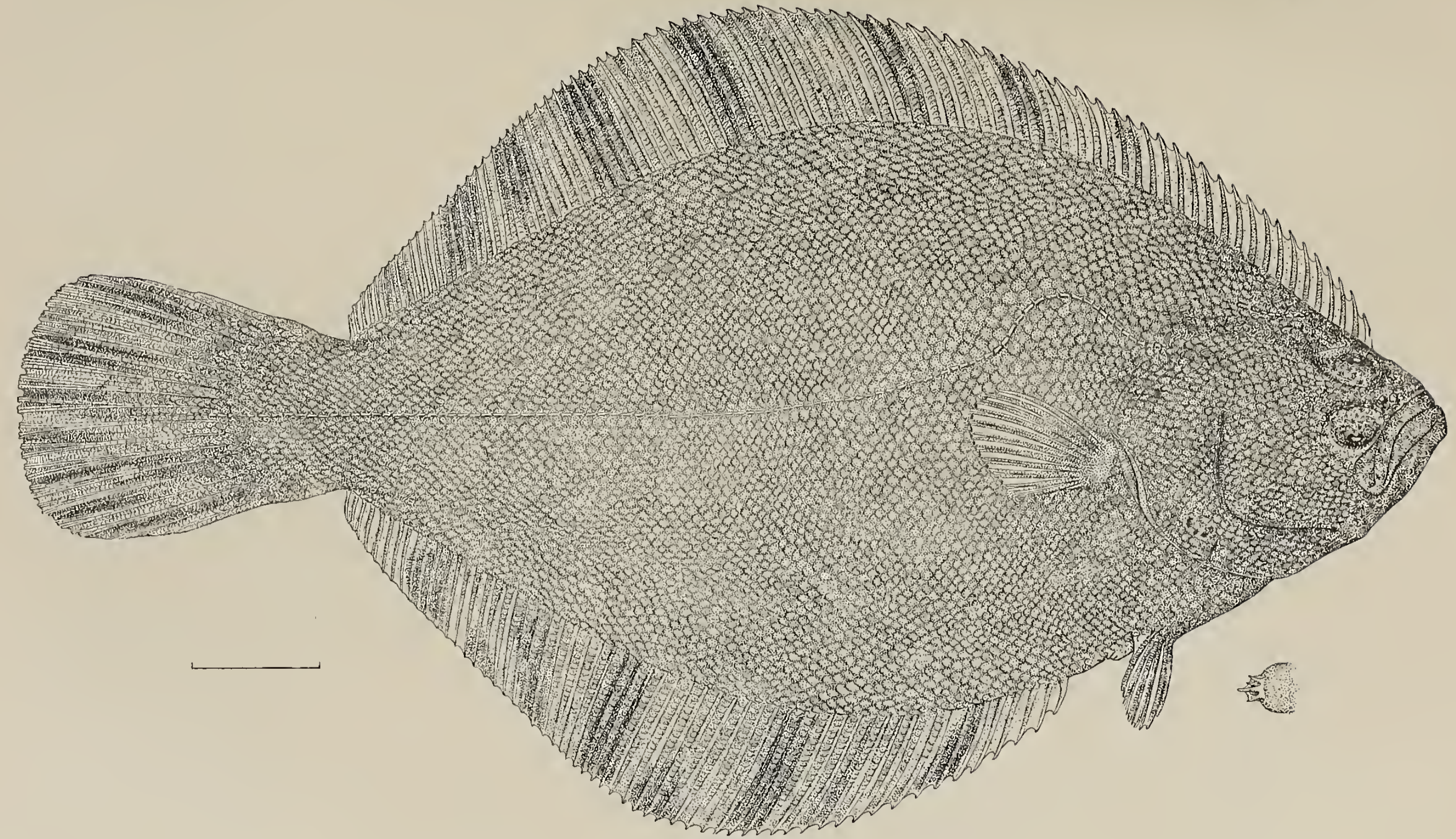
Drawn by Chloe Lesley Starks.

PLATE LXXXIV.



HIPPOGLOSSOIDES HAMILTONI (type).
Albatross Station 3641, Avatcha Bay, Kamchatka.
Drawn by Chloe Lesley Starks.

PLATE LXXXV.



VERASPER MOSERI (type).
Shana Bay, Iturup Island, Kurils.
Drawn by Chloe Lesley Starks.

XIX.—A CONTRIBUTION TO THE KNOWLEDGE OF THE TUNICATA OF THE PRIBILOF ISLANDS.

By William Emerson Ritter, Ph. D.,
Associate Professor of Zoölogy, University of California.

The Tunicata here described reached me in two installments. The first was collected by President Jordan himself on Lukanin Beach, St. Paul Island, during July, 1896; the second by Messrs. R. E. Snodgrass, Trevor Kincaid, and A. W. Greeley from July to September, 1897. This second installment contains specimens gathered from various points, which will be found specified in connection with the descriptions of the species. The first lot contained four species, viz, *Dendrodoa tuberculata*, *D. subpedunculata*, *Aplidiopsis jordani*, and *Polyclinum globosum*. It is perhaps significant that the last two species are not represented in the second installment, even though this contains a much larger number of specimens all told and is the result of a considerably longer continued and wider range of collecting. President Jordan informs me that the summer of 1896 was particularly stormy at the Pribilofs. The following is a list of the species contained in the collection:

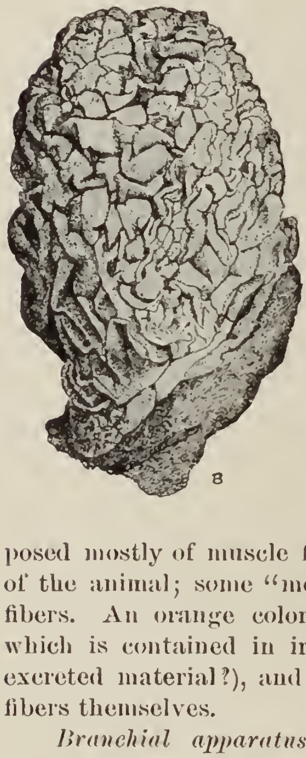
Ascidiae Simplices:
- *Boltenia elegans*, Herdman.
- *Styela greeleyi*. New species.
- *Dendrodoa tuberculata*. New species.
- *subpedunculata*. New species.

Ascidiae Compositae:
- *Polyclinum globosum*. New species.
- *pannosum*. New species.
- *Aplidiopsis jordani*. New species.
- *Amaroucium kincaidi*. New species.
- *pribilovense*. New species.
- *snodgrassi*. New species.
- *Synoicum irregulare*. New species.

Facts of some interest relating to the geographical distribution are brought out by considering the species here described in connection with other known far northern tunicates. Of the genera represented, two, viz, *Dendrodoa* and *Synoicum*, are, so far as we now know, confined to the Arctic or North Atlantic oceans. Of the other species, *Boltenia elegans* is known only from the extreme North Pacific; *Aplidiopsis jordani* has as its nearest ally *A. sarsii*, Huitfeldt-Kaas, from Lofoten Islands; and both *Amaroucium pribilovense* and *A. snodgrassi* have apparently rather closer affinities with *A. mutabile*, Sars, from Hammerfest, than with any other species of the genus. It would thus seem that at least half of the species might be regarded as characteristically far northern; and the evidence at hand seems to justify the conclusion that there exists a distinct Arctic Ascidian fauna.

Before entering upon the main work in hand, I wish to express not only my satisfaction at having the opportunity to make this contribution to the knowledge of this group of animals, but also my pleasure at doing the work at the instance of one so watchful and energetic as President Jordan ever is in all his capacities as a promoter of learning. I also most gladly acknowledge the important assistance that has been rendered me in the work by one of my advanced students, Miss Edith Byxbee.

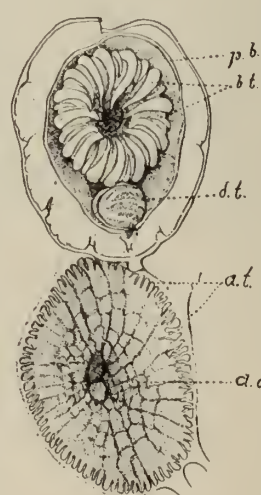
1.



Dendrodoa tuberculata, new species.

General characteristics.—Subcylindrical, about one-third longer than broad, quite regular in form, usually attached by the posterior end, sometimes by one side. Dimensions of a large specimen: Length, 53 mm.; greatest diameter, 35 mm. Entire surface closely beset with short, blunt, irregular tubercles. Color brown to yellowish brown, a little darker at the anterior end. (Fig. 1.)

2.



Test.—Coriaceous, almost horny, scarcely 1 mm. thick excepting through the tubercles. Dull opaque white on cut surfaces; inner surface, after being separated from the mantle, with a somewhat pearly luster. Contains no vessels.

Mantle.—Well developed, considerably thicker than test, composed mostly of muscle fibers, most of which run lengthwise of the animal; some "mesenchyme" cells among the muscle fibers. An orange coloring matter in the mantle, some of which is contained in irregular branched bodies (crystals? excreted material?), and some diffused through the muscle fibers themselves.

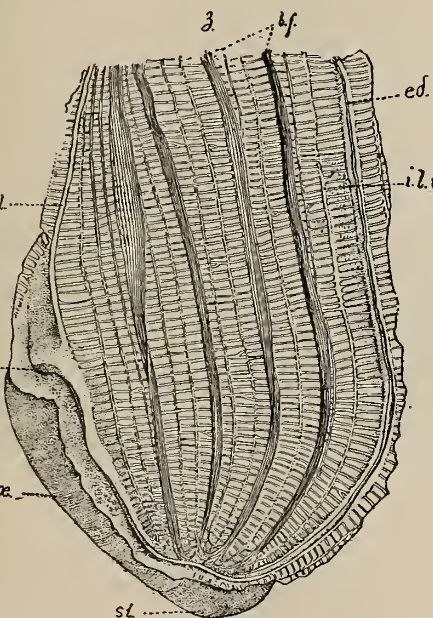
Branchial apparatus.—No projecting siphons, orifices scarcely detectable, so completely are they hidden by the tubercles of the test. Both situated at anterior end, not far apart. Branchial tentacles simple, about 24 in number, not of equal length, but not regularly alternating, a long and a short one; the circle close to the peripharyngeal band. Atrial tentacles present, numerous, short, and small. Dorsal tubercle conspicuous, biscuit-shaped, the horseshoe-shaped mouth of the hypophysis situated on its surface. (Fig. 2 *d. t.*)

Branchial sac, figs. 3 and 4, with four longitudinal folds on each side, the pair nearest the dorsal lamina somewhat larger than the others, each of these having about 14 longitudinal vessels, while each of the others have about 10. Usually two or three longitudinal vessels between each two folds. Transverse vessels numerous, averaging

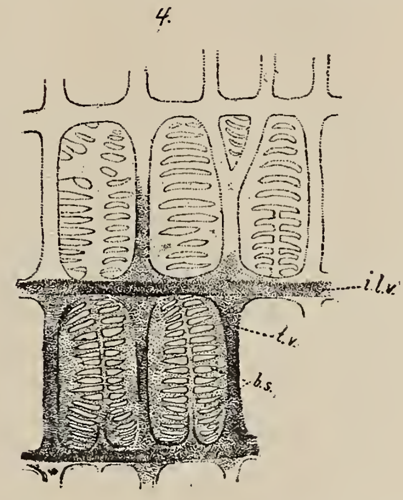
0.2 mm. apart; intermediate transverse vessels, i. e., vessels crossing the stigmata, frequently present, but small. About 20 stigmata in the space corresponding to the interval between two internal longitudinal vessels. The series of stigmatae extend fully to the dorsal lamina. (Fig. 3.)

Dorsal lamina a plane narrow membrane. "Endocarps" (fig. 5 *en'c.*) present, numerous, and rather large, contain many pigment cells.

Digestive tract.—Situated on left side of branchial sac, the portion posterior to the stomach forming an S, the two loops of which are closed; the end of the limb of the S corresponding to the pylorus is extended to form the stomach and œsophagus; the two last-mentioned parts of about equal length. Œsophagus issues from the dorsal side of the branchial sac. Stomach not well set off from intestine; considerably longer than broad, its walls with numerous internal folds, but smooth on outer surface; rectal portion of intestine runs close along the œsophagus, but extends farther forward than mouth of œsophagus.



Sexual organs.—On the right side of



the animal only, closely attached to the inner surface of the mantle. Ovary (fig. 5, *ov.*), a long, branched, cylindrical body of uniform diameter throughout, the whole consisting of a basal portion situated near to and extending approximately parallel with the midventral line, and five or six simple branches given off from this basal piece, these reaching dorsalward and being inclined somewhat toward the anterior end of the animal.

This species clearly belongs to the genus *Dendrodoa*, founded by MacLeay, 1824, as a subgenus of Ascidia. His species was from Winter Island, in Fox Channel. Until now no other member of the genus has been described.

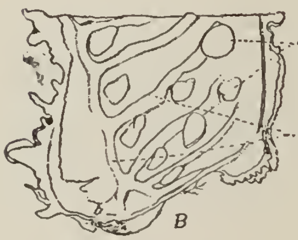
The chief differences between the present species and *D. glandaria*, MacLeay, are as follows:

The test of the latter is described as "whitish, subpellucid, coriaceous, and smooth;" and in another connection the author speaks of the ovary as being visible through the test. The "anterior nervous tubercle" (dorsal tubercle) in MacLeay's species is said to have "many spirals." These are undoubtedly the hypophysis mouth, which in our species, as shown by the description, is horseshoe shaped.

The "pharynx" of *D. glandaria* is described as being situated "at the bottom of the body cavity." By the "pharynx" is here evidently meant the entrance to the œsophagus; and this opening in our species, it will be observed, is on the dorsal side of the branchial sac. (Fig. 3, *o. œ.*)

In the structure of the branchial sac the two species differ in the number of longitudinal vessels between the folds, there being three and sometimes four in our species, while there are only two in MacLeay's species. It is thus seen that the two species are very distinct.

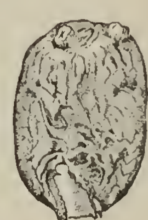
5



Herdman, 1882, has expressed the opinion that the genus *Dendrodoa* is not distinct from *Styela*. The genus is based on the position and character of the ovary, this being single, branched, and situated on the right side of the body here, while *Styela* has several unbranched ovaries situated on both sides of the body.

In his diagnosis of the genus *Styela*, written in 1882, Herdman speaks of the genitalia as being "in the form of one or more simple, lobed, or branched bodies." According to this definition *Dendrodoa* would, so far as this character is concerned, be merged in *Styela*. The same author has, however, in his Revised Classification of the Tunicata, 1891, stated that the gonads of *Styela* are present "on both sides of the body." As this is essentially the view of the case held by Savigny, 1816, MacLeay, 1824, Hancock, 1868, and Heller, 1877, and others who have written about the genus, it has seemed to me best to regard the difference as sufficiently great and constant to justify the recognition of both genera. I do not, however, believe that it is any more closely related to *Styela* than to *Polycarpa*, or any more closely related to *Styela* than the latter is to *Polycarpa*.[1] There are a large number of specimens in the collection, all from St. Paul Island.

6.



Dendrodoa subpedunculata, new species.

General characteristics.—Subspherical; slightly elongated anteroposteriorly, frequently showing a tendency to be pedunculated; somewhat laterally compressed. Usually attached by the posterior end, and by only a small area, so that specimens may be more or less pendulous. Of the two dozen specimens at hand, 13 are attached close together on a small bit of seaweed, indicating an aggregated habit for the species (fig. 7). In one instance two individuals were fused together by their tests (fig. 7*a*). Length from 1 to 1.5 cm.; surface rather closely but

[1] Kiær, 1893, has described and figured a species which appears to be *Dendrodoa glandaria*, or a closely related form, but which he identifies as *Styela aggregata* J. Rathke, and he refers to Traustedt as holding the same view. I find, however, on looking up the author's references to Traustedt that the latter does not mention *Dendrodoa*, but he does say of *Styela aggregata* that the "genitalorgane sind wie gewöhnlich beiderseits entwickelt" (Traustedt, 1893).

Kiær does not believe that the single branched ovary as it exists in *Dendrodoa* is a character of sufficient importance and constancy to justify the founding of a new genus upon it. Since, however, we now have three species in which the character is well defined and constant, they certainly do make a distinct group, so why not call the group a genus?

not conspicuously corrugated. Color very light brown, uniform throughout. (Figs. 6 and 7.)

Test.—Coriaceous, not hard, scarcely half a millimeter thick in thickest portions.

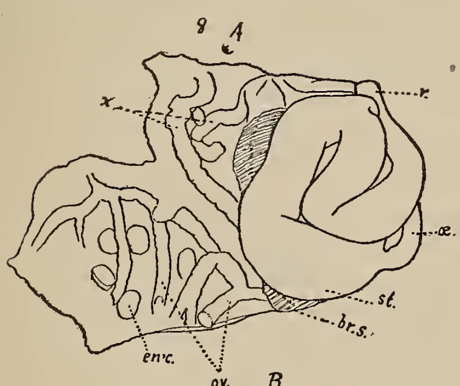
Mantle.—Not greatly developed; somewhat thicker than the test; composed mostly of longitudinal muscle fibers; does not readily separate from the test.

Branchial apparatus.—No siphons; orifices obscurely 4 lobed, rather close together, both situated at anterior end. Branchial tentacles simple, variable both in number, size, and distribution. In one specimen about 20 present—a group of 4 long, large ones near the dorsal tubercle; another group of about 10 large ones on the endostyle side, and the other 6 smaller ones situated 3 on each side, comparatively remote from one another. This arrangement of the tentacles apparently typical for the species, though less perfectly carried out in some specimens than in others. In some specimens not above 14 tentacles present. The peripharyngeal band close to the circle of branchial tentacles. Atrial tentacles present; unusually large;. numerous.

Dorsal tubercle conspicuous, biscuit shaped, the hypophysis mouth horseshoe shaped, with out-turned limbs.

Branchial sac with 4 longitudinal folds on the right side and 3 on the left; 1 or 2 internal longitudinal vessels between each two folds. The number of vessels on the folds is as follows: Right side, first fold, 10 vessels; second, 4; third, 8; fourth, 4; left side, first fold, 11; second, 8; third, 4. (The folds are numbered from dorsal to ventral.) These numbers are quite constant.

Distance between transverse vessels varies from 0.19 mm. to 0.50 mm. The vessels are variable in size. but intermediate vessels—i. e., vessels crossing the stigmata—are rarely present. Dorsal lamina a plain narrow membrane, situated somewhat to the left of the median dorsal line.



"Endocarps" present, prominent, and irregular in form, with a tendency to become lobed.

Digestive tract.—Situated on left side of branchial sac, closely coiled, the posterior half of the intestine running parallel, and in contact with, the œsophagus and anterior part of stomach. Œsophagus not as long as stomach. It issues from near the middle of the dorsal side of branchial sac, the dorsal lamina extending behind the opening and passing to its left. Stomach considerably longer than broad, somewhat broadest at œsophegeal end, not distinctly constricted off either from the œsophagus or from the intestine; smooth walled on its external surface, but inner surface thrown into numerous deep folds, causing it to resemble the psalterium of the ruminant stomach. (Fig. 8.)

Sexual organs.—Situated on right side of body only; ovary consisting of a basal portion, extending antero-posteriorly along the ventral side of the animal, and 4 branches from this basal part projecting forward and dorsalward. Testis situated around and among the branches of the ovary at their dorsal ends. Ova discharged into the atrial chamber, where they collect in its posterior portion to undergo development (fig. 8, *or.*) (In this figure the visceral mass, lying loosely on the test, has been turned halfway around; so that the rectum, *r*, is made to point toward the *posterior* instead of toward the *anterior* end of the test. This makes the ovary seem on the *left* instead of on the *right* of the body.) Ova and sperm ripe in the same individual at the same time. Ova very large, 0.57 mm. in diameter; contains much food yolk.

9

10

This species is so distinct from either of the other two species of the genus, a comparison between which was made in connection with the description of *D. tuberculata*, that it would be superfluous to dwell upon the point. It is represented in the collection by a larger number of specimens than any of the other species, there being some hundreds present. All appear to come from St. Paul.

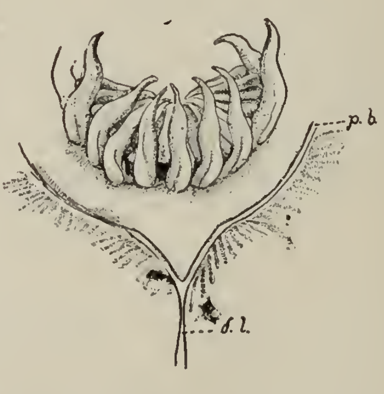
Styela greeleyi, new species.

General characteristics.—Body elongated, somewhat flattened; tapering slightly toward both ends, at the posterior abruptly contracted into a slender peduncle, which is from one and a half to two times as long as the body. Dimension of one of the largest specimens: Length of body, 1.8 cm.; greatest diameter, 1.1 cm.; length of peduncle, 4.3 cm. Color, yellowish brown, tinged with red on the anterior half. Siphons, bright orange red. Surface covered with longitudinal folds, which are less pronounced on the peduncle. Transverse folds present on the anterior half, but these possibly due to contraction. (Figs. 9 and 10.)

Test.—Tough, coriaceous, but scarcely 1 mm. thick even through the folds. Dull grayish white on the inner and cut surfaces.

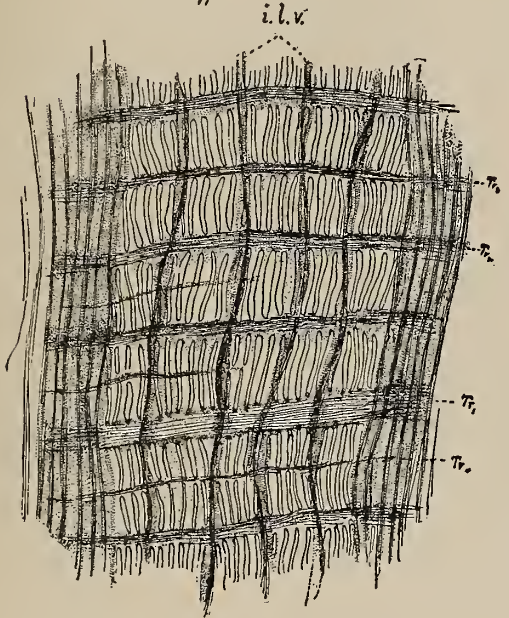
Mantle.—Closely attached to test; musculature weak.

13



Branchial apparatus.—Siphons projecting slightly, both placed at anterior end close together, the atrial pointing straight forward, while the branchial is bent over so that the opening is directed ventrally. Branchial tentacles simple, of two sizes arranged in two concentric circles, the outer circle containing about 15 large and the inner about 30 small ones. Circles close to the peripharyngeal band. (Fig. 13.) Atrial tentacles filiform, numerous. Dorsal tubercle inconspicuous, the mouth of the hypophysis irregularly horseshoe shaped, close to the tentacles, which nearly hide it. (Fig. 13.) Branchial sac with four folds on each side, the development of these folds varying with the size (age?) of the specimen. In smaller (younger?) specimens the folds on the left side more strongly developed than those on the right. In specimens 3.1 to 6.7 cm. (including peduncle), pair of folds next the endostyle had about 12 bars and those next dorsal lamina about 20. In specimen 0.85 to 1.8 cm. folds next endostyle had about 6 and those next dorsal lamina about 12 bars. Folds closely placed, only 3 to 5 bars between them. Transverse vessels of three sizes, a wide one (Tr_1, fig. 11) occurring at irregular intervals, and two narrower ones (Tr_2 and Tr_3), which usually alternate with each other. Intermediate transverse vessels (Tr_4) sometimes present, often dividing the series of stigmata into two. Meshes nearly square or longitudinally elongated with 4 to 6 (usually 5) long narrow stigmata. (Fig. 11.)

11



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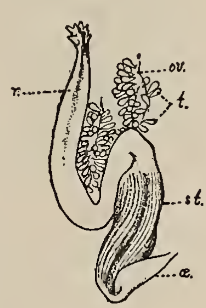


Dorsal lamina ribbed on one side by the vessels passing round the œsophagus.

Digestive tract.—Situated on the left side of branchial sac and making a narrow turn. Œsophagus short, opening from the dorsal side of the branchial sac near its posterior end. Stomach long and narrow, with numerous internal folds which show on the surface as longitudinal markings. Anal opening bilobed, each half cut into about six lobes. (Fig. 12.)

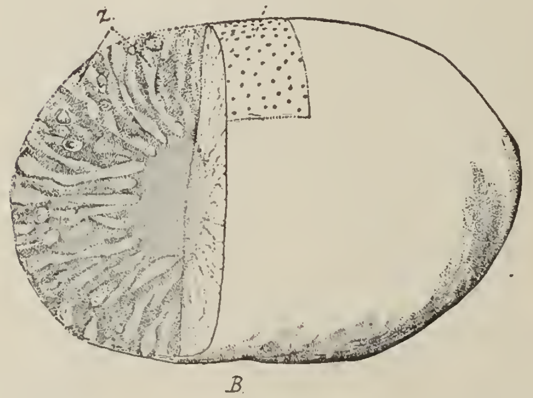
Sexual organs.—Gonads on each side of the body. Ovaries long, sausage shaped, ending in a short oviduct, those on the right side longer than those on the left. One of those on the left side placed in the loop of the intestine, the other beginning higher up and extending down under the stomach. Testis small, clustered in bunches over the ovaries. Endocarps rather numerous on the mantle.

The genus *Styela* is naturally divided into two sections—those in which the species are pedunculated, and those in which they are not. The species here described, of course, belongs to the first section. In this section *S. greeleyi* finds its nearest allies in *S. montereyensis* of the coast of California, and *S. clava*, Herdman, of the North Pacific. But it is quite distinct from either of these. So far as can be judged from the specimens at hand, it is a much smaller species than either of them. In general form it differs from *S. montereyensis* in its considerably more abrupt transition from body to peduncle; while from *S. clava* it differs distinctly by its lack of the prominent irregular tubercles of the test of the latter species. The collection contains 17 specimens of the species, all from St. Paul. Of these all but three or four are very small.

Boltenia elegans Herdman.

The three specimens in the collection, all from St. Paul Island, which I identify as this species, differ so trivially (our individuals are slightly darker in color and a little rougher on the surface) from specimens of the species taken by the *Albatross* (latitude 57° north, longitude 159° west, in 33 fathoms), that the correctness of the identification can not be doubted.

14.



Polyclinum globosum, new species.

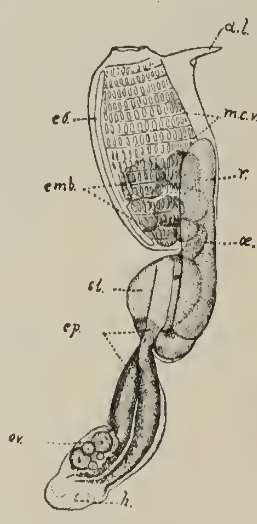
General character of the colony.—Massive, inclined toward the spherical form, attached by a small area only; apparently easily detached, since all the specimens at hand are freed from their original substrata. (Fig. 14.)

Dimensions of largest colony: Length, 45 mm.; least transverse diameter, 35 mm. The other colonies considerably smaller.

Color, greenish brown.

Zooids.—Large and numerous, though scarcely visible on the surface of the preserved colonies. The irregular systems contain numerous zooids, many of which are quite distant from the broad but inconspicuous atrial orifice common to the system. Positions approximately perpendicular to the surface of the colony. (Fig. 14 Z.)

15.



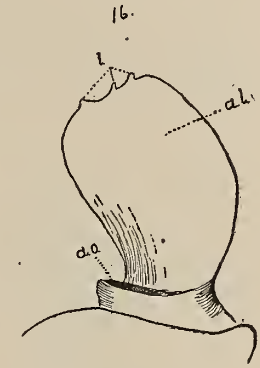
Body distinctly separated into three regions, viz, thorax, abdomen, and postabdomen. (Fig. 15.)

Measurements of the zooids: Total length, 10 mm.; length of thorax, 4 mm.; length of postabdomen and abdomen, 6 mm.

Test.—Small in quantity among the zooids, so close are these to one another; but a considerable mass in the middle of the colony in which no zooids occur. (Fig. 14.) Surface layer considerably denser and darker in color than the deeper portions, a few scattered sand grains embedded on the surface. The inner mass containing no zooids, rather firm in character; opaque white, contains many small cells, but no bladder cells; penetrated by the stolonic vessels of the zooids, though these are not numerous. A few scattered stellate crystals present.

Mantle.—Very thin, containing a few muscle fibers, mostly running lengthwise of the body; some circular fibers at the anterior end of the thorax encircling the siphons.

Branchial apparatus.—Branchial orifices indistinctly seen on the surface of the colony. (Fig. 14, area B, exaggerates the distinctness of the branchial orifices.) The common cloacal appertures wholly obliterated to superficial inspection. Branchial siphon found, after isolation of zooids, to be six lobed. Atrial siphon with a broad languet the distal edge of which is armed with three small processes (fig. 16). Branchial tentacles about 24 in number, rather large, though a few small; not forming a well-defined single circle. Rather close to the branchial orifice. Branchial sac well developed. About 15 series of stigmata and about 16 stigmata in each half series; these very regular in form and size. The interserial vessels broad and each containing a well-developed muscle band. (Fig. 15, *m. c. v.*)



Dorsal languets long and slender, about one for each series of stigmata.

Digestive tract.—Œsophagus (fig. 15 *œ*) issuing posterio-dorsally from the branchial sac, longer than the stomach; deflected to the right side by the rectum. Stomach spherical, smooth walled both without and within. Duodenal portion of the intestine with two well-marked constrictions. Rectal portion large and straight, runs far forward, nearly in the median dorsal line, which it reaches by a left curvature of the duodenal portion. (Fig. 15.)

Sexual organs.—Gonads contained in the large pear-shaped pedunculated postabdomen; ovary a well-defined mass, confined to the enlarged posterior portion of the postabdomen. (Fig. 15, *ov.*)

17A.

The ova pass into the atrial chamber, where they take a position in its posterior portion and to the right side. The larvae are developed in this incubatory chamber. No male gonads have been found in any of the specimens examined. No buds have been seen; and as the colonies at hand are all in a state of prolific sexual reproduction, it seems probable that in this species there is an alternation of periods of sexual and asexual reproduction.

This species seems to be more closely related to *Polyclinum fungosum* Herdman, 1886, than to any other known member of the genus, but it is distinctly different from this in the following points: (1) In *P. fungosum* the "colony has a plano-convex discoid form." "The lower surface is almost flat, and the point of attachment is at the center." (2) The branchial sac has 10 or 12 rows of stigmata in *P. fungosum* and 15 in *P. globosum*, and the stigmata appear to be longer and less numerous in the rows in the former than in the latter species. The collection contains but a single colony of this species.

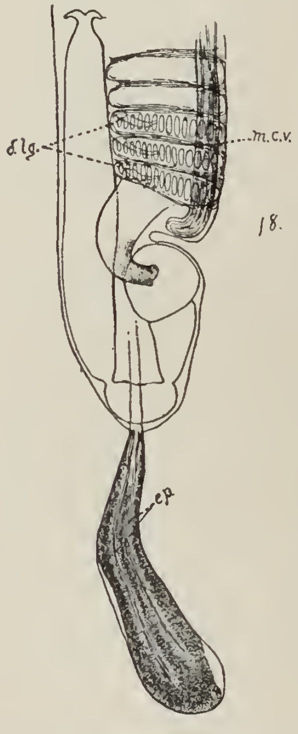
17B.

Polyclinum pannosum, new species.

General character of colony.—Form variable, from quite regularly pear-shaped to depressed and irregularly elliptical. Not distinctly pedunculated, though some colonies show a tendency in this direction. Largest colony in collection measures 3 cm.

to 2 cm. to 1½ cm. Unyielding to the touch, dirty greenish-brown in color. Portions of the surface of the colonies smooth, almost shiny, but for the most part a surface crust of test becomes broken up and the broken fragments partially or wholly peeled off. Where these pieces are fully removed sand adheres to the underlying exposed test. By reason of the conditions of the surface test thus described the colonies usually present a ragged appearance, hence the specific name chosen. (Fig. 17 A *y*.)

Test.—Matrix firm, relatively large in quantity, there being a large central core in each colony, into which the zooids do not reach, and the zooids themselves are rather remote, making the intervening test considerable in quantity. Cells numerous, of many sizes, some of them large. The cells contain a diffuse greenish coloring matter, to which is due the tint of the test when seen in section. The central core of test penetrated by a wide areolar mesh work of rather fine fibers. (Fig. 17 A.)



Zooids.—Moderately numerous, not visible on surface view of the colony. Owing to their variously twisted condition and the differing angles which they form with the surface of the colony, the entire length of a single zooid is seldom seen uncut on radial sections of the whole colony. Average length of individuals, about 6 mm., about one-half of which is postabdomen. Thorax about 2 mm.; abdomen about 1 mm. Postabdomen joined to the postero-ventral side of the abdomen, somewhat to the left side, by a narrow peduncle. (Fig. 18.)

Mantle.—Feebly developed. Longitudinal muscle fibers in distinct bands; circular fibers almost wholly absent, except in the siphons, and here they are not strongly developed.

Branchial apparatus.—Orifices very indistinctly seen on the surface of the colony. On removal from test, branchial siphon found to be encircled by six unequal rather pointed lobes. Atrial languet not easily seen intact, of moderate length, broad at base, tapering rapidly to a blunt point, which, however, sometimes shows traces of two or three lobes.

Branchial sac removed whole from test with much difficulty, this due to the delicacy of it and the mantle, and the fact of its being thrust up more or less sidewise into the specially dense, firm, and rather thick layer of surface test. This displacement apparently caused by the numerous large embryos contained in the atrial chamber.

Organs of the peripharyngeal region distinguished with much difficulty; ganglion moderately large, tentacles about 25 in number, of different sizes, the largest ones but few, not large. All situated close around the base of the siphon. Branchial sac containing about 12 series (in some specimens 13, and some apparently 10 or 11) of stigmata. Cilia of the stigmata unusually long and stout. In some specimens the stigmata quite pointed and with a peculiar process, sometimes of considerable length at the ends. A well-developed muscle band in each interserial space. Dorsal languets long, sometimes reaching more than halfway across the sac, about equal in number to the series of stigmata. (Fig. 18, *δlg.*)

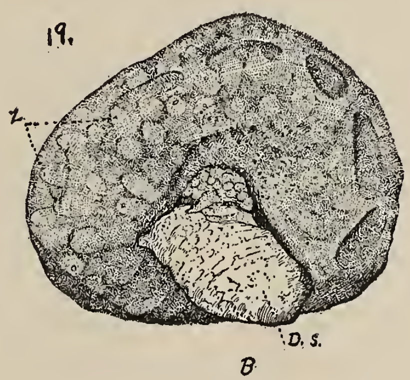
Digestive tract.—Œsophagus rather wide at its mouth, issuing from nearly the middle of the posterior end of the branchial sac, distinctly curved so as to enter the stomach on its right dorsal side. Stomach globular, smooth walled. Intestinal loop rather wide, slightly shorter than the combined length of œsophagus and stomach. Two well-marked constrictions in the intestine at the base of the loop, these including between them the base of the U-shaped loop; the rectum passing to the left of the œsophagus to reach the atrial chamber. Anus sometimes with a wide, flaring lip. (Fig. 18.)

Sexual organs.—Ovary not large, situated far back in the post-abdomen, behind the testis. The entire post-abdomen so filled with mesenchymatous cells that the sexual organs are much obscured; no distinct lobulation of either ovary or testes observable. The embryos, developing in the atrial chamber, greatly distend and distort this cavity.

This species appears to be more closely related to *P. aurantium*, Milne-Edwards, than to any other member of the genus. The last-named species is, however, described by both Milne-Edwards, 1842, and Lahille, 1890, as having a gelatinous test, and no mention is made by either of these authors of the network of fibers in the test. This latter character, I take it, constitutes a distinct difference between the two. The presence of such a network seems to be of such rare occurrence in *Polyclinum* that were it present in *P. aurantium*, Lahille, whose studies were largely morphological, would have noted it. Furthermore, according to the figure of a zooid of *P. aurantium*, given by Milne-Edwards (Pl. III, fig. 4, *b*), the postabdomen of this species is relatively much longer than in *P. pannosum*.

There are about two dozen colonies of this species in the collection, all from St. Paul Island.

19.



Aplidiopsis jordani, new species.

General character of the colony.—Massive, irregularly polyhedral in form, the three dimensions not greatly different. Attached by a small area only (fig. 19). Quite hard and unyielding to the touch; surface rather uneven. Light gray in color, with the yellowish zooids distinctly visible. A thin surface layer of test considerably harder and less transparent than the interior portions, which latter is quite transparent. A few sand grains imbedded on the surface.

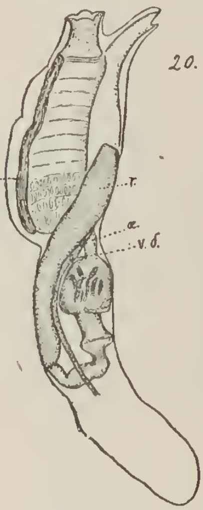
Greatest diameter of the one colony in the collection, 2.3 cm.; least diameter, 1.5 mm.

Cells in test very numerous, rather uniform in size. No vessels present in the test.

Zooids.—Rather large and numerous, readily seen on the surface of the colony. No systems present, each zooid opening to the surface by its own atrial orifice. Many of the individuals placed at very oblique but differing angles to the surface of the colony, so that they are crossed by and wound around one another. Post-abdomen not pedunculated. A finger-like ectodermal process projecting from posterior end of body. Total length about 8 mm., one-fourth of which is branchial sac, another fourth intestinal loop, and the other half post-abdomen. (The post-abdomen outlined in fig. 20 is unusually short.) Post-abdomen very large at its posterior end, and is dense and opaque with the contained generative and mesenchyme cells. It gradually narrows toward its attachment to the abdomen, but is not pedunculated, it being at the junction fully as thick as the abdomen itself.

Mantle.—Very thin, though its ectodermal layer presents, particularly in posterior part of the post-abdomen, a layer of well-defined epitheloid cells. Musculature consisting of a few small, widely separated bundles of longitudinal fibers and a still smaller number of circular fibers, the latter confined to the anterior region of the animal. Owing to this disposition of the circular fibers, in the contracted state the anterior end of the thorax becomes much smaller and denser than the posterior end. But few mesenchyme cells in the mantle.

Branchial apparatus.—Branchial orifices readily seen on the surface of the colony by the aid of a hand lens, but the atrial orifices scarcely visible; former circular in outline, no lobes distinguishable till the zooids are removed from the test, when the branchial siphon is found to be obscurely six lobed, while the atrial siphon, often considerably elongated, has no constant lobulation. In some zooids a large lobe, undoubtedly representing the atrial languet of some species, is seen on the dorsal side of the atrial orifice (fig. 20). Owing to the persistently contracted condition of the anterior portion of the branchial sac the number and arrangement of the branchial tentacles have not been determined; it is, however, found that they are rather small and few in number. Peripharyngeal band situated close to the branchial siphon. Ganglion not large, spherical, distinctly seen through the mantle in uncontracted zooids. Hypophyseal duct distinct, wide mouthed, well ciliated. Endostyle of moderate size, never greatly tortuous, extends forward nearly to the base of the branchial siphon. Branchial sac well developed, 12 or 13 series of stigmata, each half series containing about 15 stigmata. Well developed interserial muscle bundles. Dorsal languets at least as numerous as the series of stigmata; highly developed, sickle shaped, with the concave side directed forward, the epitheloid cells of the wall of this side considerably higher than those of the convex or posterior side.



20.

Digestive tract.—Œsophagus about equaling the stomach in length, stomach somewhat longer than broad when not contracted, extension of loop behind stomach about equal to the combined length of the œsophagus and stomach; rectal portion of intestine passing to left of the œsophagus to reach the mid dorsal line in the region of the branchial sac. Stomach wall with a few irregular longitudinal thickenings, but no well-defined folds.

Sexual organs.—Gonads contained in the large post-abdomen, the testis consisting of a large number of closely crowded lobes, occupying its posterior two-thirds, while the ovary is confined to its narrower anterior third. The ovary is situated close behind the intestinal loop. Vas deferens, well filled with ripe sperm, passes forward, sometimes on the right and sometimes on the left of the loop of the intestine. No embryos or ripe ova in the specimens at hand. No buds seen.

This species, which I take pleasure in dedicating to President Jordan, belongs to a group of Ascidians, the exact systematic position of which has troubled me for some years. It has several representatives on the coast of California, so I have had ample opportunity for studying it; notwithstanding this, I have not been able to fully satisfy myself as to whether a new genus should be established for it or not. That it belongs to the family Polyclinidae there can be no doubt. The possession by the zooids of a large, well-marked post-abdomen in which are situated the reproductive organs and heart leaves no room for question on this point. When, however, the effort is made to determine with which of the known genera of this family the group is most closely allied, much difficulty is experienced.

The entire absence of systems or coenobia in the colonies leads us, in the first place, to compare it with those Polyclinidae presenting a like deviation from the prevailing condition in this particular.

In the genus *Tylobranchion*, Herdman, no common cloacal apertures are present, according to the author, but this is about the only resemblance between the two groups; the most distinctive difference being, perhaps, the possession of papillae on the internal transverse vessels of the branchial sac in *Tylobranchion*. *Sigillina*, Savigny, is another genus in which the common cloaca is wanting; but the shortness of the branchial sac and great length and slenderness of the post-abdomen are characters which preclude the admission of our species to this group. *Sigillina australis*, Savigny, the only species known of this genus, has but four series of stigmata, while there are never less than six or seven present in any of the representatives of the group now under consideration, and the rule is that twelve or thirteen series are present.

As regards the post-abdomen in *Sigillina*, its great length, relative to the length of the rest of the animal, and its tenuity, set it off very sharply not only from our forms, but also from all other known species of the family.

The genus *Atopogaster*, Herdman, contains one species, at least, viz, *A. aurantiaca*, in which, according to this author, there are no systems or common cloacal apertures, and there are certainly some rather weighty considerations in favor of regarding this group as the one to which the present species is most closely related. Several points, however, the most important being the transverse folds of the stomach wall in *Atopogaster*, stand rather seriously in the way of doing this. There is considerable variability in the character of the stomach wall in our species, and the folds are never well pronounced. Such as are present, however, incline distinctly toward the lengthwise instead of toward the crosswise direction of the stomach.

I am disposed to place somewhat less reliance than some writers have done on this character as an index to relationships; nevertheless a condition so unusual as a transverse folding must, as our knowledge now stands, be regarded as of real systematic value.

I have resolved, after much deliberation, to place the species, for the present at least, in the genus *Aplidiopsis*, Lahille. There are certainly some objections to this, the most considerable being found again in the structure of the stomach wall. Lahille instituted this genus for the reception of those Polyclinidae in the restricted sense in which he recognizes this family, which have a smooth walled stomach, no torsion of the intestinal loop, and a nonpedunculated post abdomen. The smooth wall of the stomach, therefore, is one of the important characters on which the genus rests, and the placing of my species in it does some violence to it, for there is certainly a strong tendency, to say the least, for the stomach wall here to become folded, i. e., there are more or less pronounced and regular thickened areas in the wall, and in connection with these, at least in many of the preserved specimens, there are indications of folding. (Fig. 20.) But in some specimens, again, I can detect scarcely a trace of either thickening or folding, and there are so many and close resemblances between our species and *A. sarsii*, Huitfeldt-Kaas, 1896, from the Norwegian coast, that I am fully convinced of the very close affinities of the two. I have consequently deemed it the wiser course to place it here rather than to add another to the already long list of rather illy-defined genera into which the Polyclinidae are divided. In this connection I can not refrain, after having spent much time in examining the stomachs of numerous species and genera, and in critically reading the utterances of other writers, from quoting that master zoologist, Milne-Edwards, 1842, on this point. After describing the stomach of his *Amaroucium argus* (transferred by Giard, 1872, largely on account of the structure of the stomach, to the genus *Morchellium*), he says: "Mais si l' on descendait à des caractères de cet ordre pour en faire la base des divisions génériques, on serait conduit à multiplier inutilement ces coupes et on rendrait les déterminations d' une difficulté extrême." The advance of knowledge since this remark was made has undoubtedly shown that the character of the stomach wall is of diagnostic importance, but that it in itself can be relied upon in all cases, even as a distinctive specific mark, to say nothing of its generic value, I do not believe. The species is represented in the collection by a single colony from St. Paul Island.

Amaroucium kincaidi, new species.

Colony cake-like, irregular in outline, but always depressed. When attached to cylindrical bodies of small diameter, as seaweeds, which seems to be the usual habit, colony entirely incircling these. Firm and unyielding to the touch. In color, little sand on the surface, zooids showing through the test quite distinctly. Common atrial orifices large and open.

Dimensions of largest colony, 54 mm. to 31 mm. to 21 mm.; of smallest colony, 27 mm. to 20 mm. to 17 mm.

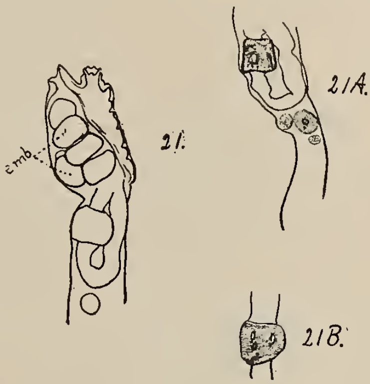
Test.—Surface layer, which is quite thick, containing so much brownish-gray coloring matter that the transparency characteristic of the interior portions is here wholly obscured. Cells of the test vary; abundant fibers absent. Sand grains penetrating the entire mass, though not numerous, not incrusting the surface. Only a small interior portion of test into which the zooids do not reach.

Mantle.—Longitudinal muscle fibers in bands, though not as completely separated from one another as in many species. Circular fibers almost wholly absent excepting in the siphons, but not numerous even here.

Zooids.—Visible, though not distinctly so, on the surface of the colony. Arranged in definite, circular systems, each containing about six or eight individuals. Standing at various angles to the surface of the colony, and considerably contorted, so that they appear only in fragments on cut surfaces of the colony, whatever be the direction of the section. Subdivisions of the body not distinct. Size, medium; total length, about 8 mm.; thorax, about 2.5 mm.; abdomen, about 1.5 mm., and post-abdomen about 4 mm. Peduncular portion of post-abdomen easily noticeable, though not conspicuous as compared with many other species (fig. 21). An ectodermal appendage of the mantle at the posterior end of the post-abdomen.

Branchial apparatus.—Branchial orifice scarcely recognizable on the surface of the colony. Common atrial orifice, large and open, at least in some colonies.

branchial siphon, with six quite regular, broad, low lobes. Atrial siphon with a dorsal languet, but this apparently never of considerable length, usually broad and blunt, sometimes, probably usually, three lobed, sometimes two lobed, and at least in one instance observed, only one lobed. Contraction of branchial sac about equal throughout its length, in no portion so great as to render the structure indistinguishable. Ganglion moderate in size, spherical, visible through the body wall. Tentacles fairly well developed, about 24 in number, of unequal length, somewhat more removed from base of siphon than in the other species of the genus described in this paper. About 16 series of rather small, short, elliptical stigmata. A well-developed muscle band in each interserial space of the sac. Dorsal languets not conspicuous.



Digestive tract.—Unusually small and contracted. Œsophagus very short in proportion to its diameter, at least as presented in all the specimens examined. Stomach small and contracted, often apparently but little greater in diameter than the rectal portion of the intestine. Wall never with distinct longitudinal folds, but never smooth. In some zooids it presents merely thickened patches of irregular shape and unequal size, while in others there are distinct indications of areolation. In some individuals the areolae are elongated lengthwise of the organ, while in others their greatest extent is crosswise of it, but this last condition may be the result of contraction. (Figs. 21 A and 21 B.)

Remaining portions of the tract without characteristic features. The constrictions of the intestine in the base of the loop irregular, but apparently never very pronounced.

Sexual organs.—Ovary immediately behind the intestinal loop in the peduncular portion of the post-abdomen. Ova large, containing much yolk; not numerous. Testis situated behind the ovary and extending to the extreme posterior end of the post-abdomen; composed of many small lobes; vas deferens not conspicuous.

24

Embryos developed to the completed tadpole stage in the atrial chamber, this becoming much distended by them. (Fig. 21).

There are four colonies of this species in the collection, all from St. Paul Island.

Amaroucium pribilovense, new species.

General character of the colony.—Massive, regular in outline, smooth surface, subglobular, very little or no indication of pedunculation, though usually attached by small area only. Greatest diameter of largest colony 5.5 cm., least diameter 3 cm. (Fig. 24.)

Unyielding to the touch; dark gray with a slight olive tinge; considerable sand adhering to and embedded in the surface. Zooids quite distinctly visible on the surface. Testicular mass not large in quantity, the zooids being rather crowded, particularly in the larger colonies. A surface layer considerably denser and darker colored than the deeper portions. Sand grains scattered over the surface and also penetrating the whole test mass. Cells numerous in the test, but no vessels.

Zooids.—Closely crowded, particularly in the larger colonies, quite distinctly visible on the surface of the colony, each standing generally at nearly a right angle to the surface. Systems usually distinct, number of zooids in each usually small—6, 8, or 10, sometimes more. The three divisions of the body distinct, but not constricted off from one another. Length of thorax 3 mm., length of abdomen 3 mm., of post-abdomen 5 to 10 mm., depending on the extent of development of the testis.

25

Post-abdomen when fully developed somewhat, though not greatly, larger at its posterior than at its anterior end. (Fig. 25.)

Mantle.—Feebly developed. Circular muscle fibers almost wholly absent, they being restricted to a few scattering ones around the branchial siphon. Longitudinal fibers grouped in distinct bundles, though these not numerous.

Branchial apparatus.—Branchial orifices easily recognizable on the surface of the colony by the aid of hand lens, though no lobes visible. Common atrial orifices moderately large. When removed from the test, branchial siphon found to possess six quite distinct and regular lobes. Atrial siphon with a broad dorsal languet, usually two-lobed, but sometimes three-lobed. This languet very variable in length, in some zooids the siphon departing but slightly from the normal six-lobed condition.

Anterior half of the branchial sac usually considerably more contracted than the posterior half. The globular ganglion seen without difficulty when the anterior end is examined after having been cut off. Tentacles apparently about twenty in number, of different lengths, about half of them being long and stout. The circle situated close to the siphon.

Branchial sac well developed. Fifteen series of stigmata certainly present in some individuals, but apparently twelve or thirteen in others—possibly immature ones. Interserial muscle bands present; posterior end of the endostyle invariably produced into a U-shaped loop in the preserved specimens.

Digestive tract.—Œsophagus issuing from the postero-dorsal angle of the branchial sac; form and proportions of the tract as a whole conforming closely to the usual type for the genus. Stomach somewhat barrel shaped, folded longitudinally, but the folds are irregular and are neither conspicuous nor numerous, the number being about seven. In addition to the folds, or rather furrows, which never involve the entire surface, there is a tendency for the surface between the furrows to become areolated in many specimens. (Fig. 25.)

Sexual organs.—Ovary immediately behind and in contact with the intestinal loop, small in volume as compared with the testis, which latter is very large, it appearing to constitute almost the whole of the long post-abdomen.

Vas deferens filled with sperm in the specimens at hand, consequently large and conspicuous; passes to the left of the intestinal loop. No embryos seen.

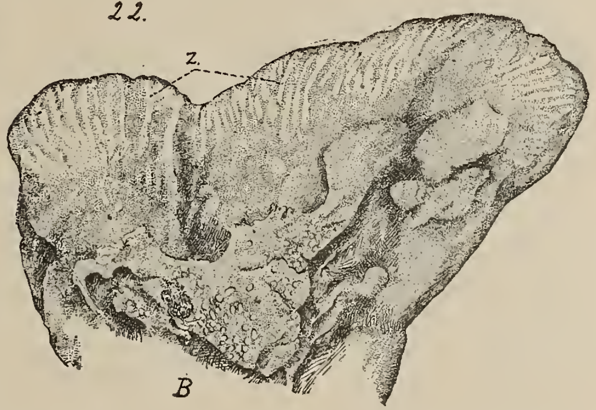
The simplicity of the systems of zooids, the two-lobed atrial languet, and the few remote furrows in the wall of the stomach are the most distinctive characters of this species. In the first-mentioned particular it agrees more nearly with *A. nordmani*, Milne-Edwards, than with any other species of the genus.

So far as I have been able to ascertain, this is the only instance in the genus in which the atrial languet is two lobed, it being in all other species either one or three lobed.

A collection contains a half dozen colonies, all from St. Paul Island.

Amaroucium snodgrassi, new species.

General character of the colony.—Form quite variable, but always depressed and cake-like. Area of attachment considerably smaller than the superior free surface. Greatest transverse diameter of largest colony 7 cm., greatest width 5 cm., greatest thickness 2.8 cm. Rather soft and yielding to the touch. Light gray in color, excepting where covered with sand, which is quite abundant on some of the colonies. The zooids, indistinctly seen on the top surface of the colonies, but distinctly visible on the edges, where the outermost ones show throughout their entire length, as they reach entirely through the thickness of the colony. (Fig. 22.)



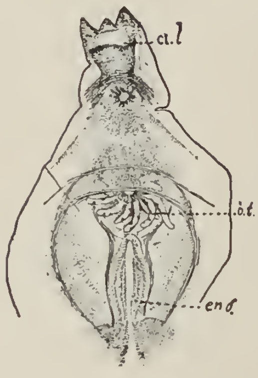
Test.—Not in great quantity, there being no central core into which the zooids do not enter. A few sand grains scattered through entire mass. Cells very numerous, but no vessels or fibers present.

Zooids.—Large, each reaching entirely through the thickness of the colony; quite straight, and placed nearly at a right angle to the surface of the colony. As seen on a cut surface of a vertical section of the colony, the thoracic-abdominal portion distinctly set off from the post-abdominal portion by the greater thickness of the former and the lighter but more opaque color of the latter. Post-abdomen joined to the abdomen by a very long, slender peduncle. Total length of zooid from 2 cm. to 2.5 cm.; of this about 4 or 5 mm. are thorax, about an equal part abdomen, and the remainder—12 or 15 mm.—post-abdomen. Systems not readily seen either on surface of colony or on horizontal sections of same; dissection discovers them to be present, however, with about 8 or 10 zooids in each.

Mantle.—Musculature not highly developed. Longitudinal fibers, as usual, in bands; circular fibers present, but confined to anterior half of thorax.

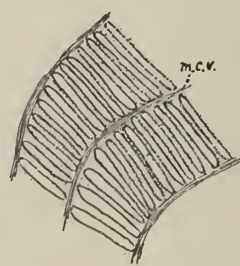
Branchial apparatus.—Branchial orifices found with difficulty on surface of colony; common atrial openings quite large, though collapsed and not obvious until searched after. Branchial siphon with six wide, well-defined, though not prominent, lobes. Atrial languet three lobed, at least usually, broad and never very long. Anterior end of thorax usually considerably contracted, so that the various contained organs are seen with difficulty. Ganglion not spherical, not large. Tentacles not numerous, apparently about twelve, presenting a peculiar distorted, shriveled appearance, situated very close around the base of the siphon. (Fig. 23 A). Branchial sac consisting of about twelve series of long, narrow, regular stigmata. A well-developed muscle band in each interserial space. (Fig. 23 B.) Dorsal languets long and slender, one for each series of stigmata. Endostyle nearly straight, moderate in size.

23 A.



Digestive tract.—Œsophagus issuing from the branchial sac at its postero-dorsal angle. Nothing characteristic in the general form and proportions of the tract as a whole. Stomach distinctly longer than broad. Folds of its wall distinct, about six extending the entire length of the organ, and in addition two or three shorter and narrower ones on one side; in some cases these strongly suggesting the areolated condition (fig. 23). Rectum terminating in a broad, trumpet-shaped anus.

Sexual organs.—Ovary small, situated in the post-abdomen, a short distance behind but not in contact with the intestinal loop. Testis occupying nearly the whole of the remainder of the long post-abdomen. The numerous rather small regular lobes are distinctly visible, those of the anterior narrower portion of the post-abdomen forming a single row only in many specimens. Vas deferens conspicuous, passing to left of intestinal loop. No embryos seen.



23 B.

This species has much in common with *A. pribilovense* when the two are compared with reference to the zooids only; though from this standpoint they are rendered specifically quite distinct by differences in size, in the atrial languets, and in the folds of the stomach wall. The greatest difference between them, however, as will be noticed, is in the general character of the colony. These species would appear to be somewhat closely related to *A. mutabile*, Sars, though, as I know this form only by the figures and partial description given by Huitfeldt-Kaas, 1896, I am unable to make a complete comparison between them. *A. mutabile* is, however, represented as having a much more distinctly 3-lobed atrial languet than either of my species, and also with only 4 furrows or folds in the stomach. It is therefore well set off from the present species. There are about 8 colonies of this species in the collection, all from St. George Island.

23.

Amaroucium dubium, new species.

I designate by this name a species of Amaroucium collected by Mr. Leonhard Stejneger at Copper Island during his visit there in the summer of 1897. There are only three fragments of colonies at hand, and as these are considerably eroded, apparently from having been torn from their anchorage and washed about by the waves, and as the zooids are all in a state of extreme contraction, I have hesitated very much about describing it as a new species. As, however, sufficient information concerning its structure is obtainable to show it to be different from any hitherto described species of the genus, I have concluded that a description of it would be justifiable, even though this must be more or less incomplete.

General character of the colony.—Apparently flat and incrusting. Specimens at hand closely adherent to and somewhat interwoven with laminaria roots. Quite dense to the touch; a considerable quantity of sand imbedded in portions of the test; this rather more abundant in the deeper parts than on the surface. Greatest dimension of largest piece 3 cm., average thickness about 1 cm. Color grayish white; in portions where sand is absent somewhat opalescent, so that the zooids can be seen through the test with some distinctness.

Zooids; general characters.—Probably arranged in systems, each containing but comparatively few individuals; but the specimens at hand do not permit of certainty on this point. Moderately numerous, rather irregularly distributed, there being considerable areas of test which contain none at all. Placed at various angles to the surface of the colony. Removed from the test with much difficulty. All in condition of extreme contraction. Owing to this fact and the well-nigh impossibility of removing them complete from the test, the length of the individuals can not be determined with any accuracy, but this not more than a few millimeters—4 or 5. Thickness considerable as compared with length, even after contraction is taken into consideration. Regions of the body very indistinct. Post-abdomen apparently about as long as combined thorax and abdomen; broad at its origin, and tapering rapidly back to its termination.

Branchial apparatus.—Little information obtainable concerning the orifices. Branchial siphon short, its 5 lobes well marked, probably in living specimens quite long. Atrial siphon inconspicuous, with a wide, short languet, apparently having but one lobe. Thorax very dense,owing in considerable degree to the large quantity of mesenchymatous tissue and the thickness of the epithelial layer of the mantle; for in spite of the extreme state of contraction the musculature is not developed to an unusual extent.

As nearly as can be determined the branchial sac contains about 10 series of stigmata.

Digestive tract.—Intestinal loop very short, indistinguishable in its several parts excepting the stomach and rectum, the latter being very wide and filled with dark brown faecal matter not formed into pellets. Stomach somewhat broader than long. Walls longitudinally ridged on the inner surface, though the ridges are not always regular and parallel. Apparently about 10 or 12 in number.

Reproductive organs.—Ovary forming a compact mass situated some distance behind the intestinal loop. Not large, so thoroughly embedded in the mesenchymatous tissue(?)—food yolk—contained in the post-abdomen that it is found with difficulty. Testis not distinctly lobed, but large and massive, occupying most of the post-abdomen.

Embryos present in the atrial chamber of a few zooids.

It is possible that careful study of more material of this species will prove there are in reality two species represented here, distinguished by difference in size of zooids, form of post-abdomens, ridges in the wall of stomachs, and perhaps in some other particulars. But with the small number of specimens now available for examination it is impossible to differentiate two such species with any satisfaction.

Synoicum irregulare, new species.

General character of the colony.—In all cases distinctly lobed, but the lobes very variable in size and shape. In some instances they are separate almost to the base of the colony, while in others the upper half or even less of the entire length of the lobe is free from the common basal mass. Some of the lobes decidedly enlarged at the summit, others not so. An occasional lobe stands out at nearly a right angle to those with which it is in closest relation. Rarely any free spaces between the free portions of the lobes. No longitudinal furrows on the lobes marking the intervals between the zooids, though the zooids quite clearly visible through the test on the sides of the lobes. Surface of the test at the bases of the lobes and of the basal undivided mass often shows well-marked transverse corrugations (fig. 26). Color of the lobes milk white; of the basal portions grayish. This appears to be the predominating color characterization, but some colonies gray throughout. Very little sand or other foreign substance on the surface. Test relatively large in quantity, semicartilagenous, no distinct surface layer. Cells very numerous. Basal portions traversed by a few vessels. Height of largest colony, 3 cm.; length of longest lobe in this colony, 17 mm.; thickness of base of this lobe, 8 mm.; thickness of summit of same lobe, 13 mm. These values would not appear to be greatly above the average.

26.

Zooids.—From two or three to eight or ten in each lobe. Not visible on the summit of the lobes in any of the specimens at hand, but quite distinctly so on the sides of the lobes in some colonies. Of large size, always at least as long as the lobes of the colony, usually extending to very near the base of the colony. Average length about 17 mm. Of this, considerably more than half is post-abdomen. Thorax relatively very short in all specimens at hand, but this largely due to great contraction. Post-abdomen not pedunculated (fig. 28). Condition as to systems in doubt. Apparently a common cloaca not usually present, but material at hand does not permit final determination of the point.

28.

In some colonies zooids in a peculiar state of disorganization. (This subject more fully treated in another connection.)

Musculature consisting almost exclusively of longitudinal fibers; these not disposed in bundles to the usual extent in compound ascidians.

Branchial apparatus.—Neither of the orifices found with certainty on the surface of the colony in any of the specimens at hand. In the few colonies in which the thorax is present at all, so much contracted and so thick walled that its structure could be but imperfectly determined. Branchial siphon six-lobed; these thick and rather obscure. Atrial orifice obscurely unequally lobed. A short and thick atrial languet present; its lobulation not determined. Tentacles not large or numerous, of unequal sizes.

At least 17 series of stigmata, the individual stigmata exceedingly small and obscure, though the series fairly well marked by the heavy muscle band in each inter-stigmatic space. This muscle band as broad as, or broader than, the stigmatic area (fig. 28, *m. c. v*).

Endostyle broad, not greatly tortuous. No information concerning the dorsal languets.

Digestive apparatus.—Loop rather wide, not twisted, particularly characterized by the great thickness of the rectal limb.

Œsophagus exceptionally broad, particularly at its mouth; much narrower at its entrance into the stomach. Stomach apparently nearly spherical in its normal form, but usually broader than long in preserved specimens. Its entire wall covered with small, rather uniform, thickened patches or areolations (fig. 28). Length of the loop behind the stomach considerably greater than combined length of œsophagus and stomach. Rectal portion of intestine greatly enlarged in most specimens. It reaches the dorsal side of the branchial sac by turning at a short angle immediately behind the sac.

Reproductive organs.—Situated in the long, broad post-abdomen. Ovary in the form of a long, narrow band placed at one side of the post-abdomen (fig. 28, *ov.*), the ova distinctly amoeboid, and without recognizable follicular epithelium or "test" cells. No oviduct observed. Testis distinguished with difficulty (excepting when containing ripe sperm) from the great mass of mesenchymatous material by which the post-abdomen is filled. Vas deferens not seen. Embryos develop in packages in cavities of the test (fig. 27). No budding seen.

27.

(See end of paper for account of sexual reproduction of this species.)

This species is certainly closely related to *S. turgens* Phipps, and at first I was much inclined to consider it to be identical with that species. There seem, however, to be several points of difference between them so considerable as to make it necessary to regard them as distinct species.

In the first place *S. turgens* as figured by both Savigny, 1816 (Pl. III, fig. 3), and Sars (see Bonnevie, 1896, p. 12, and Pl. IV, fig. 36), has the lobes in general much more separate than is the case in *S. irregulare.* And in his description Savigny speaks of the systems as being in the form of solid cylinders "isolated or associated by their peduncles." Again, our species shows no trace of the channels on the surface of the lobes marking the intervals between the zooids, such as are described and figured by Savigny in *S. turgens.* The systems and common cloacal orifices of *S. turgens* are, according to the authors already mentioned, very distinct, while in *S. irregulare,* as will be noted from my description, there is much doubt about their being present at all.

As concerns the zooids, it would appear that the two forms agree very closely, though it is hardly possible that the branchial sac of *S. turgens* could be so closely contracted, and the stigmata thereby so greatly obscured, as is the case in all the material of *S. irregulare* at my disposal, without having been mentioned by Savigny.

From *S. incrustatum,* Sars, Huitfeldt-Kaas, 1896, the only other species of the genus, the present species differs so markedly that a detailed contrast between them would be superfluous.

The collection contains about a dozen colonies and pieces of colonies of this most interesting ascidian, all, so far as my information goes, from St. Paul Island.

Both *Synoicum irregulare* and *Polyclinum pannosum* present interesting conditions in connection with their sexual reproduction. I describe that shown by the first-named species only. Unfortunately, however, the collection does not contain sufficient specimens to enable me to make the account as full as might be desired.

In the formal description of the species I have pointed out that the thorax is very small relatively, and is much contracted and so dense and opaque as to make it impossible to distinguish the branchial sac with any clearness. This is the condition in all the colonies at hand in which the thorax of the zooids is found at all. But in most of the colonies a great proportion of the zooids are wholly without the thorax. It frequently happens that, although the lobes of the colonies are of nearly normal size, the upper half or more of some of them may contain no zooids or parts of zooids, and the test may be entirely solid, i. e., without cavities such as are usually found in preserved specimens of compound ascidians in which the zooids have withdrawn upon killing into the deeper portions of the test. This condition is the result of degeneration of the zooids, or at least their anterior portions. Post-abdomens alone are found in great numbers in such colonies. Frequently these do not differ in any respect, either in form, size, or composition, from others that are still connected with branchial sacs. I have not been able to follow the process of disappearance, either of the thorax or of the solidification of the test in the parts of the lobes containing no zooids. It is very possible that the condition of the thorax as I have described it is not typical for the species, but is a result of the retrogressive process having already set in. Of this, however, I have no certain proof. Examination of the free post-abdomens shows them to be densely filled with a material that is for the most part undoubtedly of the nature of food yolk. This does not differ in any essential particular from the food material that is found in many compound ascidians. When fully elaborated it consists of an enormous number of small granules, very regular in size, form, and optical properties. They are almost perfectly spherical and are highly refractive, and possess a slightly yellowish tinge.

In many species these granules can be easily seen to be contained in the mesenchymatous cells, but here no evidence of cell structure in connection with them can be made out in most cases. It is probable that the cell substance has become wholly converted into the granules, though just how the thing is accomplished is not clear, since the bodies into which the granules are aggregated are much larger than the individual mesenchyme or body-substance cells ever are, and at the same time they appear to be too definite and constant in form to permit, without much misgiving, the supposition that they are formed from the running together of several cells. Their form approaches spherical in almost all cases where they are not under external pressure from some cause. Many of them reach a diameter of 45 or 50 μ, while their average size would probably be about 30 μ. From their form and behavior under pressure of the cover slip, and from what is known of the similar bodies in other species, it is quite certain that each one possesses an exceedingly thin membrane. But this is difficult to prove directly. In most, if not in all of these free post-abdomens portions of the mantle containing the characteristic muscle fibers and epithelial cells are present, and also the heart and the epicardiac tubes may frequently be found.

But the most interesting facts in connection with them relate to the sexual cells and their development. In many of the abdomens, particularly those that are least changed in form and structure, the band-shaped ovary is found to differ in no respect from the condition which it presents in ordinary normal zooids. (Fig. 28, *ov.*) The ova, however, many of them at least, are distinctly amoeboid, and at no period of their existence are they enveloped by either a follicular epithelium or "test" cells (Pl. LXXXVI, figs. 29, 29^a, 29^b.) The absence of these two layers, the latter of which in particular is so characteristic of the tunicate ovum, is noteworthy. I know of no other instance of the kind in the group. This peculiarity of the individual ova gives an appearance to the ovary as a whole strikingly different from that of the ordinary ovary of these animals. The ova are very closely packed together, and the pseudopodia-like processes, in some instances quite long and narrow, lock together and overlap in an intricate way; and as the cytoplasm is quite homogeneous and refractile, particularly in the smaller and middle-sized ova, the appearance is, as remarked above, striking. Whether or not this amoeboid condition prevails before the abdomen is separated from the rest of the zooid, I do not know; but in all probability it does, since the smaller ova of the severed abdomens show it to almost as great a degree as do the larger ones. The character is, however, wholly lost before maturation takes place. At least this is the case so far as my observations have gone. I have found a few ova, one of which is shown in Pl. LXXXVI, fig. 30, that are perfectly spherical, and as the cytoplasm of these is entirely filled with food granules, I assume that they are nearly ready to undergo the maturation changes.

In addition to the amoeboid form of the ova, they show the same nature to a still greater extent in their *power of ingesting other cells.* Figs. 29 and 29^b (Pl. LXXXVI) illustrate this. That the small cells are actually contained in the cytoplasm of the ova, and are not merely situated on the surface, may be shown conclusively by isolating the ova and so manipulating the cover slip as to cause them to swim about and turn over in the fluid in which they are contained. Such ova as the ones figured, showing the cells in various stages of penetration and disintegration, are very abundant. Ova are easily found in which as many as five or six of the ingested cells may be seen.

I have not been able to satisfy myself as to the nature of these cells. Such instances as that shown at *a*, fig. 29^b, where the cell is only embedded in the surface of the ovum, gives rise to the suspicion that they represent either the follicular epithelial cells or the "test" cells, characteristic of the ova of tunicates. They may also, at least in some cases, be very young ova. Indeed it is highly probable that *many of the ova are consumed by their companions, for certain it is that only a small fraction of the entire number contained in an ovary ever develop into embryos.* I have said that the cytoplasm of the smaller and middle-sized ova is quite homogeneous and refractile, and also that in the older ones it is filled with food granules. These granules in such an ovum as the one shown in fig. 30, for example, are not recognizably different from those already described as constituting most of the bulk of the large bodies which I have said fill the post-abdomen, and which are in all probability yolk-laden mesenchyme cells.

There is little doubt that the yolk granules serve as nutriment for the growing ova and embryos, as do the ingested young ova and "test" cells (?). It is true I have not been able to actually observe the ingestion of the granules by the ova, but the fact that they have wholly disappeared from the cavities in which the embryos are situated by the time the fully developed tadpole stage is reached hardly admits of any other explanation. My failure to observe the ingestion of the granules by the growing ova may be due to the fact that the process actually does not begin until a comparatively late stage in the growth of the latter. If such be the case, it is probably due to the fact that the young ova and the "test" and follicular epithelial cells furnish a more accessible and an ample food supply for the ova during the early stages of their growth. This would result not only from the fact that the ova are held in the ovary for a time, but also from the further fact that the masses of yolk granules are, as already pointed out, enveloped by a membrane at the time when the post-abdomen is set free from the zooid.

It is worthy of special notice in this connection that at no time in the career of the growing ovarian ova are there, so far as my observations have gone, any indications of amoeboid or other changes in their nuclei. As is seen by reference to figure 30, Pl. LXXXVI, the germinative vesicle presents in each ovum the familiar characteristics of this body in ovarian ova, and this notwithstanding the fact that the ova are actively ingesting and presumably digesting also.

The embryonic stages which I have observed are the early cleavage stages (Pl. LXXXVI, fig. 31); late morula and early gastrula stages (fig. 32); fully developed tadpoles, and tadpoles in which the metamorphosis is well advanced (fig. 33). I describe the last two of these first. On making a section of the lobes of several of the colonies, packets of bodies, a few of which are shown in figure 27, are found embedded in the semi cartilaginous test. Cursory examination proves the bodies to be embryos in various stages of development. In one capsule, almost perfectly spherical, 3 mm. in diameter, were contained 13 embryos; in another, 3.5 mm. in diameter, were 16 embryos. Others examined contained fewer than the first mentioned, but none more than the last. The embryos are very closely packed together in the capsule, and they constitute its entire contents, so that after they are picked out the capsule is entirely empty and its interior is almost as regular and smooth as that of a bullet mold. The capsules are perfectly closed at all points. Concerning the embryos themselves, not much need be said. Figure 33 shows one in which the metamorphosis is well advanced.

The structural fact of most interest in connection with the full-grown embryos is the thickness and the composition of their own test. A general idea of this is given by figure 33 *ts* (Pl. LXXXVI), and a more detailed representation is shown by figure 34. The interest that attaches to this point lies in the probable fact that some of the elements contained in the test are unconsumed remnants of the extra ovarian portions of the post-abdomens of the parent zooids. There can be scarcely a doubt that such is the nature of the bodies shown at *y'k*, figure 34. These have the form, size, and composition of many of the masses of yolk granules already described as constituting so large a part of the bulk of the recently severed post-abdomen. In another part of the test of the same embryo there occurred a considerable number of fibers (Pl. LXXXVI, fig. 34 *m. f.*) which so strongly resembled the ordinary muscle fibers of the mantle of the adult that I should not have thought of questioning their nature but for the remarkable position occupied by them. Structures more or less similar both to the masses and the fibers are very common in almost every embryo. Most of these certainly belong to the test of the embryo itself, and are of course the same as those similarly situated in the embryos of all tunicates. But the number is here unusually large, and when this circumstance is considered along with that of the structure of the ones described above, it appears almost certain that, as already said, some of the various bodies contained in the test of the embryos are remnants of the parent zooids. Whether or not this would signify that the test of the embryo serves in any way as a medium of nutrition I do not know. The mere fact of the presence in the test of parental substance that might be used for food by the embryo would not prove that it actually is so used. Both the fibers and the bodies which I have described and figured are, as a matter of fact, either imbedded in or only slightly beneath the surface of the embryonic test, and their presence there may signify no more, so far as the nutrition of the embryo is concerned, than do the great variety of foreign bodies that may be found imbedded in the test of almost all tunicates. Nevertheless, the facts as presented do undoubtedly raise this very interesting question, and there is certainly some ground for suspecting that the test in these embryos does actually play a part in the nutritive function.

All the developmental stages that I have found earlier than the tadpole were contained in a single post-abdomen. This had evidently been quite recently set free from the zooid, since it still retained nearly its usual form and size. It was 4 mm. long and quite narrow as compared with the almost perfectly spherical shape assumed at a later time.

It only remains to say a few words about the fertilization of the ova. I have found fully developed spermatozoa in several post-abdomens, but not in any of those containing embryos. I have, however, seen so few post-abdomens with embryos in the early stages of development that I would not venture to conclude that the same individuals never do contain both ripe sperm and ova at the same time, and hence that self-fertilization does not take place. In fact it appears exceedingly probable that this is the method of fertilization. Certain it is that ripe sperm and well-developed ovarian ova occur together in the same abdomen, and it is difficult to conceive either that self-fertilization would be avoided in such cases, or how it could be accomplished in any other way after the post-abdomens have become set free and fully and deeply imbedded, as they do, in the hard test of the colony.

In conclusion, I must express my regrets that I have not sufficient material to make possible a fuller account of the interesting processes here seen in outline only. The facts are sufficient, however, to render this outline quite distinct, and we may hope that opportunity will come before many years to fill in more of the details.

BERKELEY, *February 17, 1898.*

EXPLANATION OF FIGURES.

Fig. 1. *Dendrodoa tuberculata*, natural size.

Fig. 2. The branchial and atrial orifices of *D. tuberculata*, with their adjacent parts, seen from the inside.

Fig. 3. The left half of the branchial sac of *D. tuberculata*, seen from the inside.

Fig. 4. Small portion of the branchial sac of *D. tuberculata*, from the inside.

Fig. 5. The ovary, in place on the mantle, of *D. tuberculata*.

Fig. 6. General view of *D. subpedunculata*, natural size.

Fig. 7. A group of eleven individuals of *D. subpedunculata* attached to a fragment of seaweed. Two of these fused together.

Fig. 8. Specimen of *D. tuberculata* dissected to show the digestive tract and ovary in outline. The bands at *x*, and having considerable resemblance to the ovary, are folds in the mantle. (See note under description of species in the text relating to position of parts in this figure.)

Figs. 9 and 10. *Styela greeleyi.*

Fig. 11. Branchial sac of *S. greeleyi.*

Fig. 12. Digestive tract and sexual organs of same species.

Fig. 13. Branchial tentacles of same.

Fig. 14. Colony of *Polyclinum globosum*, with a portion cut away. The small area at β indicates about the distribution of the zooids, and shows the branchial orifices, though much more distinctly than they can actually be seen.

Fig. 15. A single zooid of same species.

Fig. 16. Atrial languet of same, seen from the under side.

Figs. 17A and 17B. Two sectioned colonies of *Polyclinum pannosum*, 17A showing the zooids in their normal form and position, and 17B the degenerated zooids. The characteristic ragged surface of the colony is shown at *y*, 17B.

Fig. 18. Portion of a zooid of *P. pannosum*.

Fig. 19. A colony of *Aplidiopsis jordani* with an individual of *Dendrodoa subpedunculata*, D. S., imbedded in it.

Fig. 20. A zooid of *A. jordani*. The post-abdomen outlined in this specimen is unusually short.

Figs. 21, 21A, and 21B. Portions of different zooids of *Amaroucium kincaidi*. 21A and 21B drawn particularly to show the equivocal character of the irregularities in the stomach walls.

Fig. 22. A colony of *Amaroucium snodgrassi*. The specimen is seen from its base, B, and one of its precipitous edges, on which latter the zooids *z* are visible through the semitransparent test.

Fig. 23. Stomach and small portion of intestinal loop of *Amaroucium snodgrassi*.

Fig. 23A. Anterior end of zooid of same species, seen from inside.

Fig. 23B. A few of the remarkably long, narrow stigmata of same species.

Fig. 24. A colony of *Amaroucium pribilovense*.

Fig. 25. A single zooid, the posterior part of the post-abdomen wanting, of the same species.

Fig. 26. A colony of *Synoicum irregulare*.

Fig. 27. The cut surface of one of the lobes of a colony of same species, showing the packages of embryos, *e*, imbedded in the test.

Fig. 28. A zooid of *S. irregulare*.

Plate LXXXVI.

Figs. 29, 29*a*, and 29*b*. Ovarian ova of *S. irregulare*, 29 and 29b containing ingested cells. × 360.

Fig. 30. An ovarian ovum, presumably nearly ready for maturation. × 360.

Fig. 31. Two-celled stage. × 360.

Fig. 32. Morula? early gastrula stage. × 360.

Fig. 33. Embryo well advanced in metamorphosis. This from one of the cavities containing embryos only. × 40.

Fig. 34. Small portion of the test of an old embryo. The cellular masses, *x*, are the same as the bodies shown at *x*, fig. 33. These probably belong to the test of the embryo itself. The mass *y. k.* is imbedded in the test, and is without doubt a cluster of the mesenchymatous yolk containing bodies found in the parental post-abdomen. *m. f.* appear to be muscle fibers derived from the mantle of the parent.

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ABBREVIATIONS USED IN THE ILLUSTRATIONS.

A	Anterior, or siphonal end.
B	Base, or posterior end.
a. l	Atrial languet.
a. o	Atrial orifice.
a. t	Atrial tentacles.
b. f	Branchial folds.
b. s	Branchial stigmata.
br. s	Branchial sac.
br. si	Branchial siphon.
b. t	Branchial tentacles.
d. l	Dorsal lamina.
d. t	Dorsal tubercle.
emb	Embryo.
en'c	"Endocarps."
ep	Epicardiac tubes.
h	Heart.
i. l. v	Internal longitudinal vessels.
m. c. v	Muscle bands of circular vessels.
o. œ	Œsophageal mouth.
o. p	Optic pigment.
œ	Œsophagus.
ov	Ovary.
p. b	Peribranchial band.
r	Rectum.
st	Stomach.
t	Testis.
t_1, t_2, t_3, t_4	Transverse vessels of different orders.
ts	Test, or cellulose "mantle."
v. d	Vas deferens.
y'k	Yolk-containing mesenchyme cells.
z	Zoid.

SYNOICUM X

FIG. 29

SYNOICUM X 360

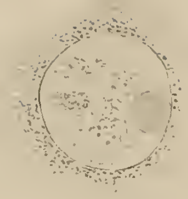

FIG. 29 A

FIG. 29 B

SYNOICUM X

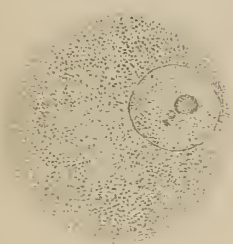

FIG. 30

SYNOICUM X 360

FIG. 31

SYNOICUM X

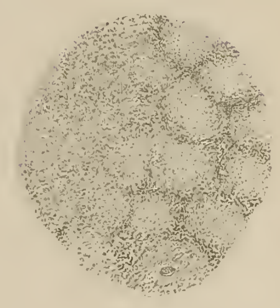

FIG. 32

SYNOICUM X 40

FIG. 33

FIG. 34

DEVELOPMENT OF SYNOICUM IRREGULARE.

A. Hoen & Co. Lith. Baltimore.

XX.—THE MOLLUSK FAUNA OF THE PRIBILOF ISLANDS.

By William H. Dall.

(With a map.)

The west coasts of America, taken together in both hemispheres, so far as the mollusks are concerned might be regarded as forming one great faunal region, modified only by the influence of temperature. In practice it is divided into three regions between the Polar faunas: The *Peruvian*, whose northern limit is usually placed at Cape Blanco, and whose extent roughly coincides with the coast washed by the Peruvian current; the *Mexican* or *Panamic*, which extends from Cape Blanco northward to Point Conception, California, though until lately supposed to be much more restricted; and the *Oregonian*, which includes the coast northward from Point Conception to and including the Aleutian Islands and that part of the basin of Bering Sea south of the area covered by pack ice in winter. The Pribilof group stands on the very northern verge of the Oregonian region. The latter is conveniently subdivided into three provinces or subregions: The *Californian*, from Point Conception to Cape Mendocino, California; the *Oregonian* proper, thence northward to Mount St. Elias or Yakutat Bay; and the *Aleutian*, extending thence westward to and including the Aleutian or Catherina Archipelago and the Commander Islands. The most northern outpost of the Aleutian province is the Pribilof group. The faunal conditions of Bering Sea are somewhat peculiar and require a particular description. They are dependent upon bathymetrical and thermal factors. Contrary to the traditions of the text-books, as I have elsewhere[1] shown at length, the chief current of this sea is a drift of cold water southward, which is particularly marked along the Kamchatkan coast. On the northern border of the Pacific, south of the peninsula of Alaska and the Aleutian Islands, the tides rise toward the northward and westward, while a reflected branch of the Japan current or Kuro Siwo, which is deflected northward from the vicinity of Dixon entrance, in north latitude 54°, feebly reenforces the action of the tides and at flood pours through the passes between the islands during summer a certain amount of water having a temperature between 45° and 50° F., which has a westerly set. This flow endures only for about a third of the twenty-four hours, and is so feeble that west of west longitude from Greenwich 170° it can not be discriminated from the ordinary flow of the rising tide. A few fathoms below the surface the water temperature rarely exceeds 40° F., which is the mean summer temperature of

[1] Notes on Alaska and the vicinity of Bering Strait; Am. Journ. Sci., 3d ser., XXI, pp. 104–111, with map, February, 1881; and Appendix No. 16, Rep. U. S. Coast and Geodetic Survey for 1880; The Currents and Temperatures of Bering Sea, 46 pp., 4°, 2 maps and section, Washington, March, 1882.

the arctic water of the vicinity of Bering Strait. In winter the water temperatures range but a few degrees above the freezing point of salt water, about 28° F.

The topography of the Bering Sea basin has been elucidated by the work of the United States Fish Commission and the Revenue Marine, though much remains to be done. In general, the southwestern part of the sea is deep on both sides of the Aleutian Islands. The northern and eastern parts of the sea are relatively shallow, forming a large submarine plateau covered by less than 100 fathoms of water, and over a great part of its extent by less than 50 fathoms. The western edge of this plateau is some distance west and south of the Pribilof group, and the margin between them and the peninsula is somewhat deeply embayed, so that the plateau joins dry land on the south not far from the western end of the peninsula.

By platting the positions where the edge of the pack ice was met in early spring from the log books of a large number of whale ships, I have been able to determine, approximately, the usual extent of the pack in winter.[1] It must be stated that the margin of the ice pack is not a strictly determinate line, but is fringed with more or less floating and broken ice, which varies in position with the prevailing winds. Occasions have been known when long-continued northerly winds in February and March have carried the loose ice as far south as the northern border of the eastern Aleutians, filling the bays of Unalaska with the drift and obstructing navigation, but this is very exceptional. Usually the water about the islands is free of obstructive ice throughout the year. The Pribilof group, however, lie so much nearer the average limit of the winter pack that few winters pass when the shores are not, for at least a short period, surrounded by the floes, and sometimes they are icebound for one or two months.

The presence of floe ice is destructive to a littoral fauna unless the animals can retreat into the depths of the sea beyond the reach of ice. For this reason the Arctic shores and the beaches of the Pribilof Islands are poorly supplied with living mollusks. The shores of the Aleutians have a fairly rich littoral fauna, though for some reason, perhaps the scarcity of the red and green seaweeds noted by botanists all through this region, there is a general scarcity of the minuter, mostly phytophagous, forms of mollusks, such as *Rissoidae* and the like. The dredgings of the United States Fish Commission have chiefly been made with the beam trawl, which does not retain the more minute species; but my own, done with the dredge, also failed to obtain any large number of small mollusks, so we may regard the fact that the fauna is rather deficient in them as fairly well proved.

The shallow waters around the Aleutians possess a well-marked and pretty uniform fauna of some two or three hundred species of mollusks, a certain number of which are common to the adjacent continental shores and the Pribilof Islands. This fauna comprises a number of characteristic species, together with a contingent of Arctic forms and a certain number of Oregonian types.

The work of the *Albatross*, however, has shown that another fauna exists in Bering Sea largely distinct from that of its shores and widely spread over the great plateau to which reference has been made. This is not a deep-sea fauna, for the water is no deeper, and often shallower, than that of the bays and harbors of the Aleutians, in which but few of its component species are found. It is marked by a rather limited number of bivalves and an unusual predominance of species of *Buccinum*, *Chrysodomus*, and *Strombella* (or *Volutopsis*). My study of this fauna has not progressed far enough

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[1] See accompanying map.

to enumerate its species, many of which are new, characteristic, and peculiar. A number of them have been described and figured,[1] but many more remain to be worked up. A few of them farther south descend into the Archibenthal region and extend their range as far south as the Galapagos Islands, off the South American coast, but the great majority seem to be limited to the Bering Sea plateau.

In a certain sense the inhabitants of this plateau might be regarded as forming part of the fauna of the Pribilofs, although never found upon the beaches; but I have in the accompanying list of Pribilof shells included only a few of them which have been dredged in comparatively shallow water close to the islands. They are marked with an asterisk to distinguish them from the littoral species. It might be considered proper to enumerate as belonging to the Pribilof fauna all littoral species which have been found both south and north from the islands, as a thorough search would probably reveal them somewhere about the group. But for present purposes I have preferred to catalogue only such species as have actually been collected by some one on the islands, though it is certain that by this method the total number of species is considerably underrated.

The first collections made on the islands were gathered by Elia Wossnessenski, a preparator of the Imperial Academy of Sciences at St. Petersburg, who was sent out for the purpose of obtaining for the Zoological Museum a full representation of the fauna and flora of Russian-America. He spent three years in the colony, and his shells were worked up by Middendorff in his Malacozoologia Rossica and Sibirische Reise, 1849–1854.

No other collector appears to have visited the Pribilofs for many years In 1868 I made a small collection from the beaches of St. George, but was unable to do any dredging. In 1874 and 1880 I visited St. Paul and St. George and did a little dredging, but with scanty results. A few species were collected by Messrs. H. W. Elliott and William Palmer in 1880. Later the work of the *Albatross* for the United States Fish Commission resulted in rich collections from the plateau region of Bering Sea, but very few specimens were actually obtained on the islands.

The following list includes all the species which I have been able to determine as actually collected on the islands. I have noted in separate columns the species found on St. Paul and St. George and have given in parallel columns the range of these species in Japan, on the Kamchatka coast, in the Arctic Ocean, the Aleutian chain, and California. Species collected by Wossnessenski are indicated by a capital W, others noted by Middendorff with an M; Palmer's species by a P; those collected on the voyage of the *Vega* by a V; the *Albatross* shells by A; my own by a D, and others by an X.

It must be distinctly understood that this list can not be regarded as complete, since none of the collectors made thorough search on shore or by dredging. However, the catalogue will serve for a beginning, and doubtless includes the majority of the species most likely to be found on the shores of the island.

There are only three land shells known from the group—a *Pupa*, *Succinea*, and a *Vitrina*—all of which are common to the Kamchatka coast as well as the northeastern coast of Bering Sea. There is much probability that a search by a competent collector would reveal several small species of *Zonitidae*, *Pupidae*, etc.; and probably *Pisidium* exists in the pools of St. Paul, as it does on many of the Aleutians.

[1] Proc. U. S. Nat. Mus., XIV, pp. 186–190, July 1891; and XVII, pp. 706–713, 1895.

The characteristic marine forms of the fauna are *Chitonidae*, limpets and *Buccinidae*, of which several highly characteristic forms occur. I have added the giant squid, *Onychoteuthis*, as I have heard that specimens have been cast ashore at St. Paul, though no naturalist has seen them. Occurring as they do at Unalaska, it would be strange if they did not also extend their range to the Pribilof group. A few species have so far been found only in this locality, but there is no reason to suppose that they are actually restricted to it. Such are *Chrysodomus insularis*, *Strombella fragilis*, and *Beringius frielei*, of the plateau fauna; and *Strombella callorhina* and *Buccinum fischerianum*, of the shore fauna. St. Paul seems to be the source of nearly all the specimens of *Strombella beringi* Midd., which have hitherto been collected. Altogether 86 forms are known from the group, of which 66 have been collected on St. Paul and 42 on St. George; 17 are common to California, 72 to the Aleutian Islands, 42 to the Arctic fauna, 31 to Kamchatka, and 10 to the northern islands of Japan. All of the latter are common to the American shores, so it can not be said that there is any characteristically Asiatic element in the fauna.

For comparison, I have added a similar list of the species of the Commander Islands, in which we have a squid, one land shell, one fresh-water shell, and one chiton, which are known elsewhere only on the Asiatic coasts, a proportion out of 74 species which can not be said to be large. Besides the mollusks an ascidian, *Boltenia beringi*, was described by me from St. George, and a brachiopod, *Rhynchonella* (*Hemithyris*) *psittacea*, is abundant at times on the beaches of St. Paul Island.

Pribilof Islands, Bering Sea.

FAUNAL SUMMARY.

Species identified.	St. Paul.	St. George.	Range.				
			Japan.	Kamchatka.	Arctic Ocean.	Aleutians.	California.
Onychoteuthis robusta Dall		X				D	
Succinea chrysis Westerlund	P	D			X	X	
Vitrina exilis Morelet	P			X			
Pupa decora Gould, var.?		A		X		X	
Cryptochiton Stelleri Midd	W			X		X	X
Amicula vestita Sby	D				D	X	
Amicula Pallasii Midd	D				D	D	
Trachydermon ruber (L.) Cpr	D	D	X	X	D	D	
Tonicella submarmorea Midd		D	X	X	D	D	D
Tonicella saccharina Dall	D					D	
Tonicella lineata Wood	D	X		X	D	D	D
Acmaea mitra Esch		D				D	D
Acmaea testudinalis Mull	D	D		D	D		
Acmaea patina var. ochracea Dall		D				D	D
Acmaea Cumingi Rve	X	D				D	D
Acmaea sybaritica Dall	D	D	X			D	
Acmaea apicina Dall		D				D	
Lepeta concentrica Midd		D				D	
Velutina coriacea Pallas	M					D	
Velutina cryptospira Midd	D					D	
Crepidula grandis Midd	W					D	
Litorina sitkana Phil	X	D				D	
Litorina subtenebrosa Midd		D			X		
Haloconcha reflexa Dall	D					D	
Cingula Martyni Dall		D				D	
Acrybia flava Gould	W				D	D	
Natica russa Gould		D				D	
Natica clausa Brod. and Sby		D		D	D	D	
Lunatia pallida Brod. and Sby		X			D	D	
Margarita helicina Fabr	X	D		D	D	D	
Scala grönlandica Fabr	X			X	D	D	
Tritonium oregonense Redf	X	D	X	D		D	D
Trichotropis insignis Midd		D				D	

Pribilof Islands, Bering Sea—Continued.

FAUNAL SUMMARY—Continued.

Species identified.	St. Paul.	St. George.	Range. Japan.	Kamchatka.	Arctic Ocean.	Aleutians.	California.
Purpura lima Mart	......	X	......	......	......	X	X
*Trophon Dalli Kobelt	X	......	......	......	X	D	......
Chrysodomus liratus Mart	A	......	......	X	......	D	......
Chrysodomus fornicatus Gray	W	......	X	D	D	......	......
*Chrysodomus insularis Dall	A	A	......	......	......	......	......
Chrysodomus (var.?) communis Midd	W	......	......	......	X	......	......
Tritonofusus Kroyeri Möll	A	......	......	......	D	D	......
Sipho spitzbergensis Rve	......	X	......	......	D	D	......
Sipho? shautarica Midd	W	......	M	......	......	......	......
*Sipho Herendeenii Dall	A	A	......	......	......	A	......
*Heliotropis deformis Gray	A	......	......	......	D	A	......
Heliotropis deformis var. harpa Mörch	X	......	......	......	......	D	......
*Strombella fragilis Dall	A	......	......	......	......	......	......
Strombella Beringi Midd	W	D	......	......	D	......	......
Strombella callorhina Dall	D	......	......	......	......	......	......
*Strombella Middendorffii Dall	A	......	......	......	......	A	......
*Beringius Frielei Dall	A	......	......	......	......	......	......
*Ancistrolepis magnus Dall	A	......	......	......	......	A	......
Volutoharpa ampullacea Midd	W	D	......	D	D	D	......
Buccinum cyaneum v. Mörchianum F	......	D	......	......	D	D	......
Buccinum cyaneum v. Baeri Midd	W	D	......	......	......	D	......
Buccinum Fischerianum Dall	......	D	......	......	......	......	......
Buccinum glaciale L	X	......	......	D	D	D	......
Buccinum tenue Gray	X	......	......	X	X	D	......
Bela simplex Midd	W	......	......	......	D	D	......
*Pleurotoma Beringi Aur	A	A	......	V	......	A	......
*Pleurotoma circinata Dall	A	......	......	......	D	D	......
Saxicava rugosa L	......	D	......	V	D	D	D
Mya truncata L	X	......	X	D	D	D	......
Siliqua patula Dixon	X	......	......	......	......	D	......
Siliqua media Gray	X	......	......	D	D	......	......
Spisula alaskana Dall	W	......	......	......	D	D	D
Kennerlia grandis Dall	D	......	X	......	......	D	......
Lyonsia arenosa Möll	X	......	......	......	X	X	......
Macoma inconspicua Brod. and Sby	D	D	X	X	D	D	......
Macoma frigida Gray	D	......	......	D	X	D	......
Macoma nasuta Conr	X	......	......	X	......	D	D
Macoma Middendorffii Dall	D	......	......	......	X	D	......
Tellina alternidentata Brod	W	D	......	......	......	D	......
Liocyma fluctuosa Beck	X	......	......	X	X	D	......
Cardium Nuttallii Conr	W	......	......	D	......	D	D
Cardium blandum Gld	D	......	X	......	......	D	D
Cardium islandicum Gmel	......	D	......	D	D	D	......
Serripes gronlandicus Fabr	D	W	......	X	X	D	......
Astarte semisulcata Leach	D	W	......	D	D	......	......
Venericardia borealis Conr	A	......	......	X	D	D	......
*Lucina acutilineata Conr	......	D	......	......	......	D	D
Pecten strategus Dall	D	......	......	......	......	D	D
Pecten islandicus Mull	X	......	......	D	D	D	......
Pododesmus macroschisma Desh	W	D	......	......	......	D	D
Mytilus edulis L	W	D	......	D	D	D	D
Modiolus modiolus L	W	D	......	......	D	D	D
Modiolaria vernicosa Midd	......	W	......	......	......	D	......
Total, 86 forms	66	42	10	31	42	72	17

Commander Islands, Bering Sea.[1]

FAUNAL SUMMARY.

Species identified.	Range. Japan.	Kamchatka.	Arctic.	Aleutians.	California.
Gonatus amoenus Fabr	....	....	×	×	....
Lestotenthis fabricii (?) Licht	×	×	....	....	....
Cylichna propinqua Sars	....	....	×	×	....
Acolidia papillosa L	....	....	....	×	....
Cadlina pacifica Bergh	....	....	....	×	....
Acanthodoris pilosa Mull	....	....	×	×	....
Limax (Agriolimax) hyperboreus West	....	×	×	×	....
Vitrina exilis Mor	×	×	×	×	×
Hyalina radiatula Ald	....	×	×	×	....
Conulus fulvus var. Mull	×	×		×	....
Patula ruderata var. pauper Gld	×	×	....	....	....
Pupilla decora Gld	....	×	×	×	....
Limnaea ovata Drap	....	×	....		....
Limnaea humilis Say	....	(?)	....	....	....
Siphonaria thersites Cpr	....	....	....	×	....
Trachyradsia aleutica Dall	....	....	....	×	....
Tonicella marmorea Fabr	×	×	×	×	×
Tonicella submarmorea Midd	×	×	×	×	....
Trachydermon ruber L	×	×	×	×	....
Schizoplax brandtii Dall	....	×	....	×	....
Leptochiton cancellatus Sby	....	....	....	....	....
Placiphorella stimpsoni Gld	×	....	....	....	(?)
Cryptochiton stelleri Midd	×	×	×	×	×
Acmaea patina Esch	....	×		×	×
Acmaea pelta Esch	....	....	....	×	×
Velutina cryptospira Midd	....	×	....	×	....
Piliscus commodus Midd	....	....	×	×	....
Crepidula grandis Midd	×	×	×	×	....
Litorina sitkana Phil	×	×	....	×	×
Litorina var. subtenebrosa Midd	×	×	×	×	....
Litorina var. atkana Dall	....	....	....	×	....
Lacuna vincta Mtg	×	×	×	×	×
Haloconcha reflexa Dall	....	....	....	×	....
Natica clausa Brod	×	×	×	×	....
Natica russa Gld	....	×	....	×	....
Tachyrhynchus erosus Couth	×	×	×	×	....
Trichotropis insignis Midd	....	×	....	×	....
Tritonium oregonense Redf	×	×	....	×	×
Cerithiopsis stejnegeri Dall	....	....	....	×	....
Margarita belicina Fabr[2]	×	×	×	×	....
Margarita vorticifera Dall	....	×	×	×	....
Margarita varicosa Migh	....	×	×	×	....
Purpura lima Mart	×	×	×	×	×
Trophon truncatus Strom	....	....	×	×	....
Strombella var. stejnegeri Dall	....	....	×	....	....
Tritonofusus kroyeri Moller	....	....	×	×	....
Chrysodomus liratus Mart	....	×	×	×	....
Chrysodomus spitzbergensis Rve	....	×	×	×	....
Volutharpa ampullacea Midd	×	×	×	×	....
Astyris rosacea Gld	....	×	×	×	....
Buccinum tenue Gray	....	....	×	×	....
Buccinum var. mörchianum Fischer	....	×	....	×	....
Buccinum percrassum Dall	....	....	×	....	....
Pleurotoma (Bela) violacea Migh	....	....	×	×	....
Pleurotoma beringi Aur	....	....	....	(?)	....
Zirfaea crispata L	×	....	....	....	×
Pholadidea penita Conr	×	....	....	....	×
Saxicava rugosa L	×	×	×	×	×
Mya truncata L	....	×	×	×	....
Cuspidaria var. beringensis Leche	....	....	....	×	....
Siliqua patula Dixon	....	×	....	×	×
Spisula alaskana Dall	....	....	×	×	....
Macoma middendorffi Dall	....	....	....	×	....
Tapes staminea Conr	×	×	....	×	×
Cardium grönlandicum L	×	×	×	×	....
Cardium blandum Gld	....	×	....	×	....
Pisidium aequilaterale Hald	....	....	....	×	....
Modiolaria discors Gray	×	×	×	×	....
Modiolaria laevigata (var. ?) Gray	....	×	×	×	....
Modiolus modiolus L	×	×	×	×	×
Mytilus edulis L	×	×	×	×	×
Pecten alaskensis Dall	....	....	....	×	....
Pododesmus macroschisma Desh	×	×	....	×	×
Total 74 species	28	44	41	63	17

[1] Modified from table given by me in Proc. U. S. Nat. Mus. for 1886. Report on Bering Island Mollusca, pp. 217, 218, October, 1886. Cf. also these Proceedings for 1884, pp. 340-349.

[2] Since this paper was prepared a publication has appeared (Proc. Mal. Soc., of London, III, p. 205, Mar., 1899) on Some Mollusca from Bering Sea, by Mr. Edgar A. Smith, of the British Museum. These were collected by Mr. G. E. H. Barrett-Hamilton of the Bering Sea Commission, at the Commander Islands. They comprise (1) a species of *Ommatostrephes* not specifically identified; (2) *Astyris rosacea* Gould; (3) *Margarita beringensis* Smith; (4) *M. albolineata* Smith (both described under the generic name of *Valvatella*); and (5) *Acmæa sybaritica* Dall (from Copper Island). This brings the total number of species known from the Commander Islands up to 77, of which numbers 3 and 4 are known also from the Aleutians, and number 5 from the Pribilof Islands, the Aleutians, and Japan.

FOSSIL MOLLUSKS OF ST. PAUL ISLAND.

The only molluscan fossils known in the group come from St. Paul Island, and I have added an extract from my geological report on the Tertiary coals of Alaska (Report on Coal and Lignite of Alaska, 17th Ann. Rep. U. S. Geol. Survey, 1886), which summarizes all that is known of them up to the present time.

On the eastern side of the point which forms the southeastern extreme of the island is a bluff or crag known as Black Bluff, which, according to the observations of Wossnessenski in 1847–48, is composed of horizontal layers of a hard claystone, with others in which lime preponderates, forming a pale gray, fine-grained, clayey limestone, or in which a conglomerate of pebbles of volcanic origin is bound together in a limy matrix.[1] Over these are layers of black or brown volcanic breccia and vesicular lava. These bluffs rise abruptly to a height of 60 to 80 feet above the sea at their base.

[1] Grewingk, Beitrag, p. 190.

From the limestone and argillite marine fossils have been obtained by Wossnessenski, Elliott, Dall, W. Palmer, and C. H. Townsend, of which a collection exists in the National Museum, enumerated in the following table. About twenty-eight species are known from this locality, which is stated to be the only spot in the whole group where any fossiliferous rocks occur,[1] the remainder of the islands being composed of volcanic rocks and alluvium of very recent origin.

Observations made in 1891 by Mr. J. Stanley-Brown,[2] special agent of the Treasury Department, convinced him that at present no distinct trace of any limy stratum is perceptible in the Black Bluff. The fossils obtained by him were contained in rounded, apparently water-worn, pebbles, which were indiscriminately included in a general mass of volcanic ashes and other eruptive matter of which the bluff is formed. No extinct species appeared in the collection brought back by Mr. Stanley-Brown, while several are noted from the material of the earlier collections. It would seem possible that pebbles of more than one geological epoch may be included in the mass, or that the wear of the waves for half a century has cut away enough of the bluff to hide or destroy the limy stratum referred to by Grewingk and which may have been of limited extent. It is certain that from an examination solely of the material collected in 1891 the fossils might be referred to an age as late as the post-Pliocene, which would not agree very well with the fauna reported by Grewingk and others. The fossils collected by Mr. Stanley-Brown and not included in the earlier collections are as follows: *Buccinum tenue* Gray ?, *B. polare* Gray ?, *Admete couthouyi* Jay ?, *Leda* sp., *Yoldia limatula* Say, *Pseudopythina grandis* Dall, *Cardium islandicum* (very abundant), *Macoma sabulosa* Spengler, and a fragment possibly of a Panopea. All these occur lying at moderate depths in Bering Sea, adjacent to the island, at present.

This deposit has been discussed by Dr. George M. Dawson,[3] who corroborates Mr. Stanley-Brown's description of the conditions under which the fossils are found, but regards them as having been detached from the sea bottom by a volcanic eruption, with the products of which they were mixed, and therefore does not consider them as fixing the age of the formation in which they occur, but only as representing beds already in existence at the time of the eruption.

COMMANDER ISLANDS.

On the Commander Islands, west of the Aleutians, rocks of the same age probably occur, since on Bering Island Stejneger collected some specimens of a conglomerated hard gravel of highly polished pebbles united by a limy cement, containing fragments of bivalves (Saxicava?) and a single piece of claystone with the imprint of a bivalve not yet identified.

[1] Cf. H. W. Elliott, Condition of Affairs in Alaska, 1875, p. 70.

[2] Bull. Geol. Soc. Am., III, 1892, p. 496.

[3] Bull. Geol. Soc. Am., Vol. V, 1895, pp. 130–132.

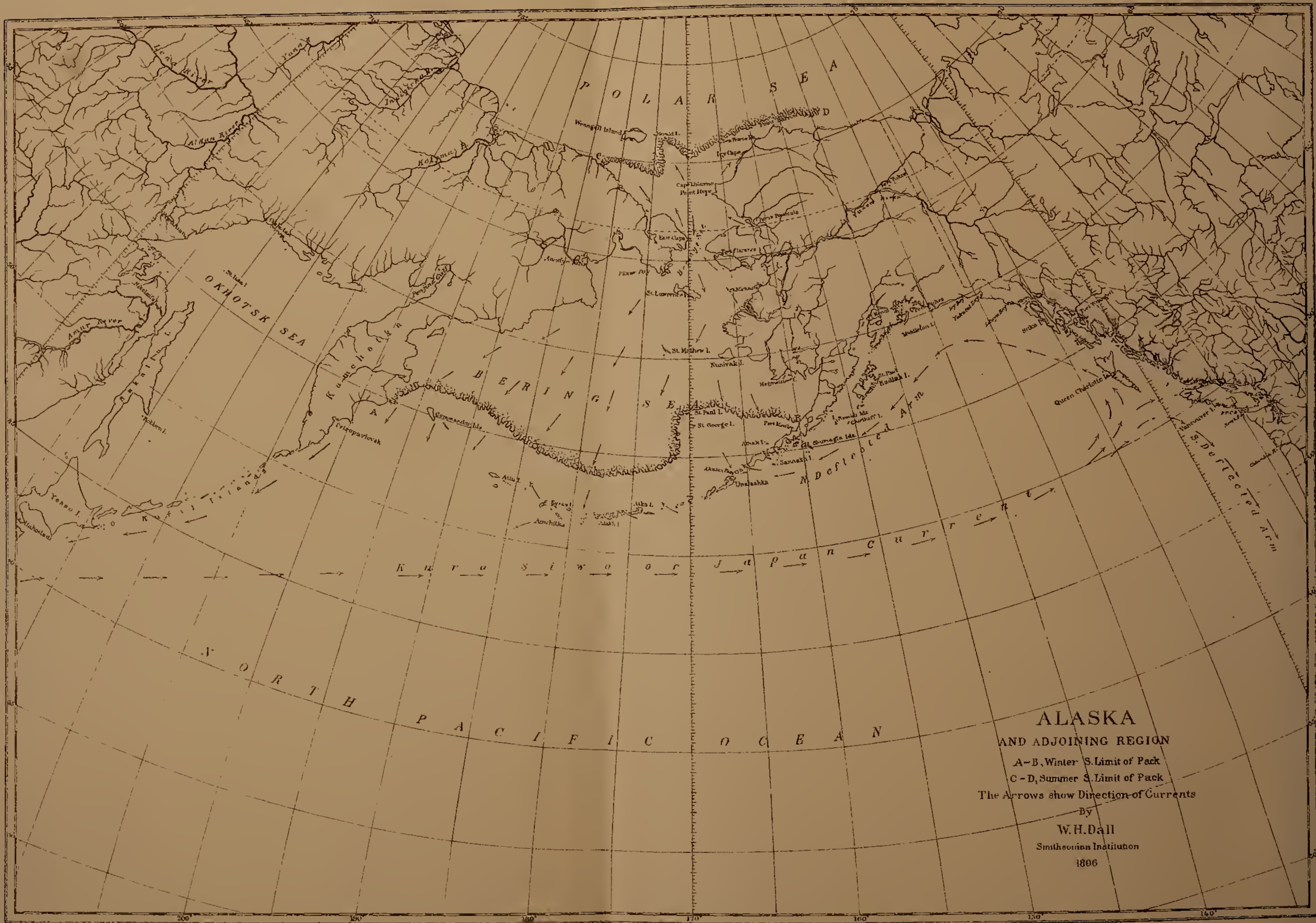
ALASKA
AND ADJOINING REGION
A–B, Winter S. Limit of Pack
C–D, Summer S. Limit of Pack
The Arrows show Direction of Currents
By
W. H. Dall
Smithsonian Institution
POLAR SEA
OKHOTSK SEA
BERING SEA
NORTH PACIFIC OCEAN
Kuro Siwo or Japan Current
Deflected Arm
Wrangell Island
St Lawrence I.
St Matthew I.
Nunivak I.
St Paul I.
St George I.
Unalashka
Kadiak I.
Queen Charlotte Is.
Vancouver I.
Attu I.
Amur River
Petropavlovsk
Kamchatka
Yesso I.

Table showing range of Black Bluff fossils.[1]

Name of species identified.	St. Paul Island.	Nushagak.	Port Möller.	Atka Island.	Unalaska.	Morzhowi.	Pavloff Bay.	Unga Island.	Katmai.	Kadiak Island.	Miocene.			Pliocene.	Pleistocene.	Recent.	
											B. C.	Oreg.	Cal.	Cal.	Cal.	N.	S.
Glycymeris kashevaroffi Grewingk	×							×		×							
Glycymeris patulus Conrad	×	×					×					×	×	×			×
Nucula tenuis Lamarck	×	×														×	
Nucula (Acila) ermani Girard	×			×													
Yoldia limatula Say, var	×														×	×	
Astarte borealis Gray	×															×	
Cardium islandicum Gmel	×														×	×	×
Cardium decoratum Grewingk	×			×			×	×		×	×						
Serripes gronlandicus Beck	×	×						×		×	×					×	
Liocyma fluctuosa Beck	×															×	
Tapes staminea Conrad	×						×	×					×	×	×	×	
Lioconcha sp	×				×	×											×
Tagelus sp	×																
Pseudopythina grandis Dall	×														×	×	×
Soletellina sp	×																
Tellina frigida Gray	×	×			×						×					×	
Tellina alternidentata Brod. and Sby	×			×	×	×		×								×	
Macoma middendorfii Dall	×	×	×			×		×								×	
Macoma inconspicua Brod. and Sby	×										×			×	×	×	
Macoma sabulosa Spgl	×														×	×	
Lyonsia arenosa Möller	×															×	
Kennerlyia grandis Dall	×															×	
Saxicava arctica L	×	×		×		×	×	×		×						×	
Teredo sp	×	×						×									
Cylichna (alba Brown?)	×																
Admete couthouyi Jay	×																
Buccinum tenue Gray	×																
Buccinum polare Gray	×																
Buccinum plectrum Stimpson	×				×				×							×	
Odostomia sp	×																
Lunatia (pallida B. and S.?)	×															×	
Neverita saxea Conrad	×	×									×	×	×				
Natica clausa Brod. and Sby	×	×												×		×	
Margarita striata Brod. and Sby	×				×											×	
Margarita sp	×																

[1] This table is derived chiefly from a table of Alaskan Tertiary fossils given by me in the Seventeenth Annual Rept. U. S. Geol. Survey, Part 1, 1896.

XXI.—LIST OF INSECTS HITHERTO KNOWN FROM THE PRIBILOF ISLANDS.[1]

The insect fauna of the Pribilof Islands is still most imperfectly known, and I am not aware that the islands have ever been visited by an expert entomologist. Among the Russian explorers and visitors of Alaska in the first half of the present century, Wosnesenski seems to be the only one who collected insects on the Pribilof Islands. They are still preserved in the Imperial Museum of St. Petersburg, but only the Coleoptera have been worked up.[2] After the acquisition of Alaska by the United States a few small collections of insects were made on the islands, of which the following were transmitted to the Entomological Department of the United States National Museum:

Accession No. 23646, received April, 1894, collected by Messrs. Elliott and Palmer in 1890—one species of insects.

Accession No. 30147, received January, 1896, collected by Messrs. F. W. True and D. W. Prentiss, jr., in 1895—six species of insects.

Accession No. 31335, received November, 1896, collected by Mr. G. E. H. Barrett-Hamilton, of Ireland, in 1896—twenty-two species of insects and Arachnids.

The only general observations on the insect fauna of the islands which have been recorded are those by Mr. Henry W. Elliott, published in Volume VIII of the Tenth Census of the United States, 1880 (1884), page 12. Unfortunately, the determination of the insects given by him is guesswork, and his collection never reached the Museum. Whatever points of interest there are in his remarks are incorporated in the following list.

The small size of the Pribilof Islands, their isolated position, and the inclement climatic conditions are certainly not favorable to the existence of a rich insect fauna. Still, according to a very moderate estimate, the number of insects on the islands will amount to at least 400 species. Since of this number not more than about 40 can be enumerated at present, it is evident that any general considerations on the character of this fauna, or a comparison with the faunas of Kamchatka, the Aleutian Islands, and the mainland of Alaska would be premature, and the following list is herewith given without further comment:

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[1] Compiled by E. A. Schwarz, of the Division of Entomology, United States Department of Agriculture.

[2] E. Ménétriés: Sur un envoi d'insectes de la côte N. O. de l'Amerique (Bull. Acad. d. St. Petersbourg, 2, 1844).

V. von Motschulsky: Die Käfer Russlands (Bull. Soc. Imp. Nat. Moscow, 18, 1845).

C. G. von Mannerheim: Nachträge zur Käferfauna d. Aleutischen Inseln und der Insel Sitka, I–III (Bull. Soc. Imp. Nat. Moscow, 19, 1846; 25, 1852; und 26, 1853).

I. COLEOPTERA.[1]

Family CARABIDAE.

Carabus truncaticollis Eschscholtz.

Numerous specimens collected by Messrs. Elliott and Palmer on St. Paul in 1890 and also by Mr. Barrett-Hamilton on St. Paul in 1896. Mr. Elliott says of this beetle: "The famous green and gold Carabus is exceedingly common, crawling everywhere," but fails to record the food habits. The species is known from the Yukon River, "Sierra Nevada," and Kamchatka and eastern Siberia. The specimens from St. Paul show great variation in sculpture and color.

Nebria bifaria Mannh. (*carbonaria* Mannh.).

Originally described from St. Paul. Two specimens were also found there by F. W. True and D. W. Prentiss, jr., and by Mr. Barrett-Hamilton. It is known to occur in Kamchatka and at St. Michael, Alaska.

Pelophila eschscholtzii Mannh.

One specimen collected by True and Prentiss. Originally described from Unalaska; the species is also known from Methy, H. B. T.

Patrobus septentrionis Dej.

Six specimens from St. George Island collected by True and Prentiss and one specimen from St. Paul collected by Barrett-Hamilton. A circumpolar species, occurring also on the Alps of Europe and in the Rocky Mountains of North America.

Pterostichus (Pseudocryobius) pinguedineus Eschscholtz.

Originally described from St. Paul Island; also known from the Aleutian Islands, Kadiak, and Sitka.

Pterostichus (Pseudocryobius) hyperboreus Mannh.

Hitherto recorded only from St. George Island.

Pterostichus (Pseudocryobius) similis Mannh.

Described from St. George Island; known also from St. Stephens.

Pterostichus (Pseudocryobius) quadricollis Mannh.

Described from St. George Island; occurs also in St. Lawrence Bay (Peninsula of Tschutsk).

Pterostichus (Pseudocryobius) empetricola Dej.

Eight specimens from St. Paul Island, collected by Barrett-Hamilton, and one specimen from St. George (True and Prentiss). Widely distributed in Alaska, Hudson Bay territory, Kamchatka, and Siberia.

Pterostichus (Pseudocryobius) ventricosus Eschscholtz.

One specimen from St. Paul Island (Barrett-Hamilton) and two specimens from St. George (True and Prentiss); also known from Unalaska and Sitka.

Amara hyperborea Dej.

Collected by Wosnessenski on St. Paul Island. Widely distributed in boreal America and boreal Asia.

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[1] Determined by Mr. M. L. Linell.

Family DYTISCIDAE.

Laccophilus decipiens Lec.

Collected by Wosnessenski on St. George. Widely distributed in western North America, occurring as far east as Kansas.

Family HYDROPHILIDAE.

Berosus maculosus Mannerheim.

Described from St. George Island; also recorded from Unalaska.

Cercyon lateralis Marsham.

Collected on St. Paul Island by Wosnessenski. Occurs along the Pacific coast of North America; also in Siberia and the more boreal part of Europe.

Family SILPHIDAE.

Lyrosoma opacum Mannh.

Collected on St. Paul Island by Wosnessenski. Also known from the Aleutian Islands, Bering Island, Copper Island, and Kamchatka.

Family STAPHYLINIDAE.

Hadrotus crassus Mannh.

Collected on St. George Island by Wosnessenski. A maritime species occurring along the coast as far south as California.

Tachinus apterus Mén.

Found on St. George Island by Wosnessenski.

Olophrum fuscum Grav. (*latum* Mäklin).

Found on St. George Island by Wosnessenski. Also known from the peninsula of Kenai, Alaska, Siberia, Caucasus Mountains, and in more boreal parts of Europe.

Family CHRYSOMELIDAE.

Chrysomela subsulcata Mannh.

Described from St. Paul Island (Wosnessenski), from which locality Messrs. True and Prentiss forwarded two specimens. Another specimen from the same collectors from St. George Island. This remarkable species seems to be peculiar to the Pribilof Islands.

Family AEGIALTIDAE.

Aegialites californica Motschulsky.

This remarkable species does not appear to be rare on St. Paul Island, for in the stomach of a shore bird, *Limosa lapponica* (shot on Walrus Island, 6 miles distant from St. Paul on June 20), which was examined at the Department of Agriculture in 1896, numerous specimens were found. The locality, "California," of the typical specimen in Motschulski's collection is extremely doubtful; the species is known to occur in the peninsula of Kenai and in Sitka.

II. HYMENOPTERA.

Family CHALCIDIDAE.

Tridymus capreae L.[1]

One specimen found in vial with ticks and lice found on the fur seal (Barrett-Hamilton). This is a common North European species and is parasitic in dipterous galls on willow.

Family ICHNEUMONIDAE.

Exolytus sp.[1]

Four specimens were collected by Mr. Barrett-Hamilton on St. Paul Island.

Pezomachus sp.[1]

Two specimens from St. Paul Island collected by Mr. Barrett-Hamilton.

Family APIDAE.

Mr. Elliott (Report on the Seal Islands of Alaska, p. 12) says: "The, to our eyes, familiar form of the bumblebee, *Bombus borealis*, passing from flower to flower, was rarely seen; but a few are resident here." The determination must be considered doubtful and the species may possibly be the *B. gelidus* Cresson, which has been described from the Aleutian Islands. It is possible, also, that several species of Bombus may occur on the Pribilof Islands.

III. LEPIDOPTERA.

Suborder LEPIDOPTERA RHOPALOCERA.

No species of this suborder seem to be recorded from Pribilof Islands and none were among the collections transmitted to the Museum, but Mr. Elliott (l. c.) remarks that "a very few species of butterflies, principally the yellow Nymphalidae, are represented by numerous individuals." The yellow butterflies referred to are unquestionably Papilionids of the genus Colias, several species of which are recorded from Alaska, viz, *C. hecla* Lef., *C. palaeno* Linn., *C. chippewa* Edw. The last-named species is almost sure to occur on the Pribilof Islands.

Suborder LEPIDOPTERA HETEROCERA.

None are recorded from the islands, though various families are undoubtedly represented. The Museum possesses only two specimens of an undetermined Arctiid larva collected by Barrett-Hamilton on St. Paul Island.

IV. Order DIPTERA.

No species have hitherto been described from the Pribilof Islands, but Mr. Elliott (l. c.) records some interesting notes on Diptera which are incorporated in the following list. Nine species of this order (besides a single larva) were collected by Mr. Barrett-Hamilton on St. Paul Island and have been determined by Mr. D. W. Coquillett.

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[1] Determined by Mr. William H. Ashmead.

Family CULICIDAE.

Arctic regions are notorious on account of the prevalence of mosquitoes, so that the absence of the pests on the Pribilof Islands, as noted by Mr. Elliott, is certainly a fact worth recording. He says: "Then, again, perhaps this is the only place in all Alaska where man, primitive and civilized, is not cursed by mosquitoes."

Family TIPULIDAE.

Trichocera sp.

A single specimen collected by Mr. Barrett-Hamilton. To this or an allied species I am inclined to refer the "gnat" mentioned by Mr. Elliott which "flits about in in large swarms, but it is inoffensive and seeks shelter in the grass."

Tipulid.

A single larva from Mr. Barrett-Hamilton's collection from St. Paul indicates a larger species than the Trichocera just mentioned.

Family MUSCIDAE.

Calliphora obscœna Eschscholtz.

Four specimens collected by Mr. Barrett-Hamilton; originally described from Unalaska from specimens found on the ocean beach. This is unquestionably the large flesh fly mentioned by Mr. Elliott, but quite incorrectly named by him *Bombylius major*. He says that it "appears during the summer and settles in a striking manner upon the backs of the loafing natives or strings itself in rows of millions upon the long grass blades which flourish over the killing grounds [of the seals], especially on the leaf stalks of the Elymus, causing this vegetation on the whole slaughtering field and vicinity to fairly drop to earth, as if beaten down by a tornado of wind and rain. It makes the landscape look as though it had molded in the night, and the fungoid spores were blue and gray." The larva lives, no doubt, in the carcasses of the slaughtered seals, and the species has enormously increased in individuals in consequence of the sealing industry on the islands.

The absence of the common house fly, *Musca domestica*, noted by Elliott, deserves mention.

Family CORDYLURIDAE.

Scatophaga squalida Meigen.

Three specimens collected by Mr. Barrett-Hamilton. Previously known from temperate and boreal Europe and North America.

Scatophaga diadema Wiedemann.

Three specimens collected by Mr. Barrett-Hamilton. Previously known from Montevideo (Uruguay) and Labrador.

Scatophaga dasythrix Becker.

Eleven specimens collected by Mr. Barrett-Hamilton. The type locality is "Bering Straits." No other locality is known for this species.

Scatophaga sp.

A single specimen collected by Mr. Barrett-Hamilton.

Blepharoptera pectinator Loew.

Two specimens collected by Mr. Barrett-Hamilton. Widely distributed throughout North America.

Family PHYCODROMIDAE.

Coelops frigida Fallen.

One specimen collected by Mr. Barrett-Hamilton. This is a maritime species previously known from Europe and the New England States.

Family BORBORIDAE.

Borborus annulus Walker.

One specimen collected by Mr. Barrett-Hamilton. Type locality, Albany River, Hudson Bay Territory.

V. HEMIPTERA.

Family CAPSIDAE.

Orthocephalus saltator Hahn.

A single specimen of the brachypterous form collected on St. Paul Island by Mr. Barrett-Hamilton. No other Hemiptera are recorded from the Pribilof Islands, though this order, and more especially the suborder Homoptera, is no doubt represented on the islands by a number of species. Mr. Elliott says "the Hydrocorisae occur in great abundance, skipping over the water in the lakes and pools everywhere," and from this statement we suppose that one or several of the aquatic families possessing the habit mentioned by Mr. Elliott are represented on the islands.

VI. NEUROPTERA.

Family PHRYGANEIDAE.

Limnophilus sp.

Two specimens from St. Paul Island, collected by Mr. Barrett-Hamilton.

Other species of the same family, as well as representatives of some other families of the old order Neuroptera, are no doubt represented on the islands. Elliott mentions "a single dragon fly, *Perla bicaudata*, flitted over the lakes and ponds of St. Paul." The determination is of course erroneous and the species is one of the Odonata.

VII. OPILIONIDA.

A single not yet determined specimen is among the collection of Mr. Barrett-Hamilton from St. Paul Island.

VIII. ARACHNIDA.

Family LYCOSIDAE.

Two species, *Lycosa septentrionalis* and *Pardosa pellita*, from St. George Island are recorded by Dr. Marx (Proc. Ent. Soc. Wash., II, pp. 196, 197), but have never been described.

Another undetermined species of this order from St. Paul, and represented by six specimens, was collected by Mr. Barrett-Hamilton.

IX. ACARINA.

By Prof. Herbert Osborn.

Haematopinus callorhini Herbert Osborn, new species. (Type, No. 3501, U.S.N.M.)

Head but slightly produced, less than a semicircle in front of the antennae, wider behind the antennae than in front; eyes inconspicuous or wanting; dorsal surface with a very strong basally swollen lateral bristle and a number of stiff shorter bristles or spines merging anteriorly into short blunt spines; posterior margin subangular and projected on to prothorax; beneath with long slender bristles posteriorly and short blunt spines anteriorly; antennae five-jointed, basal joint very large, succeeding joints gradually diminishing in size but of nearly equal length.

Fig. 1.

Thorax wider than long, concave in front and behind, lateral margins rather evenly arcuate; prothorax produced posteriorly, nearly reaching abdomen; sutures of pro- meso- and meta- thorax converging near posterior margin, posterior margin of meso- thorax strongly chitinous, surface bristly and spiny, meso- and meta- thorax each with larger bristles. No sternal plate, coxae wide apart, and surface of sternum scantily armed with short spines.

Abdomen widest near the middle, tapering to apex; set with short stiff spines and bristly hairs; the spiracles opening in small prominent tubercles; beneath with short spiny hairs.

Legs nearly uniform in size, middle and posterior ones slightly larger; middle and hind tarsal claws fitting into a semicircular cup on the spur of tibia.

Genitalia of male located dorsally, most apparent from above, where the chitinous structure is conspicuous, especially the two bars converging forward so as to form a triangle, from base of which, at apex of abdomen, the protruding penis and hooks appear as a second triangle. Length, 2 mm.

This species falls in *Haematopinus*, on account of the five-jointed antennae and structure of sternum, though approaching *Echinophthirius* in body covering. It is perhaps nearest *piliferus*, but stands pretty clearly by itself, and may doubtless be referred to a distinct subgenus.

Described from a number of examples from the northern fur seal, *Callorhinus ursinus*, from Pribilof Islands.

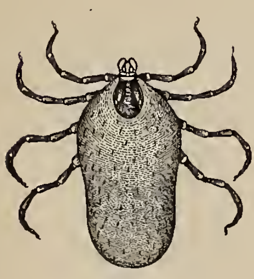

Fig. 2.

Ixodes arcticus Herbert Osborn, new species. (Type, No. 3500, U.S.N.M.)

Elongate oboval slightly contracted behind the middle, finely transversely striated; dorsal shield deep chestnut brown, oval except where truncated to join head; two divergent impressed lines or furrows from near the anterior margin to behind the middle, where they terminate abruptly, and external to which, near their ends, are short, impressed lighter marks, one on either side. Palpi rather short, blunt, truncate at apex, sharp edged, flat, and somewhat impressed above; legs blackish except the joints, long, strong. The dorsum of the expanded abdomen has two deep parallel furrows anteriorly and three posteriorly, and the ventral surface has the ordinary furrows of the genus, much as in *ricinus*. The color of the alcoholic specimens is a testaceous yellow. Length of expanded female, 6 mm. Length of dorsal shield, 1.25 mm.; width, 0.92 mm.

This species appears to be closely related to *Ixodes ricinus*, as determined for me by the late Dr. George Marx, but is larger; the dorsal shield is more perfectly oval and larger; the legs larger and much blacker; as also the head parts and the palpi are shorter, more truncate at apex, and the spiracle is located in a larger, blacker circle. These points, with its extreme difference in host, warrant its description as a distinct species. The description is from a single female which appears to be mature and fully expanded, but not distended to its full limit by development of eggs.

Both this tick and the louse described above seem to have been encountered heretofore, as I find in Allen's Monograph of the Pinnipedia (p. 352) the following, quoted from Elliott: * * * "The seal, in common with all animals, is preyed upon by vermin, a species of louse and a tick, peculiar to itself," but neither of them appears to have been technically described.

XXII.—LIST OF CRUSTACEA KNOWN TO OCCUR ON AND NEAR THE PRIBILOF ISLANDS

By Mary J. Rathbun.[1]

Second Assistant Curator, Division of Marine Invertebrates, U. S. National Museum.

The Crustacea occurring at the Pribilof Islands are by no means restricted to that archipelago. For example, of the Brachyura or true crabs, *Hyas coarctatus* and *Chionœcetes opilio* are circumpolar, while *Oregonia gracilis* and *Hyas lyratus* are very common in the North Pacific. The hairy crabs or horse crabs, *Telmessus* and *Erimacrus*, reach their fullest development in Bering Sea. The former, *T. cheiragonus*, was first recorded by Tilesius, the Russian naturalist, from specimens collected by Steller at Avacha Bay, Kamchatka, where it occurred in great abundance, and was used for food by the sailors. It extends southward to Oregon.

The three triangular anomuran crabs, *Lithodes brevipes*, *Dermaturus mandtii* and *Hapalogaster grebnitzkii* are distinctively Bering Sea species, inhabiting that body of water and the Aleutian Islands. Nine species of North Pacific hermit crabs (*Pagurus*) are known to inhabit the shores of the Pribilofs. Most of these are of recent discovery. Of the sixteen shrimps enumerated eight are circumpolar.

It is to be expected that a more thorough study of the lower forms of Crustacea will add many names to the list given below.

Oregonia gracilis Dana. 25 to 26 fathoms; U. S. Fish Commission.

Hyas coarctatus Leach. 20 to 62 fathoms; U. S. Fish Commission.

Hyas lyratus Dana. 25 to 62 fathoms; U. S. Fish Commission.

Chionœcetes opilio (O. Fabricius). 20 to 65 fathoms; U. S. Fish Commission.

Telmessus cheiragonus (Tilesius). St. Paul Island; Palmer and Elliott.

Erimacrus isenbeckii (Brandt). St. Paul Island; Palmer and Elliott. 29 to 41 fathoms; U. S. Fish Commission.

Lithodes brevipes Milne-Edwards. Young. St. Paul Island; Palmer and Elliott. 25 to 47 fathoms; U. S. Fish Commission.

Dermaturus mandtii Brandt. 25 fathoms; U. S. Fish Commission.

Hapalogaster grebnitzkii Schalfeew. 25 fathoms; U. S. Fish Commission.

Pagurus alaskensis Benedict. St. Paul Island.

Pagurus aleuticus Benedict. 56 to 65 fathoms; U. S. Fish Commission.

Pagurus brandti Benedict. 65 fathoms; U. S. Fish Commission.

Pagurus confragosus Benedict. 57 to 65 fathoms; U. S. Fish Commission.

Pagurus dalli Benedict. 26 fathoms; U. S. Fish Commission.

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[1] The lists of Anomura and Isopoda were made from specimens determined by Dr. James E. Benedict.

Pagurus rathbuni Benedict. 47 to 65 fathoms; U. S. Fish Commission.

Pagurus splendescens Owen. 41 to 62 fathoms; U. S. Fish Commission.

Pagurus trigonocheirus (Stimpson). 26 to 57 fathoms; U. S. Fish Commission.

Pagurus undosus Benedict. 20 fathoms; U. S. Fish Commission. St. Paul Island; Palmer and Elliott.

Crangon communis, sp. nov. 40 to 121 fathoms; taken at 31 stations by the U. S. Fish Commission steamer *Albatross*.

Allied to *C. crangon* (L.). The most noticeable differences are as follows: Two median spines on the carapace, considerably in front of the middle; rostrum longer, more slender and spatulate; eyes larger; first to fifth abdominal segments each with a transverse posterior smooth flattened crest; third to fifth segments with a similar median longitudinal crest; sixth segment with two prominent blunt longitudinal keels.

Dimensions of female.—Length of carapace from tip of rostrum, 16 mm.; width, 11 mm.; length of body from tip of rostrum to tip of telson, 64 mm.

Type locality.—Lat. 57° 4′ 20″ N., long. 170° 52′ 30″ W.; 51 fathoms, station 3441

Types.—U. S. Nat. Mus., No. 22826.

This species is one of the most abundant shrimps in Bering Sea. It can not be confused with *C. intermedia* Stimpson, in which the posterior of the median spines is at the middle of the carapace, and in which the first two abdominal segments have a median carina.

Crangon intermedia Stimpson. 32 to 34 fathoms; at 3 stations of the *Albatross*.

Sclerocrangon sharpi Ortmann. 54 fathoms; *Albatross*.

Nectocrangon lar (Owen). 33 to 368 fathoms; 36 stations of the *Albatross*.

Nectocrangon crassa, sp. nov. 17 to 34 fathoms; at 6 stations of the *Albatross*.

Allied to *N. alaskensis* Kingsley in having three spines on the median line of the carapace and a smaller spine or spinule just behind the rostrum. The carapace differs from that of *N. alaskensis* in being shorter and broader. All the abdominal segments are sculptured and keeled; the first to fifth have a blunt median keel, very short and hump-like in the first and second segments; the first three segments have transverse sulci; the keel of the fifth segment disappears toward the posterior margin; the sixth segment is much shorter than in *N. alaskensis;* its double keel is not continued to the posterior margin, and this margin is devoid of the sharp spines present in *N. alaskensis*.

Dimensions of female.—Length of carapace, 13 mm.; width, 10.5 mm.; length of body from tip of rostrum to tip of telson, 48.5 mm.

Type locality.—Lat. 57° 4′ N., long. 170° 24′ W.; 26 fathoms, station 3557.

Types.—U. S. Nat. Mus., No. 22827.

Spirontocaris spinus (Sowerby). 41 to 121 fathoms; at 13 stations of the *Albatross*.

Spirontocaris gaimardii (Milne-Edwards). 20 to 368 fathoms; at 17 stations.

Spirontocaris gibba (Kröyer). 50 to 52 fathoms; at 2 stations.

Spirontocaris barbata, sp. nov.

Carapace with two spines on the anterior margin, one below the eye, the other at the middle of the antenna. Dorsal carina extending to the posterior third of the carapace. Rostrum about one-third longer than the carapace; upper margin straight, armed with five teeth, one of which is on the carapace proper; distal two-fifths of upper margin unarmed; extremity acute; lower limb of slight depth and tapering from near the base to the tip, armed with about nine small teeth and denticles, diminishing in size and distance apart, toward the tip of the rostrum.

Inner antennæ about two-thirds length of rostrum. Scale of outer antennæ about seven-eighths length of rostrum. Maxillipeds reaching a little over one-half length of rostrum.

Abdomen with the fourth, fifth, and posterior half of the third segment carinated, the carina of each segment prolonged in a slender, sharp spine; carina of third segment with a subterminal hump; postero-lateral angle of fifth segment armed with a spine; posterior margin of the sixth segment armed with a median and lateral spine, also a spinule at the inferior angle.

Dimensions of female.—Length of carapace, to orbit, 12 mm.; length to tip of rostrum, 19.6 mm.; length of body from tip of rostrum to tip of telson, 74.5 mm.

Type locality.—Lat. 56° 18′ N., long. 169° 38′ W.; 86 fathoms, station 3497.

Type.—U. S. Nat. Mus., No. 22828.

Spirontocaris camtschatica (Stimpson). 20 fathoms; at station 3438, *Albatross*.
Spirontocaris macilenta (Kröyer). 39 fathoms; station 3511.
Spirontocaris avina, sp. nov.

Carapace with one anterior spine, below the eye; lower angle with a minute spinule. Anterior half of carapace dorsally carinated; a small spine at the anterior fifth; in front of this spine arises a thin arcuate crest which forms the chief part of the rostrum. Rostrum short, extending beyond the carapace about one third of its length, but not reaching the penult joint of the antennular peduncle; its lamellate crest, half of which is above the carapace, is armed with about thirteen small crowded spines; extremity beak-like, straight, slightly deflexed, acute, unarmed above, one or two teeth near the end below. Antennulæ extending considerably beyond the antennal scale. Antennal peduncle a little shorter than antennular peduncle; scale extending two-thirds its length beyond the rostrum. Maxillipeds slightly longer than antennal scale. Legs long and weak.

Abdomen smooth, not carinate; third segment produced over the fourth, posterior margin convex; posterior angle of fourth segment armed with a spinule; of fifth and sixth with a spine.

Dimensions of female.—Length of carapace, to orbit, 9 mm.; length of rostrum beyond posterior line of orbit, 3 mm.; length of body 35 mm.

Type locality.—North of Unalaska, lat. 54° 00′ 45″ N., long. 166° 53′ 50″ W.; 351 fathoms, station 3330.

Types.—U. S. Nat. Mus., No. 22829.

Spirontocaris polaris (Sabine). St. Paul Island (Brandt); William Palmer, June 21, 1890.
Pandalus borealis Kröyer. 36 to 121 fathoms; very abundant; taken at 34 stations by the *Albatross*.
Pandalus montagui Leach. 25 to 121 fathoms; taken at 22 stations· less abundant than the last.
Pandalus dapifer Murdoch. 36 to 50 fathoms; at 3 stations.
Rocinela belliceps (Stimpson). St. Paul Island; F. W. True.
Arcturus beringanus Benedict. 32 fathoms; U. S. Fish Commission.
Idotea ochotensis Brandt. Seal stomach. St. Paul Island; F. A. Lucas.
Synidotea biscuspida (Owen). 49 to 62 fathoms; U. S. Fish Commission.
Synidotea nebulosa Benedict. 32 fathoms; U. S. Fish Commission.
Anonyx nugax (Phipps). Seal stomach. St. Paul Island; F. A. Lucas.
Amphipoda of family **Lysianassidae**. Seal stomach. St. Paul Island; F. A. Lucas.
Branchipus sp. St. George Island; F. A. Lucas.

XXIII.—A LIST OF THE PLANTS OF THE PRIBILOF ISLANDS, BERING SEA. WITH NOTES ON THEIR DISTRIBUTION.

By James M. Macoun

Assistant Naturalist to the Geological Survey of Canada.

This list is believed to include all the plants that have been found on the Pribilof Islands since their discovery in 1786. The early travelers who made such complete collections on Unalaska and other islands of the Aleutian chain seem to have spent very little time on the Pribilof Islands, only 35 species being recorded from them in Ledebour's Flora Rossica. I have been able to find no record of any collection having been made there between the time of Chamisso and Eschscholtz and the purchase of Alaska by the United States. Mr. Charles Bryant, in 1875, made a large collection on the Pribilof Islands. A set of these plants is in the United States National Herbarium at Washington, and, I believe, in the Gray Herbarium also. In 1890 Mr. William Palmer collected about 100 species of flowering plants there, and many mosses and lichens. The phaenogams were determined by Mr. Theodor Holm, the mosses by Dr. Kindberg, the lichens by Mr. Calkins. In 1891 Dr. C. H. Merriam, one of the United States Bering Sea commissioners, made extensive collections (over 90 species) on both St. Paul and St. George islands, and in 1892 published a list of the plants he had collected.[1] In 1895 Messrs. F. W. True and D. W. Prentiss, jr., brought from the Pribilof Islands a very fine collection of flowering plants (90 species). Their specimens are the best I have seen from that region. They were determined by Dr. J. N. Rose and are in the National Herbarium at Washington.

My own collections were made in the years 1891, 1892, 1896, and 1897, principally on St. Paul Island, and comprise 182 species and varieties of phaenerogams and vascular cryptogams. In 1897 I had ample time at my disposal, and had then seen the collections of other visitors to the islands, so that I was able to greatly extend the number of species collected by me in former years. Reference is made in the text to the species that I failed to find. St. George Island has never been well botanized, and future collectors on that island will probably add many species to this list.

Through the courtesy of Mr. F. V. Coville and Dr. J. N. Rose, the curator and assistant curator of the United States National Herbarium, I have been enabled to examine all the Pribilof Island plants in that herbarium, and have admitted no species into the present list of which I have not seen specimens.

[1] Proceedings of the Biological Society of Washington, Vol. VII, pp. 133–150.

For the use of books from their private libraries and much kindly assistance in the preparation of this paper I have to thank my friends Dr. Edw. L. Greene, Mr. Theodor Holm, and my father, Prof. John Macoun. Mr. Holm's beautiful and correct figures of new species were made after a careful study of the plants they represent. Species which I considered new have been described by specialists, and other difficult species have been submitted to botanists who have made a special study of the groups to which they belong—the Carices to Messrs. Bailey, Kukenthal, Holm, and Wheeler, the grasses to Prof. Scribner—but I have in every instance given the result of my own work. Where I have failed to agree with others who have examined my specimens I have given the result of their investigation as well as my own.

Dr. Nils C. Kindberg. Dr. J. W. Eckfeldt, Pastor J. S. D. Branth, and Dr. C. Warnstoff have verified or corrected my determinations of the cryptogams.

BRIEF DESCRIPTION OF THE PRIBILOF ISLANDS WITH SPECIAL REFERENCE TO THEIR VEGETATION.

Dr. Merriam's description of the natural features of the Pribilof Islands is so good that I shall not attempt to improve upon it. He says:

> The Pribilof group in Bering Sea is about 350 kilometers (220 miles) north of the Aleutian chain and comprises the islands St. Paul and St. George, separated by about 64½ kilometers (40 miles) of sea, and two islets, known as Walrus and Otter islands, near St. Paul. St. Paul is the largest, measuring about 23½ kilometers (14 miles) in length by 12 kilometers (7½ miles) in greatest breadth. St. George is a little less than 19.3 kilometers (12 miles) in length by a little more than 8 kilometers (5 miles) in greatest breadth. The highest land is on St. George, where a precipitous cliff fronting the sea and a hill in the interior exceed 275 meters (900 feet). The highest land on St. Paul is a little over 183 meters (600 feet). The group is of volcanic origin and the general surface is rolling with precipitous cliffs along the water front in many places, alternating with broad valleys and basins. The cliffs predominate on St. George. In summer the islands are almost constantly enveloped in fog. The atmosphere is saturated (the wet and dry bulbs registering the same) and the temperature is uniformly low, the thermometer ranging from 7° C. (45° F.) to 9° C. (48° F.), or rarely 10° C. (50° F.).

The sandy shores and dunes of the Pribilof Islands support a very scant vegetation. *Cochlearia officinalis*, *Arenaria peploides*, and *Elymus mollis* are the characteristic species. *Lathyrus maritimus* and *Mertensia maritima*, though not rare, are far from common, and these five species are the only shore plants that were seen. A few plants that are not of general distribution grow on cliffs near the sea. Among these are *Draba hirta*, *Nesodraba grandis*, *Arabis ambigua*, *Sagina linnaei* and *Saxifraga bracteata*. Near the village on St. Paul Island and elsewhere on the lower levels on both islands the ponds and lakes are surrounded by mud flats, on which a number of species grow that are not found elsewhere. The commonest of these are *Ranunculus hyperboreus*, *Ranunculus reptans*, *Montia fontana*, *Stellaria humifusa*, and *Potentilla anserina*. *Chrysanthemum arcticum* is sometimes found with them, but is commoner in wet places on higher levels, especially on St. George Island.

The number of bog and marsh plants is very small, though many of the species that grow elsewhere are also found on the damp, boggy spots that are so characteristic of both islands. There is but one true bog on St. Paul Island, several on St. George. On these *Rubus chamaemorus*, *Saxifraga hirculus*, *Pedicularis sudetica*, and *Petasites frigida* grow in profusion, but they are all found on other parts of the island.

The greater part of the surface of both islands is tundra-like and much resembles the barren grounds of arctic America. The commonest plants throughout the wind-blown and elevated parts of the islands are *Silene acaulis*, *Arenaria macrocarpa*, and *Eritrichium chamissonis*, all forming cushions a foot or more in diameter, *Eutrema edwardsii*, *Papaver radicatum*, *Geum rossii*, *Potentilla villosa*, *Artemisia globularia*, *Campanula lasiocarpa*, *Pedicularis langsdorfii*, and *Pedicularis lanata*. On the more exposed places and of not nearly so general distribution are *Cardamine bellidifolia*, *Lychnis apetala*, *Chrysosplenium beringianum*, *Saxifraga davurica*, *Saxifraga serpyllifolia*, *Aster sibiricus*, and *Gentiana glauca*.

Grassy banks and upland meadows are frequent, generally near the sea, and on these grow many species that are not found on the bleaker and more elevated parts of the islands. Conspicuous among these are *Ranunculus altaicus*, *Ranunculus Eschscholtzii*, *Valeriana capitata*, *Taraxacum officinale* var. *lividum*, two species of *Polemonium* and *Pedicularis verticillata*. *Claytonia sarmentosa*, *Viola langsdorfii*, *Gentiana frigida*, and *Primula eximia* are sometimes found with the above species, but are more common in damp sheltered places among the rocks in the interior of St. Paul Island. On one bank near a little pond at the southwest end of St. Paul Island I found *Coptis trifolia*, *Geranium erianthum*, *Arnica unalaskensis*, and *Veronica stelleri*, not seen elsewhere on the Pribilof Islands.

There are many level areas of considerable extent on both islands, called by Dr. Merriam "moss-bogs," but no true bog plants are found on them, though the soil is saturated with water and covered with a thick carpet of moss, principally *Hypnum* and *Racomitriun*—little *Sphagnum*. No plants are found on these areas that do not grow on the higher and drier ground, though *Empetrum nigrum* is in such places more abundant than elsewhere.

Special reference has been made to but a small part of the whole number of species on the islands, but those named give, it is hoped, a general idea of the nature of the vegetation. Many of the commoner species have not been mentioned and no grasses or carices have been referred to, but the relative abundance, and generally the habitat, of each species is given elsewhere.

GEOGRAPHICAL DISTRIBUTION OF THE PHAENOGAMS AND VASCULAR CRYPTOGAMS KNOWN TO OCCUR ON THE PRIBILOF ISLANDS.

No part of this paper has been prepared more thoroughly and carefully than that showing the geographical distribution of the plants found on the Pribilof Islands. Some of the plants may have a wider range than I have indicated, but I have in all cases good authority for the occurrence of species in the districts I have referred them to. The authorities consulted will be found at the end of the list itself. This part of my paper was written in conjunction with Mr. Theodor Holm. Mr. Holm has collected from Greenland eastward to Nova Zembla, I from Labrador and Hudson Bay westward to Bering Straits and Kamchatka.

As will be seen from the list itself, the great majority of the plants found on the Pribilof Islands are circumpolar in their range, and in this respect the flora of the Pribilof Islands affords a marked contrast to that of the Commander Islands, in nearly the same latitude, on the west side of Bering Sea. Many of the species are the same on both groups of islands, but on the Commander Islands the number of species that are essentially Asiatic far exceeds the number of those on the Pribilof Islands that are distinctly American.

ANNOTATED LIST OF SPECIES.

PHAENOGAMS.

1. **Anemone richardsoni**, Hook.

Very abundant among moss and grass. Flowering in June and difficult to discover later in the season. Specimens collected with underground stems from 2 to 3 feet long.

2. **Ranunculus trichophyllus**, Chaix.

Found in only one locality on St. Paul Island—a small lake near the village. The water in this lake varies in depth in different years, and three forms have been collected there—the typical, the subterrestrial (var. *caespitosus*), and "the dwarf form with capillary, flabby leaves" (var. *confervoides*).

3. **Ranunculus hyperboreus**, Rottb.

Common by lakes and on mud flats on both islands. Generally associated with *Montia fontana*.

4. **Ranunculus pygmaeus**, Wahl.

St. Paul Island. Collected only by Mr. William Palmer.

5. **Ranunculus reptans**, L.

Common by ponds and lakes on both islands.

6. **Ranunculus pallasii**, Schl.

Growing in *Sphagnum* by a small pond on St. George Island.

7. **Ranunculus altaicus**, Laxm.

Common in upland meadows on both islands. The specimens from these islands have been generally referred to *R. nivalis*, but in the writer's opinion are not that species.

8. **Ranunculus eschscholtzii**, Schl.

Not rare on St. Paul Island on grassy banks where the snow lies late in the spring.

9. **Coptis trifolia**, Salisb.

Two specimens of this species were found in 1896 on a grassy bank near the south end of St. Paul Island.

10. **Aconitum delphinifolium**, DC.

From 3 or 4 inches high on bleak uplands to 2 feet high among grass near the sea level. Common on both islands.

11. **Papaver radicatum**, Rottb.
P. nudicaule, L. var. *arcticum*, Elkan.

Common on both islands. The flowers of this poppy are on the Pribilof Islands larger and more showy than I have seen them elsewhere. Murbeck has shown (fide Botaniske Litteraturblade, No. 13, p. 208) that the arctic poppy so generally referred to *P. nudicaule* is not that species.

12. **Papaver macounii**, Greene, Pittonia, Vol. III, p. 247. (Plate LXXXVIII.)

Perennial, scapose, the very stout scapes often a foot high in fruit, three or four times surpassing the tuft of leaves, hirsute hispid; leaves, even the petioles, comparatively devoid of hairiness, sometimes wholly glabrous; leaf outline ovate rather than obovate, the pinnae oblong lanceolate to almost linear; petals 4 (rarely 5), round obovate, erosdentate, often $1\frac{1}{2}$ inches long, yellow, fading greenish; pods 1 inch long, narrow, clavate oblong, 4 to 5 angled, hispid except on the prominent angles or ribs.

Easily distinct from all other boreal poppies by its narrow capsules, which are almost acute by the ascending position of the 4 or 5 rays of the stigma, thus approximating the scarcely tenable genus *Meconopsis*.

This beautiful poppy flowers about two weeks later than *P. radicatum*. It was while collecting the latter species in 1897 that the author's attention was attracted by the leaves of *P. macounii*, which differ in color as well as shape, etc., from those of *P. radicatum*. Visiting the same spot later, *P. radicatum* was found with ripened seeds, while *P. macounii* was only in flower. It was found in abundance later in the season on other parts of St. Paul Island.

13. **Corydalis pauciflora**, Pers.

Not uncommon on St. Paul Island, generally in moss. Flowering early it is soon hidden by grass and the foliage of other plants.

14. **Nasturtium palustre** DC.

Among Mr. Palmer's plants from St. Paul Island were specimens of this species. After carefully looking for it in all localities where it was likely to grow but without discovering it, I am forced to the conclusion that Mr. Palmer's specimens were collected elsewhere. As I may be mistaken in this, however, I include it in the list.

15. **Draba hirta**, L.
Draba incana, Merriam's List.

Common on the edges of cliffs and on sandy slopes, St. Paul Island.

16. **Draba wahlenbergii**, Hartm.

Rare on exposed hilltops on St. Paul Island.

17. **Nesodraba grandis**, Greene, Pittonia, Vol. III, p. 253. (Plate LXXXIX.)
Draba grandis, Langsdorff.

Peduncles about twice the length of the central tuft of leaves and 5 to 10 inches high; pods nearly 3 lines broad and from orbicular to oval, on ascending pedicels of one-half to three-fourths inch long.

Common on dampish rocks and cliffs on both islands.

This is without doubt *Cochlearia spathulata* DC., collected on St. George and St. Paul islands by Chamisso and Eschscholtz. Fruiting specimens are in general appearance much more like a Cochlearia than a Draba.

18. **Eutrema edwardsii**, R. Br.

Not rare on uplands; generally growing among moss

19. **Cochlearia officinalis**, L.

Common on both islands.

20. **Cardamine bellidifolia**, L.

Rare on the most exposed parts of the interior of both islands.

21. **Cardamine pratensis**, L.

Common by ponds on both islands.

22. **Cardamine umbellata**, Greene, Pittonia, Vol. III, p. 154. (Plate XC.)

Stems several, 10 to 20 inches high from slender horizontal rootstocks, erect, sparingly leafy to the summit, the herbage glabrous; all the leaves pinnate, the lowest with from 3 to 5 rounded or oval, the upper with 5 or 7 more elongated, leaflets, these all entire or very sparingly toothed; flowers few, small, white, often 3 to 5 only and from corymbose to subumbellate; stamens 6; pods erect (on pedicels of about one-half inch), about three-fourths line wide, three-fourths to 1 inch long including the prominent beak; valves not elastic; seeds about 8 or 9 under each valve, rather large.

Species somewhat nearly allied to the Californian *C. Breweri.*

Very common in damp places on both islands. Collected in a great variety of forms, according to habitat, but all answering well to Dr. Greene's description.

23. Cardamine hirsuta, L.

A small perennial plant much resembling the European *C. intermedia* has been referred here. It is rare on St. Paul Island.

24. Arabis ambigua, DC.

Not rare on gravelly, rocky, and sandy banks, St. Paul Island.

25. Viola langsdorfii, Fisch.

Common on hillsides and in depressions on both islands.

26. Viola palustris, L.

Rare on damp banks on St. Paul Island.

27. Silene acaulis, L.

Common on exposed hillsides on both islands.

28. Lychnis apetala, L., var. **glabra**, Regel.

Common on uplands on St. Paul Island. The St. Paul Island plants are widely different from typical *L. apetala* and probably constitute a good species.

29. Arenaria macrocarpa, Pursh.

Forming large cushions on the uplands on both islands.

30. Arenaria arctica, Stev.

With the last on St. Paul Island, but much more common.

31. Arenaria peploides, L.

Common on both islands.

32. Stellaria media, Smith.

Common on low grounds near the villages on both islands.

33. Stellaria borealis, Bigel.

S. crassifolia, Merriam's List.

Rather rare on St. Paul Island.

34. Stellaria borealis, Bigel, var. **corallina**, Fenzl.

Damp places on St. Paul Island. Common.

35. Stellaria calycantha, Bong.

Rather rare on St. Paul Island.

36. Stellaria longipes, Goldie, var. **laeta**, T. and G.

A few immature specimens of what I believe to be this variety were collected on St. Paul Island in 1891. Dr. B. L. Robinson, however, thinks them a form of *S. ruscifolia*, Willd.

37. **Cerastium alpinum**, L.

Common on both islands. Very variable, according to habitat. *C. arvense*, included in Dr. Merriam's list on the authority of Dr. Vasey, could not be found in the United States National Herbarium at Washington and has been excluded. The specimens so named were probably a form of *C. alpinum*.

38. **Sagina linnaei**, Presl.

Common on earth and rocks on both islands.

39. **Sagina nivalis**, Fr.

Rare on St. Paul Island.

40. **Sagina** ———.

A few specimens of a minute caryophyllaceous plant were collected on St. George Island by Mr. Trevor Kincaid in 1897. Dr. Robinson, to whom the specimens were submitted, decided that it was different from any caryophyll known to him, but the material was too poor to base a new species upon. Though thought by Dr. Robinson to be an *Arenaria*, I agree with Mr. Holm, who also examined the specimens, that they should be referred to *Sagina*.

41. **Claytonia sarmentosa**, C. A. Meyer.
C. arctica, Merriam's List.

Common on both islands, generally with *Viola langsdorfii*.

42. **Montia fontana**, L.

Common on mud flats and damp rocks on both islands.

43. **Geranium erianthum**, DC.

On a grassy bank by a pond near the south end of St. Paul Island.

44. **Lupinus nootkatensis**, Don.

One of the most conspicuous and characteristic plants on the Pribilof Islands.

45. **Lathyrus maritimus**, Bigel. var. **aleuticus**, Greene.

On beaches and among sand dunes on both islands.

46. **Rubus chamaemorus**, L.

In boggy places on both islands.

47. **Rubus stellatus**, Smith.

Upland meadows and on sandy soil on both islands.

48. **Rubus arcticus**, L.

Not so common as the last, but not rare on either island. Specimens easily separable from either species were collected in 1897, but as they may possibly be the result of hybridization between *R. arcticus* and *R. stellatus* no attempt to describe them has been made.

49. **Geum rossii**, Seringe.

Hillsides and uplands on both islands.

50. **Sibbaldia procumbens**, L.

Rare on exposed banks and in the interior of St. Paul Island.

51. **Potentilla anserina**, L.

By ponds and marshes on both islands.

52. **Potentilla fragiformis**, Willd. f. **villosa**, Pall.

Common on rocky banks on both islands.

53. **Potentilla emarginata**, Pursh.

Exposed hillsides on both islands.

54. **Comarum palustre**, L.

Marshy places and by bogs and ponds on both islands.

55. **Saxifraga hieracifolia**, Waldst. Kit.

Not uncommon in damp mossy places on both islands.

56. **Saxifraga davurica**, L.

Rare on exposed slopes on both islands.

57. **Saxifraga stellaris**, L., var. **comosa**, Poir.

Rare on high interior of St. George Island.

58. **Saxifraga nelsoniana**, Don.

A common and variable Saxifrage, generally referred to *S. punctata*, L., is found on shores and islands throughout the Bering Sea region, but a comparison of this plant with Morrison's figure, to which Linnaeus refers, shows that it is not *S. punctata.*

59. **Saxifraga serpyllifolia**, Pursh.
S. chrysantha, Merriam's list.

Not rare on exposed parts of interior of St. Paul Island.

60. **Saxifraga bracteata**, Don.

Common on damp rocks on both islands.

61. **Saxifraga hirculus**, L.

In boggy places, St. Paul Island.

62. **Saxifraga hirculus**, L., var. **alpina**, Engler, Mon. Sax., p. 124.

Low, 2 or 3 inches high, densely caespitose, the leaves broader than in the type, subspatulate, petals larger, deep yellow. With *Chrysosplenium beringianum* on the more exposed hillsides in the interior and toward the northwest end of St. Paul Island.

63. **Chrysosplenium beringianum**, Rose, Bot. Gaz., Vol. XXIII, p. 275. (Plate CXI.)

"Rootstock 2.5 to 5 cm. long (?), creeping, sending off many long fibrous roots; radical leaves and stems several, spreading and forming a dense rosette; radical leaves small; petiole slender, 1.3 to 4.5 cm. long, broader at base, the margins (especially below) ciliate with long purplish hairs; blade reniform, 6 to 11 mm. broad, 4 to 5-crenate, crenations sometimes gland-tipped, thickish, pale, and glabrous below, dark green and glabrous or somewhat pilose above; stem 2.5 to 5 cm. high, naked or bearing a single leaf below the involucre; involucral leaves several, entire or 3-crenate, extending beyond the flowers; calyx 5 to 6 mm. broad, 4-lobed, purplish or becoming so; sepals very broad, nearly orbicular, rounded at apex; disk very prominent, strongly 8-lobed; fruiting calyx turbinate, 1 mm. high; capsule 2-horned, 6 to 10 seeded; seeds oblong, 0.5 mm. long, shining, delicately reticulated.

This species has been confused with *C. alternifolium*, from which it appears to be abundantly distinct. *C. alternifolium* differs in its habit in lacking the thickish rootstocks and possessing only slender stolons and filiform roots; in its larger, usually much larger, leaves more numerous and generally double crenations, the smaller indentations containing a gland, or when simply crenate each crenation gland-tipped, thin, membranaceous in texture, (when dry) paler in color; petioles with margins usually glabrous but sometimes ciliate with a few white hairs.

Our form, which resembles *C. tetrandrum* in the size and shape of the leaves, has 8 stamens instead of 4, purple instead of greenish flowers, larger and definite seeds (6 to 10 instead of 30 to 50), stronger-lobed disk, and apparently differs also in its habit."

Abundant on disintegrated scoria in the interior of St. Paul Island.

64. **Chrysosplenium alternifolium**, L.

A few specimens were collected on St. George Island in 1897 by Mr. Trevor Kincaid.

65. **Parnassia kotzebuei**, Cham. and Schl.

Not rare on St. Paul Island.

66. **Hippuris vulgaris**, L.

Common on St. George Island, rarer on St. Paul Island.

67. **Epilobium clavatum**, Trelease.

Rather rare with *Gentiana tenella* on bare spots on low hills. The *E. anagallidifolium* of Dr. Merriam's list seems to be referable here.

68. **Epilobium behringianum**, Hausskn.

Not rare in damp, springy places on both islands.

69. **Epilobium spicatum**, Lam.

Not noted until 1897, when plants were found in several places on St. Paul Island. It is doubtful if it ever matures its seed there, as the only specimen seen in bloom was collected by Mr. Kincaid September 1, very soon after which date all plants are frozen.

70. **Ligusticum scoticum**, L.

Common in upland meadows and on hillsides on both islands.

71. **Selinum benthami**, Hook.

Common on both islands.

72. **Coeloplureum gmelini**, Ledeb.

Heracleum lanatum of Merriam's list.

Very abundant on both islands. The "poochka" of the natives on the Pribilof Islands, and eaten by them as *Heracleum lanatum* is eaten elsewhere.

73. **Cornus suecica**, L.

C. unalaskensis, Merriam's list.

Not rare on grassy and mossy slopes on either island.

74. **Galium trifidum**, L.

Wet banks of ponds on St. Paul Island.

75. **Valeriana capitata**, Pall.

Common in meadows and on damp, grassy slopes on both islands. *V. sylvatica*, recorded in Dr. Merriam's list as having been collected on St. Paul Island by Mr. Townsend, has been excluded.

76. **Aster sibiricus**, L.

Common in exposed places on St. Paul Island.

77. **Achillea millefolium**, L.

Common on both islands.

78. **Chrysanthemum arcticum**, L.

Low saline meadows and on damp uplands. Common on both islands.

79. **Artemisia globularia**, Cham.

Common on barren moors and hilltops on both islands.

80. **Artemisia novegica**, Fries, var. **pacifica**, Gray.

Common on both islands.

81. **Artemisia richardsoniana**, Bess.

Rare on St. Paul Island.

82. **Artemisia vulgaris**, L., var. **tilesii**, Ledeb.

Common on hillsides on both islands.

83. **Arnica unalaskensis**, Less.

A few plants in one locality near the south end of St. Paul Island.

84. **Petasites frigida**, Fries.

By all ponds and boggy places on both islands.

85. **Senecio pseudo-arnica**, Less.

Sandy shores and sand dunes on both islands.

86. **Taraxacum officinale**, Weber, var. **lividum**, Koch.

Common on grassy slopes and rocky banks on both islands.

87. **Campanula uniflora**, L.

Common among moss on the lower hills on St. Paul Island. *C. pilosa* of Merriam's list has been excluded, as no specimens could be found in the United States National Herbarium, and it has been reported by no one else.

88. **Campanula lasiocarpa**, Cham.

On grassy banks and uplands. Common on both islands and very variable. Small specimens collected in 1896 in general appearance are widely different from typical plants, but closer examination shows that except as to size they differ only in being less pilose on the calyx and less ciliate along the petioles.

89. **Pyrola minor**, L.

Rare on St. Paul Island.

90. **Armeria vulgaris**, Willd.

Common on both islands.

91. **Primula eximia**, Greene, Pittonia, Vol. III, p. 251. (Plate XCII.)

Rootstock simple; scape, 6 to 16 inches high, twice or thrice exceeding the foliage; spatulate-oblong or oblanceolate leaves thin, glabrous, entire or obscurely crenate or dentate; upper portion of the scape, and more particularly the pedicels, densely white-farinose; umbel few-flowered and somewhat one-sided, the flowers inclining one way; calyx cleft to the middle or a little more, the segments oblong-linear, scarcely acute;

corolla very large, rich black purple, its segments entire or somewhat erose, not emarginate. Usually referred to *P. nivalis*.

Very common on St. Paul Island, flowering a little later than *P. macounii*, but in bloom for a much longer period. Rarer on St. George.

92. **Primula macounii**, Greene, Pittonia, Vol. III, pp. 251 and 260. (Plate XCIII.)

Stouter than the last; the rootstock branched, and the scapes and leaf clusters thus tufted forming a mass; leaves obovate to oblanceolate, entire, glabrous, the inflorescence slightly glandular, but without a trace of farinose indument; umbels many-flowered and perfectly equilateral; calyx cleft well below the middle, its broad segments oval, or, if narrower, somewhat spatulate-oblong; corolla much as in the preceding, but of a lighter purple.

More nearly related to *P. parryi* than to *P. nivalis*. The foliage in this last is of much thinner texture, much more conspicuously veiny, even reticulately venulose, the reticulations showing central glandular dots. The dried leaf is so thin as to be perfectly translucent, and its margin is finely dentate, as Pallas's figure shows. But in *P. macounii* the leaves are thick, completely opaque when dry, scarcely veiny, not in the least reticulate or dotted; nor is there any trace of farinose indument.

Very abundant on St. George Island, flowering and maturing earlier than the last. In living plants the flowers are much lighter in color in *P. eximia* than in *P. macounii*, varying much, however, in dried specimens.

93. **Androsace villosa**, L.

Common on the slopes of the lower hills on both islands.

94. **Trientalis europaea**, L., var. **arctica**, Ledeb.

Never abundant, but found in many places on both islands.

95. **Gentiana tenella**, Rottb.

Rather rare on St. Paul Island. Found only on a few bare spots on low hills. Flowers ochroleucous or blue.

96. **Gentiana frigida**, Haenke.

Common on both islands.

97. **Gentiana glauca**, Pallas.

Rare on the most exposed places on both islands.

98. **Polemonium caeruleum**, L., var. **grandiflorum**, Ledeb.

Abundant on the slopes of the lower hills on both islands.

99. **Polemonium pulchellum**, Bunge, var. **macranthum**, Ledeb.

Often with the last, but also on the more exposed hillsides. White-flowered plants very common.

100. **Eritrichium chamissonis**, A. DC.

Common on St. Paul Island.

101. **Mertensia maritima**, Don.

Not rare along the seashore on both islands.

102. **Veronica serpyllifolia**, L.

Springy places, St. Paul Island.

103. Veronica stelleri, Pall.

Grassy banks by a pond near the south end of St. Paul Island.

104. Pedicularis verticillata, L.

Common on both islands.

105. Pedicularis sudetica, Willd.

Not rare about marshes on St. Paul Island.

106. Pedicularis langsdorfii, Fisch.

Hillsides and uplands on both islands.

107. Pedicularis lanata, Willd.

Common with the last on St. Paul Island.

108. Euphrasia officinalis, L.

One locality on St. Paul Island.

109. Gynandra gmelini, Cham. and Schl.

Rather rare on both islands.

110. Gynandra stelleri, Cham. and Schl.

Rare on St. Paul Island.

111. Koenigia islandica, L.

Rather rare on both islands

112. Polygonum viviparum, L.

Common on both islands.

113. Polygonum macounii, J. K. Small. (Plate XCIV.)

Perennial by a horizontal chaffy rootstock. Foliage bright green, glabrous or nearly so. Stems usually several together, 3 to 4 dm. tall, simple, leafy to the top; leaves basal and cauline; blades oblong, 5 to 12 cm. long, obtuse, more or less strongly revolute, sometimes minutely pubescent beneath, marginal nerves prominent; the basal and lower cauline leaves long petioled, the upper cauline short petioled or nearly sessile; ochreae very thin, 5 to 8 cm. long on the lower part of the stem, 1 to 4 cm. long on the upper parts; raceme 3 to 3.5 cm. long, short peduncled, the lower part producing numerous conic bulblets 5 to 6 mm. long, continuous; pedicels about 1 or 1.5 mm. long; ochreolae very thin, acute; perianth pink, 2 to 2.5 mm. long; segments oval or rhombic oval, obtuse; filaments strap shaped; ovary oval, 3-angled; styles 3-parted; achenes not seen. A remarkable species of Polygonum, in habit like a gigantic *P. viviparum.* Besides its much more robust habit, the compact raceme, with its large ocreolae and very small calices, serve as a ready means of distinguishing between the two species.

In boggy ground near a ditch on St. Paul Island.

Intermediate between *P. viviparum*, L., and *P. bistorta*, L.; perhaps a hybrid between these species or *P. viviparum* and *P. bistortoides*, Pursh, though differing widely from both and of much larger size than either. Mr. Holm's excellent drawing is of a small specimen; the average height is from 18 to 30 inches.

114. Polygonum bistorta, L.

By a little brook near Zapadni rookery, St. George Island. Specimens were not collected and, though recorded under the above name, the specimens seen were probably *P. bistortoides*, Pursh.

115. **Oxyria reniformis**, Hook.

Common in damp ravines or on damp spots on hillsides on both islands.

116. **Rumex acetosella**, L.

On sandy soil on St. Paul Island.

117. **Salix arctica**, Pall.

The common willow on both islands.

118. **Salix arctica**, Pall., var. **obcordata**, Anders.

Rarer than the last.

119. **Salix phylicoides**, And.

Collected on Bogoslov Hill by Dr. Merriam.

120. **Salix reticulata**, L.

Common on hillsides and uplands on both islands.

121. **Salix diplodictya**, Trautv.

Not rare on St. Paul Island. Determined by Mr. P. A. Rydberg.

122. **Salix ovalifolia**, Trautv.

Rare on St. Paul Island.

123. **Salix rotundata**, Rydberg MS.

A little willow, very abundant on a hillside near the village on St. Paul, has been collected there every year since 1891. Mr. M. S. Bebb determined specimens collected in 1891 and 1892, and wrote that he believed them to be intermediate between *S. rotundifolia* and *S. ovalifolia*. Mr. Theo. Holm, who examined specimens collected in 1897, considered them to be *Salix retusa*, L., forma, *rotundifolia*, Trautv., while Mr. P. A. Rydberg believes them to be new. Lundström, to whom specimens were sent, has at this writing not yet reported on them. This is, I believe, the same plant of which Mr. Bebb wrote Dr. Merriam "intermediate between *S. arctica* and *S. ovalifolia*—may possibly be a hybrid." I can not think it a hybrid. Distributed from the herbarium of the Geological Survey of Canada as No. 16645.

124. **Empetrum nigrum**, L.

Common on both islands.

125. **Streptopus amplexifolius**, DC.

In ravines on both islands.

126. **Fritillaria kamtschatcensis**, Ker.

In wet ground, generally by rivulets and brooks. Common on St. George Island; in one locality only (Tolstoi) on St. Paul Island.

127. **Lloydia serotina**, Reich.

Very abundant on parts of St. Paul Island, but flowering early and soon hidden by grass.

128. **Juncus balticus**, Deth., var. **haenkii** (Mey.), Fr. Buch.

Common in marshy places on both islands.

129. **Juncus biglumis**, L.

Not rare on either island.

130. **Luzula arcuata**, Hook., var. **unalaschkensis**, Fr. Buch.

Exposed hilltops on both islands.

131. **Luzula confusa**, Lindb., var. **latifolia**, Buch.

With the last, but also on lower levels on both islands.

132. **Luzula campestris**, Desv., var. **multiflora**, Celakovsky.
L. campestris, var. *sudetica*, Merriam's list.

Same distribution as the last, but not quite so abundant.

133. **Potamogeton filiformis**, Pers.

In a shallow pond on St. Paul Island.

134. **Eriophorum polystachyon**, L.

In boggy places on St. Paul Island.

135. **Eriophorum vaginatum**, L.

Bogs on St. George Island.

136. **Carex leiocarpa**, C. A. Meyer.

On boggy tundra on St. George Island. Not rare. On a grassy bank near a pond on St. Paul Island.

137. **Carex pyrenaica**, Meyer.

Young plants of what I believe to be this species were found growing with the last on St. Paul Island. My plants answer well enough to Meyer's description of *C. micropoda*, which, according to Boott, is identical with *C. pyrenaica*. Herb. No. 16611.

138. **Carex norvegica**, Schk.

Collected on St. Paul Island by Dr. Merriam.

139. **Carex lagopina**, Wahl.

Common on both islands. The var. *gracilescens* in bogs.

140. **Carex lagopina**, Wahl., var. **longisquama**, Geo. Kukenthal.

Spikes, 4 to 6, more elongate than in typical *C. lagopina*. Scales a little longer than the perigynia, broadly hyaline on the margins. Mossy uplands, St. Paul Island. Herb. No. 16620.

141. **Carex pribylovensis**, J. M. Macoun.

Culm, 30 to 40 cm. high; spikes, 3 to 4; ovate, roundish in a dense head; utriculus broadly ovate, very shortly beaked; scales broad and almost obtuse, a little shorter than the utriculi. Intermediate between *C. lagopina* and *C. glareosa*, to the latter of which species this plant has been referred by Professor Bailey. Herb. No. 16609.

142. **Carex gmelini**, Hook.

Common on both islands.

143. **Carex vulgaris**, Fries.

An almost typical form of this species is common on low flats where water lies late in the spring. Specimens nearly approaching the var. *turfosa*, Fries (Herb. No. 16612), were collected in a marsh on St. Paul Island. These have been identified as *C. vulgaris* var. *hyperborea* by Professor Bailey and *C. limula* by Mr. Kukenthal. The rhizome strong; scales black; perigynium nerveless; and in these respects they agree with *C. limula*, Fries, but the leaves are narrower and the short-peduncled spikes erect.

144. Carex salina, Wahl.

This species, in one or other of its many forms, is common on both islands. The commonest of these is *C. salina*, subsp. *cuspidata*, Wahl., var. *haematolepis*, Drej., which grows everywhere on grassy uplands. The form *thulensis*. Th. Fries (Herb. No. 16618), was collected in a slightly saline marsh. With it grew the var. *subspathacea*, Wormskj. (Herb. No. 16619). The varietal determinations given above were made by Mr. Kukenthal.

The *Carex rigida bigelovii* of Dr. Merriam's list I believe to be this species, though I have not seen his specimens.

145. Carex cryptocarpa, C. A. Meyer.

Common on both islands.

146. Carex macrochaeta, C. A. Meyer.
C. podocarpa, R. Br.

Common on both islands; the form *gracilior* found in one locality only.

147. Carex macrochaeta, C. A. Meyer, var. **subrigida**, Geo. Kukenthal.

Low, culm and leaves rather broad and very rigid, the leaves longer than the culm; the lowest spike female at the base; all the spikes longer and much narrower than in the type, club-shaped, rather loose-flowered toward the base; scales hardly or not at all aristate. Herb. No. 16615.

Perhaps a hybrid between *C. macrochaeta* and *C. haematolepis*, though as these species belong to two different sections and there.is little evidence of hybridization apart from the general appearance of the plant, I prefer to adopt the name given it by Mr. Kukenthal.

148. Carex membranopacta, Bailey, Bull. Torr. Bot. Club, Vol. XX, p. 428, 1893.

Very abundant in a large depression around a pond on St. Paul Island. This carex, at least where found by me, grows in clumps and is decumbent in habit, covering an area of from 24 to 30 inches in diameter. Dried specimens give no hint that the plant is not erect in habit; but the fact is that on St. Paul Island, at least, it lies flat on the ground, even when very young. At maturity the whole plant is frequently covered by the surrounding herbage. Herb. No. 16608, distributed as *C. compacta*, R. Br. The *C. saxatilis* of Dr. Merriam's list I take to be this species.

149. Carex rariflora, Smith.

Collected by Mr. Palmer on St. Paul Island.

150. Hierochloa borealis, R. and S.

Not rare on either island.

151. Hierochloa pauciflora, R. Br.

Rare on St. Paul Island.

152. Alopecurus alpinus, Smith.

Common on both islands.

153. Alopecurus howellii, Vasey, var. **merriami**, Beal.

On bare ground that has been used as hauling grounds by seals. Grows in dense clumps; decumbent in habit. Not seen elsewhere than on dry, bare ground.

154. **Phleum alpinum**, L.

Common on both islands.

155. **Phippsia algida**, R. Br.

Collected on St. Paul Island by Mr. Palmer in 1891, and a few specimens by myself on the same island in 1897.

156. **Arctogrostis latifolia**, Griseb.

Common on both islands.

157. **Arctogrostis latifolia**, Griseb., var.

Plants referred here were named *A. arundinacea* (Trin.) by Professor Scribner, but I can not agree with him that they are that species. In default of sufficient European material for comparison I prefer to leave my plant without a name for the present. Herb. No. 16632.

158. **Calamagrostis purpurascens**, Vasey.

Rare on St. Paul Island. Named *C. arctica* by Vasey in 1892.

159. **Calamagrostis deschampsioides**, Trin.

Very abundant where found, but local in its distribution.

160. **Deschampsia caespitosa**, Beauv., var. **arctica**, Vasey.

Very abundant on both islands.

161. **Trisetum subspicatum**, P. B.

Very abundant on both islands.

162. **Poa arctica**, R. Br.

Variable but common on both islands.

163. **Poa caesia**, Smith.

A form of this species was collected on St. George Island.

164. **Poa glumaris**, Trin.

Rare on St. Paul Island.

165. **Dupontia psilosantha**, Rupr.

Common in marshes on both islands.

166. **Arctophila effusa**, Lange.

Not rare on either island. The *A. fulva* of Dr. Merriam's list differs somewhat from other specimens collected on the Pribilof Islands, but seems to be this species.

167. **Glyceria angustata**, Fries.

Common on both islands, particularly in the vicinity of the seal rookeries and hauling grounds.

168. **Glyceria vilfoidea**, (Andn.) Fries.

Abundant on saline mud flats, but no flowering plants found. Not before known from Alaska.

169. **Festuca rubra**, L.

Common on both islands, but variable, the var. *barbata*, Hack., being very rare, and a form near *F. richardsoni* hardly less so.

170. **Festuca ovina**, L., var. **violacea** (Gaud.), Griseb.

Common on sandy soil on St. Paul Island.

171. **Elymus mollis**, Trin.

Very common on both islands.

172. **Elymus villosissimus**, Scribn.

Culms stout, 3 dm. high, from creeping root-stocks; leaves of sterile shoots narrow, as long as the culm; leaves of the culm comparatively short (6 to 13 cm.) and broad (6 to 10 mm.). Spikes ovate-oblong, 5 to 6 cm. long. Spikelets densely villous, 15 to 20 mm. long, 2 to 3 flowered. Empty glumes narrowly lanceolate, acuminate, 3-nerved, about as long as the florets, densely silky villous on the back. Third glume, 12 to 15 mm. high, 9-nerved, ovate-lanceolate, acute. Palea about as long as the glume, 2-toothed, hairy on the sides and back, ciliate on the keels, rachilla densely pubescent.

Common in depressions on grassy uplands. Growing with *Valeriana capitata*, *Viola langsdorfii*, *Rubus stellatus*, and such plants.

173. **Equisetum arvense**, L.

Common on both islands.

174. **Equisetum scirpoides**, Michx.

Common on both islands.

175. **Equisetum variegatum**, Schleich.

Abundant at the north end of St. Paul Island.

176. **Botrychium lunaria**, Swartz.

Rare among sand dunes on St. Paul Island.

177. **Phegopteris polypodioides**, Fée.

Collected on St. George Island by Messrs. True and Prentiss, and on St. Paul by Mr. Palmer.

178. **Asplenium filix-foemina**, Bernh.

Not rare in the interior of St. Paul Island.

179. **Aspidium spinulosum**, Swartz, var. **dilatatum**, Hook.

Common on both islands.

180. **Aspidium filix-mas**, Swartz.

Rare on St. George Island.

181. **Cystopteris fragilis**, Bernh.

Common on both islands.

Two ferns, *Polypodium vulgare*, L., and *Aspidium lonchitis*, Swartz, supposed to have been collected on the Pribilof Islands by Mr. C. H. Townsend, are included in Dr. Merriam's list, but as the specimens are not in the United States National Herbarium and no one else has collected these species on the Pribilof Islands, they have been excluded from this list. They are both common at Unalaska.

182. **Lycopodium selago**, L.

Common on both islands.

183. **Lycopodium alpinum**, L.

Rocky uplands on St. Paul Island.

184. **Lycopodium annotinum**, L., var. **pungens**, Spreng.

Barren uplands on St. Paul Island.

MUSCI.

Sphagnum fimbriatum Wils., var. **arcticum**, C. Jensen.

This variety and the form *fuscescens*, Warnst., recorded by Dr. Merriam. No locality. St. Paul Island. (J. M. Macoun.)

Sphagnum girgenshonii, Russ.

Boggy spots, St. George Island. (J. M. Macoun.)

Sphagnum lindbergii, Schpr., var. **microphyllum**, forma **brachydasyclada** Warnst.

Recorded by Dr. Merriam. No locality. St. Paul Island. (J. M. Macoun.)

Sphagnum riparium, Aongstr.

Bogs, St. George Island. (J. M. Macoun; Dr. Merriam.)

Sphagnum squarrosum, Pers., var. **imbricatum**, Schp.

Bogs, St. George Island. (J. M. Macoun.) Dr. Merriam records the form *brachyanoclada* Warnst. No locality.

Sphagnum squarrosum, Pers., var. **semi-squarrosum** Russ.

St. Paul Island. (J. M. Macoun.) St. George Island. (J. M. Macoun; Dr. Merriam.)

Dicranoweisia crispula, Lindb.

On rocks, St. Paul Island. (J. M. Macoun; Palmer.)

Oncophorus wahlenbergii, Brid.

On the ground, St. George Island. (Dr. Merriam; J. M. Macoun; Palmer.)

Dicranella rufescens, Schimp.

On earth, St. Paul Island. (J. M. Macoun.)

Dicranum molle, Wils.

Crevices of rocks, St. Paul Island. (J. M. Macoun.)

Dicranum strictum, Schleich.

St. Paul Island. (J. M. Macoun.)

Dicranum elongatum, Schleich.

St. Paul Island. (Dr. Merriam.)

Campylopus schimperi, Milde.

On rocks, St. Paul Island. (J. M. Macoun.)

Ceratodon purpureus, Brid.

On earth, St. Paul Island. (Dr. Merriam; J. M. Macoun; Palmer.)

Ceratodon heterophylla, Kindb. Ott. Nat., Vol. V, p. 179.

Agrees with *Ceratodon purpureus* in the shape of the capsule and the stem leaves, the not excurrent costa and the revolvable annulus, but the capsule is often more curved and distinctly strumose; agrees with *Ceratodon conicus* (Hampe.) in the peristomial teeth having few articulations; differs from both in the blunt perichetial leaves; is also very peculiar in the short, concave, suboval leaves of the long shoots.

Common on earth, St. Paul Island. (J. M. Macoun.) First collected in 1891.

Didymodon baden-powellii, Kindb. Ott. Nat., Vol. V, p. 179.

Differs from *Didymodon rubellus* in the dioecious inflorescence, the blunt, conic, very short lid, scarcely one-fifth of the capsule, and the distinctly dentate leaves (as in *Didymodon alpigenus*, Vent.). The tufts are compact, about 2 cm. high, the leaves revolute nearly all around, short-acuminate, the lower pale brown, perichetial ones longer acuminate or subulate entire. The capsules are (unripe) more or less curved, the pedicel pale red.

St. Paul Island. (J. M. Macoun.) First collected in 1891

Desmatodon latifolius, Brid.

St. Paul Island. (Palmer.)

Desmatodon systilius, Br. and Sch.

St. Paul Island. (Dr. Merriam.)

I have seen neither Mr. Palmer's nor Dr. Merriam's specimens of *Desmatodon*, but believe them to be both *D. latifolius* which *D. systilius* nearly approaches. *D. latifolius* is common at Unalaska.

Grimmia apocarpa, Hedw.

On rocks, St. Paul Island. (J. M. Macoun.)

Racomitrium lanuginosum, Brid.

On rocks, St. Paul Island. (Dr. Merriam; Palmer; J. M. Macoun.)

Racomitrium microcarpum, Brid.

St. Paul Island. (Dr. Merriam.) Probably the next.

Racomitrium microcarpum, Brid., var. **palmeri**, Kindb.; Macoun, Cat. Can. Plants, Vol. VI, p. 267.

Differs in the leaves being long-subulate, hairless, the upper cells longer and more confluent, the alar ones large and rectangular, the capsule shorter pedicellate. Differs also from the related *Racomitrium sudeticum* in the deeply cleft peristomial teeth, the narrow leaf cells, etc. (Palmer; J. M. Macoun.) First collected by Mr. Palmer in 1890.

Orthotrichum laevigatum, Zelt.

Rocks, St. Paul Island. (Dr. Merriam; J. M. Macoun.)

Orthotrichum microplephare, Schimp.

St. Paul Island. (Dr. Merriam.)

Tetraplodon mnioides, Br. and Sch.

Wet banks, St. Paul Island. (Dr. Merriam; J. M. Macoun.)

Splachnum wormskioldii (Horne.), Kindb.

St. George Island. (J. M. Macoun.)

Bartramia ithyphylla, Brid.

Crevices of rocks, St. Paul Island. (Dr. Merriam; J. M. Macoun.)

Bartramia pomiformis, Hedw.

St. Paul Island. (Palmer.)

Philonotis fontana, Brid.

St. Paul Island. (Dr. Merriam; J. M. Macoun.)

Webera polymorpha, Schimp. var. **brachy carpa**, Kindb.

Crevices of damp rocks, St. George Island. (J. M. Macoun.)

Webera microcaulon, C. M. and Kindb.

St. George Island.

Webera nutans, Hedw.

On earth, St. Paul Island. (J. M. Macoun; Palmer.)

Webera cucullata, Schimp.

Crevices of rocks, St. Paul Island. (Dr. Merriam; J. M. Macoun.)

Webera canaliculata, C. M. and Kindb. var. **microcarpa**, Kindb.

Separated from the species only by its smaller capsule. St. Paul Island. (J. M. Macoun.)

Webera cruda, Schimp.

Crevices of rocks, St. Paul Island. (J. M. Macoun; Palmer.)

Webera albicans, Schimp.

On rocks, St. Paul Island. (J. M. Macoun.)

Bryum arcticum, Br. and Sch.

St. Paul Island. (Dr. Merriam.)

Bryum pendulum, Schimp.

On rocks, St. Paul Island. (Dr. Merriam; J. M. Macoun.)

Bryum inclinatum, Br. and Sch.

St. Paul Island. (Dr. Merriam.)

Bryum froudei, Kindb., Ott. Nat., Vol. V, p. 180.

Habit of *Webera nutans*. Agrees with *Bryum inclinatum* in the synoecious inflorescence and the symmetric capsule, etc.; differs in the leaves being long-acuminate, cells long and narrow, the upper sublinear (nearly as in *Webera*), costa very long-excurrent, peristomial segments quite free from the teeth, spores smaller, scarcely 0.02 mm.; the cilia are wanting.

Crevices of rocks, St. Paul Island. (J. M. Macoun.) First collected in 1891.

Bryum brachyneuron, Kindb., Ott. Nat., Vol. V, p. 180.

Agrees with *Byrum pendulum* in the synoecious inflorescence, the peristomes orange, the segments adhering to the teeth, the apiculate lid and the large spores (about 0.04 mm.); differs in the decurrent leaves, short-ovate, the costa broad, abbreviate, not excurrent, the sterile shoots bearing globose buds (gemmae), the very much broader peristomial teeth. Stem red, very short, the pedicel about 1 cm. long or shorter, often scarcely emerging above the tufts; costa of the lowest leaves red, percurrent only in the leaves of the shoots and the perichetial ones; capsule ventricose, short-necked constricted below the mouth. *Bryum fallax*, Milde., resembling it in habit, is dioecious; the segments are free, the spores smaller. *Bryum lacustre* differs in not having decurrent leaves, the capsule not being constricted below the mouth, the pedicel longer, the peristome pale, etc.

Crevices of rocks, St. Paul Island. (J. M. Macoun.) First collected in 1891.

Bryum argenteum, L.

Common on earth, St. Paul Island. (J. M. Macoun.)

Bryum obtusifolium, Lindb.

St. Paul Island. (Palmer.)

Bryum erythrophyllum, Kindb.

St. Paul Island. (Palmer.)

Mnium subglobosum, Br. and Sch.

St. Paul Island. (Dr. Merriam.)

Psilopilum arcticum, Brid.

Common on earth on St. Paul Island. (J. M. Macoun; Palmer.)

Pogonatum dentatum, Brid.

On earth, St. Paul Island. (J. M. Macoun.)

Pogonatum alpinum, Roehl.

On earth and rocks, St. Paul Island. (Dr. Merriam; Palmer; J. M. Macoun.)

Pogonatum alpinum, Roehl. var. **septentrionale**, Brid.

On rocks, St. Paul and St. George islands. (J. M. Macoun.)

Pogonatum alpinum, Roehl. var. **microdontium**, Kindb.

Separated from the species by its nearly entire or indistinctly denticulate leaves. St. Paul Island. (Palmer; J. M. Macoun.)

Polytrichum strictum, Banks.

St. Paul Island. (Dr. Merriam.) Perhaps the next.

Polytrichum boreale, Kindb.

Differing from the nearly allied *P. hyperboreum* principally in the leaves being distinctly dentate above; the apex hyaline in the upper part, red in the lower.

St. Paul Island. (J. M. Macoun.)

Brachythecium albicans, Br. and Sch.

St. Paul Island. (Palmer.)

Brachythecium rivulare, Br. and Sch.

St. Paul Island. (Dr. Merriam.)

Eurhynchium vaucheri, (Schimp.).

On rocks, St. George Island. (J. M. Macoun.)

Plagiothecium pulchellum, Br. and Sch.

On other moss. St. Paul Island. (J. M. Macoun.)

Hypnum uncinatum, Hedw.

St. Paul Island. (J. M. Macoun.)

Calliergon cordifolium, Hedw.

St. Paul Island. (J. M. Macoun.)

Hylocomium splendens, Schimp.

St. Paul Island. (Dr. Merriam; Palmer.)

Hylocomium alaskanum, Schimp.

St. Paul Island. (J. M. Macoun.)

Hylocomium squarrosum, Schimp.

St. Paul Island. (Dr. Merriam; Palmer; J. M. Macoun.)

Hylocomium triquetrum, Schimp.

St. Paul Island. (Dr. Merriam; Palmer.)

HEPATICAE.

Diplophyllum taxifolium, Nees.

St. Paul Island. (Dr. Merriam; J. M. Macoun.)

Herberta adunca, S. F. Gray.

St. Paul Island. (Dr. Merriam.)

Gymnomitrium coralloides, Nees.

St. Paul Island. (Dr. Merriam; J. M. Macoun.)

LICHENS (COLLECTED BY J. M. MACOUN).

Ramalina cuspidata, (Ach.).

On rocks and earth, St. Paul Island. *Gracilis; altitudo* 4 to 7 cm.; sporae, 10 to 14 mik.

Ramalina polymorpha, Ach.

On rocks, St. Paul Island. *Neque haec neque praecedens kalio coloratur.*

Cetraria aculeata, (Schreb.), Fr.

On earth, St. Paul Island.

Cetraria arctica, (Hook.).

On earth, St. Paul Island.

Cetraria islandica, (L.) Ach.

Very common and variable on both islands; the forms *gracilis* and *robusta* growing with the type.

Cetraria islandica var. **delisoei**, (Bor.).

Common on St. Paul Island.

Cetraria cucullata, (Bell.), Ach.

On earth, St. Paul Island.

Cetraria nivalis, (L.), Ach.

On earth on both islands.

Cetraria fahlunensis, (L.), Schaer.

On rocks, St. Paul Island.

Cetraria lacunosa, Ach.

On rocks and earth on both islands.

Alectoria jubata, (L.), var. **chalybaeformis**, Ach.

On earth on rocks, St. Paul Island.

Alectoria divergens, Wahlenb.

Mixed with the last. *Medula chlorcalcio rubescit.*

Alectoria thulensis, Fr. Fries.

Common on earth on both islands.

Theloschistes lychneus, (Nyl.), var. **pygmaeus**, Fr.

Rare on rocks, St. Paul Island.

Parmelia saxatilis, (L.) Fr.

Common on rocks and earth on both islands; frequently found abnormally colored from red-brown to a beautiful violet. An isidiferous form on earth, St. George Island.

Parmelia saxatilis, (L.), Fr., var. **sulcata**, Nyl.

On rocks, St. George Island.

Parmelia physodes, Ach., var. **vittata**, Ach.

On earth, St. Paul Island.

Umbilicaria rugifera, Nyl.

On rocks on both islands, Nos. 27 and 28. *Chlorcalcio stratum corticale alterius speciminis rubescit, alterius non mutatur.*

Umbilicaria cylindrica, (L.), Delis., var. **delisoei**, Despa.

On rocks on both islands.

Umbilicaria erosa, Ach.

On rocks on both islands.

Umbilicaria proboscidea, (L.), Stenh.

On rocks on both islands.

Sticta linita, Ach.

On damp rocks, St. Paul Island.

Peltigera apthosa, (L.), Hoffm.

On and in wide crevices of damp rocks on both islands.

Peltigera canina, (L.), Hoffm.

On moss on both islands.

Peltigera canina, (L.), var. **spongiosa**, Tuck.

With the last, but not so common.

Peltigera canina, Hoffm., var. **spuria**, Ach.

In a dense tuft of moss which it divided, St. Paul Island.

Solorina crocea, (L.), Ach.

On earth and rocks, St. Paul Island,

Pannaria brunnea, (Sw.), Mass.

On earth and rocks, St. George Island.

Placodium elegans, (Link.), DC.

Rare on rocks, St. Paul Island.

Lecanora ventosa, (L.), Ach.

On rocks, St. George Island.

Lecanora tartarea, (L.), Ach.

Common and variable on rocks on both islands.

Lecanora tartarea, Ach., var. **frigida**, (Sw.).

Common on rocks, St. Paul Island.

Lecanora oculata, (Dicks.), Ach.

On rocks, St. Paul Island.

Lecanora oculata, (Dicks.), Ach., var. **gonatodes**, Ach.

On rocks, St. Paul Island. *Crusta Lecanora tartariac, kalio lutescit et chlorcalcio rubescit.*

Lecanora saxicola, Schaer.

Specimens which may prove to represent a new species have been provisionally referred here by Mr. Branth.

Pertusaria Sp. (?).

On rocks, St. George Island.

Pertusaria panygra (Ach.) Th. Fr.

On rocks, St. Paul Island. *Sporae solitariae 160 to 190 mik. long., 30 to 60 mik. lat.* (*Frustulum alterum ita alterum alia crusta.*) *Thallus e kalio fere immutatus.*

Stereocaulon coralloides, Fr.

On rocks, St. Paul Island.

Pilophorus robustus, Tuck.

Under overhanging rocks, St. Paul Island.

Cladonia alcicornis, Floerk.

Under damp overhanging rocks, St. Paul Island.

Cladonia decorticata, Floerk.

On earth and rocks, St. Paul Island.

Cladonia pyxidata, (L.), Fr.

On earth on both islands.

Cladonia degenerans, Tuck.

On earth, St. Paul Island.

Cladonia gracilis, (L.), Nyl. var. **elongata**, Fr.

Rare on St. Paul Island. The form *macroceras*, Tuck., is still rarer.

Cladonia furcata, Huds. var. **racemosa**, Fl.

On earth on both islands.

Cladonia furcata, Huds. var. **subulata**, Fl.

On earth on both islands.

Cladonia rangiferina, Hoffm.

Common on earth on both islands.

Cladonia rangiferina, Hoffm. var. **sylvatica**, L.

On earth, St. George Island.

Cladonia rangiferina, Hoffm. var. **alpestris**, L.

Common on earth on both islands.

Cladonia uncinalis, Fr. var. **turgescens**, Fr.

On earth, St. Paul Island.

Cladonia cornucopioides, (L.), Fr.

Common on earth on both islands.

Cladonia bellidiflora, (Ach.), Schaer.

Common on earth on both islands.

Sphaerophorum globiferum, DC.

On rocks on both islands. *Medulla I. coerulescit.*

Sphaerophorum fragile, Pers.

On rocks, mixed with *Lecanora tartarea.*

Thamnolia vermicularis, Fr.

Common on earth on both islands. The form *gracilescens* is rare on earth on rocks, St. Paul Island.

Normandia laetevirens, Turn. and Borr.

Among tufts of moss, on St. George Island.

Heterothecium sanguinarium, (L.), Flot.

On rocks on both islands.

Lecidea sp. (?).

On rocks, St. George Island.

Lecidea sp. (?).

On rocks, St. George Island.

Buellia geographica, (L.), Tuck.

On rocks, St. George Island.

Buellia alpicola, Wahl.

On rocks, St. George Island.

Buellia sp. (?).

On rocks, St. George Island.

Verucarria sp. (?).

On rocks, St. George Island.

NOTE.—The chemical reactions, measurements of spores, etc., are by Mr. J. S. D. Branth, of Sneptrup, Denmark.

LICHENS COLLECTED ON ST. PAUL ISLAND IN 1891 BY WILLIAM PALMER AND DETERMINED BY MR. W. W. CALKINS.

Cladonia furcata, Fr.
Pycnothalia cladinoides, Nyl.
Cladonia rangiferina, Hoffm.
Cladonia papillaria, Hoffm.
Theeloschistes lychneus, Nyl.
Umbilicaria hyporea, Hoffm.
Stereocaulon coralloides, Fr.
Cladonia fimbriata, Fr.
Lecanora thamnites, Tuck.

FUNGI.

Clitocybe cyathiformis, Fr.

On earth, St. Paul Island.

Clitocybe diatreta, Fr.

On earth, St. Paul Island.

Clitocybe laccata, Scop.

On earth, St. Paul Island.

Russula nigrodisca, Pk. New species.

Pileus thin, convex or nearly plane, viscid when young and moist, black or blackish on the disk, purplish-red or dark-red on the even margin; lamellae thin, entire, subdistant, narrowed toward the stem, whitish; stem nearly equal, white or whitish; spores white, subglobose, 0.00035 to 0.00045 inch long; cystidia 0.002 to 0.0024 inch long, pointed at the apex.

Pileus 1 to 1.5 inches broad; stem 1 to 1.5 inches long, 2 to 4 lines thick.

On exposed hillsides among Cladonias and other lichens, St. Paul Island, September 18, 1896. (J. M. Macoun.)

This species is apparently related to *R. fallax*, from which it may be separated by its darker colored pileus with its even margin and by its larger spores. Its numerous conical-pointed cystidia project slightly from the edge of the lamellae. Having seen only dry specimens, it is impossible to say whether the flavor of the fresh plant is mild or acrid.

Flammula fulvella, Pk. New species.

Pileus thin, convex or nearly plane, glabrous, subtawny, the margin deflexed or incurved, flesh whitish; lamellae thin, subdistant, adnate or slightly decurrent, somewhat tawny, inclining to ochraceous-tawny; stem equal, solid, fibrillose or fibrillose-squamulose, colored like the pileus; spores elliptical, 0.0005 inch long, 0.003 broad.

Pileus 6 to 12 lines broad; stem about 1 inch long, 1.5 to 2 lines thick.

Low ground, St. Paul Island, September, 1896. (J. M. Macoun.)

Having seen dried specimens only, it is not possible to give the colors of the fresh plant nor of the young lamellae. The plants are apparently closely gregarious in mode of growth. It is possible that the pileus may be slightly viscid when fresh, but this could not be satisfactorily ascertained, and therefore the tribe to which the species belongs is uncertain.

Cortinarius?

On earth, St. Paul Island.

Nalaviea?

On earth, St. Paul Island.

Geographical distribution of the phaenogams and vascular cryptogams known to occur on the Pribilof Islands.

	Arctic America.	Northeast America.	Greenland.	Iceland.	Spitzbergen.	Scandinavia.	Arctic Russia.	Nova Zembla.	Arctic Siberia.	West coast of Bering Sea.	East coast of Bering Sea.
Anemone richardsoni, Hook	....	+	+	....	....	....	....	....	....	....	+
Ranunculus tricophyllus, Chaix	+	+	+	+	....	+	+	....	....	+	+
Ranunculus pallasii, Schl	....	....	....	....	+	+	....	+	+	+	+
Ranunculus hyperboreus, Rottb	+	+	+	+	+	+	+	+	....	+	+
Ranunculus pygmaeus, Wahl	+	+	+	+	+	+	+	+	+	+	+
Ranunculus reptans, L	+	+	+	+	....	+	+	....	+	+	+
Ranunculus altaicns. Laxm	....	....	+	....	+	+	....	+	+	+	+
Ranunculus eschscholtzii, Schl	+	....	....	....	....	....	....	....	....	....	+
Coptis trifolia, Salisb	+	+	+	....	....	....	+	....	....	+	+
Aconitum delphinifolium, DC	....	....	....	....	....	....	....	....	....	+	+
Papaver radicatum, Rottb	+	+	+	+	+	+	+	+	+	+	+
Papaver macounii, Greene	....	....	....	....	....	....	....	....	....	....	....
Corydalis panciflora, Pers	....	....	....	....	....	....	....	....	....	+	+
Nasturtium palustre, DC	....	+	+	+	....	+	+	....	....	+	+
Nesodraba grandis, Greene	....	....	....	....	....	....	....	....	....	....	+
Draba hirta, L	+	+	+	+	+	+	+	+	+	+	+
Draba wahlenbergii, Hartm	+	+	+	....	+	+	+	+	+	+	+
Eutrema edwardsii, R. Br	+	+	+	....	+	....	+	+	....	+	+
Cochlearia officinalis, L	+	+	+	+	....	+	+	....	+	....	+
Cardamine bellidifolia, L	+	....	+	+	+	+	+	+	....	+	+
Cardamine pratensis, L	+	+	+	+	....	+	....	+	....	....	+
Cardamine umbellata, Greene	....	....	....	....	....	....	....	....	....	....	....
Arabis ambigua, DC	....	....	....	....	....	....	....	....	....	....	+
Viola langsdorfii, Fisch	....	....	....	....	....	....	....	....	....	....	+
Silene acaulis, L	+	+	+	+	+	+	+	+	+	+	+
Lychnis apetala, L	+	+	+	....	....	+	+	+	....	+	+
Arenaria macrocarpa, Pursh	....	....	....	....	....	....	....	....	....	+	+

Geographical distribution of the phaenogams and vascular cryptogams, etc.—Continued.

	Arctic America.	Northeast America.	Greenland.	Iceland.	Spitzbergen.	Scandinavia.	Arctic Russia.	Nova Zembla.	Arctic Siberia.	West coast of Bering Sea.	East coast of Bering Sea.
Arenaria arctica, Stev									+	+	+
Arenaria peploides, L	+	+	+	+	+	+	+	+	+	+	+
Stellaria media, Smith			+	+		+	+		+	+	+
Stellaria borealis, Bigel		+	+			+	+				+
Stellaria humifusa, Rottb	+	+	+			+	+	+		+	+
Stellaria longipes, Goldie, var. laeta, Was	+	+									
Cerastium alpinum, L	+	+	+	+	+	+	+	+	+	+	+
Sagina linnaei, Presl	+		+	+		+	+			+	+
Sagina nivalis, Fr	+		+		+	+		+	+		
Claytonia sarmentosa, C. A. Meyer											+
Montia fontana, L		+					+			+	+
Geranium erianthum, DC										+	+
Lupinus nootkatensis, Don										+	
Lathyrus maritimus, Bigel., var. aleuticus, Greene											+
Rubus chamaemorus, L	+	+	+			+	+	+	+	+	+
Rubus stellatus, Smith										+	+
Rubus arcticus, L	+	+	+			+	+			+	+
Geum rossii, Seringe										+	+
Sibbaldia procumbens, L			+	+		+	+				+
Potentilla anserina, L	+	+	+				+		+	+	+
Comarum palustre, L	+	+	+	+		+	+	+	+	+	+
Potentilla fragiformis, Willd. f. villosa, Pall										+	+
Potentilla emarginata, Pursh	+	+	+		+		+	+			
Saxifraga hieraciifolia Waldst. and Kit	+	+	+		+	+	+			+	+
Saxifraga davurica, L										+	+
Saxifraga stellaris, L. var. comosa, Poir	+		+		+	+	+	+	+	+	+
Saxifraga nelsoniana, Don										+	+
Saxifraga serpyllifolia, Pursh										+	+
Saxifraga bracteata, Don										+	+
Saxifraga hirculus, L	+	+				+	+		+	+	+
Saxifraga hirculus, L. var. alpina. Engl		+	+	+	+			+	+		
Chrysosplenium beringianum, J. N. Rose											
Chrysosplenium alternifolium, L	+	+	+		+	+	+	+	+	+	+
Parnassia kotzebuei, Cham. and Schl	+	+	+							+	+
Hippuris vulgaris, L	+	+	+	+		+	+		+	+	+
Epilobium clavatum, Trelease											
Epilobium behringianum, Haussknecht											
Epilobium spicatum, Lam	+	+	+	+		+	+	+	+	+	+
Ligusticum scoticum, L		+	+	+		+	+			+	+
Selinum Benthami, Wat	+	+									
Coelopleurum gmelini, Ledeb		+	+				+			+	+
Cornus suecica, L		+	+	+		+	+			+	+
Galium trifidum, L		+				+	+				+
Valeriana capitata, Pall	+						+	+	+	+	+
Aster sibiricus, L										+	+
Achillaea millefolium, L	+	+	+			+	+		+	+	+
Chrysanthemum arcticum, L	+	+					+			+	+
Artemisia globularia, Cham										+	+
Artemisia norvegica, Fries var. pacifica, Gray										+	+
Artemisia richardsoniana, Hook										+	+
Artemisia vulgaris, L. var. tilesii, Ledeb							+			+	+
Arnica unalaskensis, Less											+
Petasites frigida, Fries	+				+	+	+	+	+	+	+
Senecio pseudo-arnica, Less		+								+	+
Taraxacum officinale, Weber var. lividum, Koch										+	+
Campanula uniflora, L	+	+	+		+	+		+			+
Campanula lasiocarpa, Cham											+
Pyrola minor, L	+	+	+	+	+	+	+	+	+	+	+
Armeria vulgaris, Willd	+	+	+				+			+	+
Primula macounii, Greene											
Primula eximia, Greene											+
Androsace villosa, L										+	+
Trientalis europaea, L. var. arctica, Ledeb										+	+
Gentiana tenella, Rottb				+		+	+		+		+
Gentiana frigida, Haenke										+	
Gentiana glauca, Pallas										+	+
Polemonium caeruleum, L. var. grandiflorum, Ledeb									+	+	+
Polemonium pulchellum, Bungl., var. macranthum, Ledb									+		+
Eritrichium chamissonis, A. DC										+	
Mertensia maritima, Don		+	+	+	+	+	+			+	+
Veronica serpyllifolia, L	+	+		+		+	+		+	+	+
Veronica stelleri, Pall										+	
Pedicularis verticillata, L							+			+	+

Geographical distribution of the phaenogams and vascular cryptogams, etc.—Continued.

	Arctic America.	Northeast America.	Greenland.	Iceland.	Spitzbergen.	Scandinavia.	Arctic Russia.	Nova Zembla.	Arctic Siberia.	West coast of Bering Sea.	East coast of Bering Sea.
Pedicularis sudetica, Willd	+	....	+	....	....	....	+	+	+	+	+
Pedicularis langsdorfii, Fisch	....	....	....	....	....	....	....	....	+	+	+
Pedicularis lanata, Willd	+	....	+	....	....	....	....	....	+	+	+
Euphrasia officinalis, L	+	....	+	+	....	+	+	....	....	+	+
Gynandra gmelini, Cham. and Schl	....	....	....	....	....	....	....	....	....	+	....
Gynandra stelleri, Cham. and Schl	+	....	....	....	....	....	+	....	+	....	+
Koenigia islandica, L	+	+	+	+	+	+	+	+	+	+	+
Polygonum viviparum, L	+	+	+	+	+	+	+	+	+	+	+
Polygonum macounii, J. K. Small	....	....	....	....	....	....	....	....	....	....	....
Polygonum bistorta, L	+	....	....	....	....	....	+	....	+	+	+
Oxyria reniformis, Hook	+	+	+	+	+	+	+	+	+	+	+
Rumex acetosella, L	+	....	+	+	....	+	+	+	+	....	....
Salix arctica, Pall	+	+	+	....	....	....	+	+	+	+	+
Salix phylicoides, And	....	....	....	....	....	....	....	....	....	+	....
Salix reticulata, L	+	+	+	....	....	+	+	+	+	+	+
Salix ovalifolia, Trautt	....	....	....	....	....	....	....	....	....	+	+
Empetrum nigrum, L	+	+	+	+	....	+	+	....	+	+	+
Fritillaria kamtschatcensis, Ker	....	....	....	....	....	....	....	....	....	+	+
Lloydia serotina, Reich	+	....	....	....	....	....	+	+	....	+	+
Streptopus amplexifolius, DC	+	+	+	....	....	....	....	....	....	+	+
Juncus balticus, Deth. var. Haenkii, (Mey)	....	....	....	....	....	....	....	....	....	....	....
Juncus biglumis, L	+	+	+	....	....	....	+	....	+	+	+
Luzula arcuata, Hook. var. unalaskensis, Buch	....	....	....	....	....	....	....	....	....	....	....
Luzula confusa, Lindb. var. latifolia, Buch	....	....	....	....	....	....	....	....	....	....	....
Luzula campestris, Desv. var. sudetica, Celak	....	....	....	....	....	....	....	....	....	....	....
Eriophorum polystachyon, L	+	+	+	+	+	+	+	+	+	+	+
Eriophorum vaginatum, L	+	+	+	....	....	+	+	....	+	+	+
Carex leiocarpa, C. A. Meyer	....	....	....	....	....	....	....	....	....	....	....
Carex novegica, Schk	....	....	....	+	....	+	+	....	....	....	+
Carex lagopina, Wahl	....	+	+	....	....	....	+	....	....	+	+
Carex gmelini, Hook	....	....	....	....	....	....	....	....	....	+	+
Carex vulgaris, Fries and vars	+	+	+	+	....	+	+	....	+	+	+
Carex cryptocarpa, C. A. Meyer	....	+	+	+	....	+	....	....	....	+	+
Carex salina, Wahl. and vars	....	....	+	+	....	+	+	+	+	+	+
Carex macrochaeta, C. A. Meyer	....	....	....	....	....	....	....	....	....	....	+
Carex membranopacta, Bailey	+	....	....	....	....	....	....	....	....	....	+
Carex rariflora, Smith	+	+	+	+	....	+	+	+	+	+	+
Carex saxatilis, L	+	+	+	+	+	+	+	+	+	+	+
Hierochloa borealis, R. and S	....	+	....	....	....	....	+	....	....	+	+
Hierochloa pauciflora, R. Br	+	....	....	....	....	....	+	+	....	+	....
Alopecurus alpinus, Smith	+	+	+	....	+	....	+	....	+	+	+
Alopecurus howellii, V. var. merriami, Scrib	....	....	....	....	....	....	....	....	....	....	....
Phleum alpinum, L	....	+	+	+	....	+	+	+	....	+	+
Arctagrostis latifolia, Grisb	+	....	....	....	....	....	....	....	....	....	+
Calamagrostis purpurascens, V	+	....	+	....	....	....	....	....	....	....	....
Calamagrostis deschampsioides, Trin	....	....	....	....	....	....	+	....	+	....	....
Deschampsia caespitosa, Beauv. var. arctica, Trin	....	....	....	....	....	....	....	....	....	....	+
Trisetum subspicatum, Beauv	+	....	+	+	+	....	+	+	....	+	+
Phippsia algida, R. Br	+	+	+	....	+	+	+	+	+	+	+
Poa arctica, R. Br	....	....	+	....	....	+	+	....	....	+	+
Poa caesia, Smith	....	+	....	....	....	+	+	....	....	+	+
Poa glumaris, Trin	....	....	....	....	....	....	....	....	....	....	+
Arctophila effusa, Lange	+	+	+	....	+	....	+	+	+	+	....
Dupontia psilosantha, Rupr	+	....	+	....	....	....	+	....	+	+	+
Glyceria angustata, Fries	+	+	+	....	+	....	....	....	....	+	+
Glyceria vilfoidea (Andr.), Fries	....	....	+	....	+	....	+	+	....	....	....
Festuca rubra, L	....	....	+	+	+	+	+	+	+	+	+
Festuca ovina, L	+	+	+	+	+	+	+	+	+	+	+
Elymus mollis, Trin	+	+	+	....	....	....	....	....	+	+	+
Elymus villosissimus, Scribn	....	....	....	....	....	....	....	....	....	....	....
Equisetum arvense, L	+	+	+	+	+	+	+	+	+	+	+
Equisetum scirpoides, Michx	+	+	+	....	+	....	+	+	+	+	+
Equisetum variegatum, Schleich	....	+	+	+	+	+	+	+	+	....	....
Botrychium lunaria, Swartz	....	+	+	+	....	+	+	....	....	+	....
Phegopteris polypodioides, Fée	....	....	+	+	....	+	+	....	+	+	....
Asplenium filix-foemina, Bernh	....	....	....	....	....	....	+	....	....	....	+
Aspidium spinulosum, Swartz	....	+	+	+	....	+	+	....	+	+	+
Aspidium Filix-Mas	....	....	+	+	....	+	+	....	....	+	....
Cystopteris fragilis, Bernh	....	....	....	....	....	....	....	....	....	....	....
Lycopodium selago, L	+	....	+	+	+	+	+	+	+	+	+
Lycopodium alpinum, L	+	+	+	+	....	+	+	....	+	+	+
Lycopedium annotinum, L	+	+	+	....	....	+	+	....	+	+	+

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AN UPLAND MEADOW OF ST. PAUL.

From a photograph by J. M. Macoun.

PAPAVER MACOUNII Greene. Natural size.

a, The pistil, stamens, and a petal. *b*, The fruit.

Drawn by Theo. Holm.

FRUITING SPECIMEN OF NESODRABA GRANDIS (Langsd.) Greene. Natural size.

Drawn by Theo. Holm.

CARDAMINE UMBELLATA Greene. Natural size.

a, Flower, magnified. *b*, Flower with petals removed, magnified. *c*, Petal, magnified.

Drawn by Theo. Holm.

CHRYSOSPLENIUM BERINGIANUM Rose.

Fig. *a*, a plant, natural size; fig. *b*, leaf, enlarged 2 diameters; fig. *c*, enlarged 2 diameters; fig. *d*, flower; fig. *e*, section of the same; fig. *f*, the flower as seen from above; fig. *g*, ovary; *d*, *e*, *f*, and *g*, enlarged 5 diameters; fig. *h*, seed, enlarged 15 diameters.

Drawn by F. A. Walpole.

PRIMULA EXIMIA Greene. Plant natural size.

a, Flower laid open, magnified. *b*, Fruiting scape, magnified. *c*, Capsule, magnified.

Drawn by Theo. Holm.

PRIMULA MACOUNII Greene. Natural size.

a, Flowering specimen. *b*, Fruit. *c*, Vegetative shoot.

Drawn by Theo. Holm.

POLYGONUM MACOUNII Small.

Drawn by Theo. Holm.

XXIV.—ALGAE OF THE PRIBILOF ISLANDS.

By William A. Setchell, Ph. D.,
Professor of Botany in the University of California.

A very considerable region, containing many characteristic species and distinctly marked off from adjoining regions, is that extending from Yesso, and the Sea of Okhotsk, around to the east, through the Bering Sea, the Aleutian Islands, and the various archipelagoes lying along the northwestern shore of North America to the Straits of Juan de Fuca and Puget Sound. Remote and little known as this region is, yet the algae have long been a matter of study. Gmelin, in his Historia Fucorum, in 1768, described a number of forms from Kamchatka and the adjoining districts. It was not until 1851, however, that any detailed account of even the algae of the Okhotsk Sea was published. In that year appeared the work of Ruprecht (1851), since which nothing has been written about the algae of this region. Ruprecht, however, does not restrict his enumeration exclusively to the forms of the Okhotsk, but mentions quite freely localities all over the world, and among them the island of St. Paul of the Pribilof group. The various Russian expeditions brought back many seaweeds among their collections. These were studied by Postels and Ruprecht at St. Petersburg, and the results finally given to the world in a magnificent volume, the Illustrationes Algarum, in the year 1840. This account deals almost entirely with the North American coast from Unalaska to Monterey. Ruprecht also published two other papers on algae from the North Pacific (1848 and 1852)—Merters letters, published in 1829, give graphic descriptions of a number of the larger and more curious species of northwestern America. The algae of the Straits of Juan de Fuca have been enumerated by W. H. Harvey (1862), and, finally, the Bering Sea forms have received revision and augmentation at the hands of Kjellman (1889). Of all the literature of the algae of the entire region there remains to be mentioned only two small papers by Okamura (1891a and 1891b), mentioning certain species from the Kuril Islands and from Yesso, and a paper by Farlow (1886), crediting two species to the island of St. Paul. These are all the works dealing with the species of this immediate region as far as they are known to the writer. While they treat in a general way of the species of the region, they do not, with the exception of the Okhotsk flora and the paper of Farlow noted above, mention the Pribilof Islands in particular. Ruprecht, however, as mentioned above, has given a number of species as occurring at St. Paul, and the writer has attempted to bring together in this account all these references, in order that a beginning may be made in the work of exploiting the marine flora of these islands.

The collections accessible to the writer have been those made by Messrs. Greeley and Snodgrass, under the direction of President Jordan, which consist of three jars of seaweeds preserved in formalin. Besides these, there were accessible to the writer for examination two other small collections, viz, a few species obtained for the late Prof. D. C. Eaton through the courtesy of the Alaska Commercial Company about 1877, which I have been able to reexamine through the kindness of Dr. A. W. Evans of Yale University, and a collection by Charles H. Townsend, of the United States Fish Commission steamer *Albatross*, in 1895, made at the request of the writer and at the direction of the United States Commissioner of Fisheries. The *Albatross* collection has been made available for this account through the permission of Commissioner Bowers.

The present enumeration, then, includes all that can be determined from these three collections, as well as information concerning any additional species credited to the islands but not represented in the collections. In this way the writer has hoped to bring together all that is reliably known about the marine flora of this group of islands, for it has been suspected that the shores of Bering Sea are destitute of algae altogether (cf. Ruprecht, 1851, p. 203, and Merrifield, 1875, p. 56), i. e., north of the Aleutian Islands, with which, however, Ruprecht reckons the Pribilofs. Dall (1875) and Kjellman (1889) oppose this view, and Konyam or Penkegnei Bay, St. Lawrence Bay, and Port Clarence have floras very similar to that of the Okhotsk and the Aleutians. St. Paul, likewise, has a very similar flora, as may be seen from the annexed list.

CYANOPHYCEAE.

No specimens of blue-green algae have been found in the collections, either free or attached to the others. No members of this group are mentioned either by Ruprecht (1852) or by Kjellman (1889).

CHLOROPHYCEAE.

Prasiola crispa (Lightf.) Ag.

This species is commonly found covering recently vacated or little-used portions of the seal rookeries, according to the note attached to a specimen collected at the Reef rookery on St. Paul Island by B. W. Evermann July 20, 1892, and sent from the United States National Herbarium to the writer.

Chaetomorpha melagonium var. typica Kjellm. Kjellman, Beringshafvets Algflora; 55, 1889.[1]

Only a few fragments of a *Chaetomorpha* exist in the collections, but both in those of the *Albatross* and of Greeley and Snodgrass. They seem to belong to this species. (St. Lawrence Island and Port Clarence.)[2]

Cladophora mertensii (Rupr.) De-toni. ?

Conferva mertensii Rupr., Tange Och.; 403, 1851.

There is only one *Cladophora* present in the collections of Greeley and Snodgrass, and that, a single specimen too imperfect to determine at all satisfactorily. It was submitted to Professor Farlow, of Harvard University, who replies that it agrees best with this species, but is by no means certainly to be referred to it.

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[1] Only literature to localities in Bering Sea proper is quoted.

[2] The localities inclosed in parentheses show additional distribution within Bering Sea proper.

Monostroma splendens (Rupr.) Wittr. Kjellman, Beringshafvets Algflora; 54, 1883.
Ulva and *Ulvaria splendens* Rupr., Tange Och.; 410, 1851.

This fine species must be fairly abundant upon the island, as it is represented in both the collections by a comparatively large number of examples. All the specimens are of a deep brown color, more like that of an old Punctaria than of a member of this genus. (Bering Island.)

PHAEOPHYCEAE.

Dictyosiphon hippuroides (Lyngb.) Kütz. Kjellman, Beringshafvets Algflora; 50, 1889.

A rather slender form of this species occurs in the material of Messrs. Greely and Snodgrass. (Konyam Bay and Bering Island.)

Mesogloia ?

A considerable quantity of a sterile plant occurs in the collections of Messrs. Greely and Snodgrass, but as it is sterile it is impossible to tell with certainty even the genus. Further, Kjellman does not mention any member of this group as occurring in the Bering Sea.

Desmarestia aculeata (L.) Lamour. Kjellman, Beringshafvets Algflora; 50, 1889.

This species occurs in rather typical form in the collections of Messrs. Greely and Snodgrass, but it also approaches at times the broader *D. latifrons*. A somewhat more terete form is occasionally found in algae from various parts of Bering Sea, and may be what Ruprecht has called *Spinularia intermedia* var. *teretifolia* in the Okhotsk flora, and credited by him to St. Paul Island. (St. Lawrence Bay, and St. Lawrence Island.)

Scytosiphon lomentarius Lyngb. J. G. Ag. Kjellman, Beringshafvets Algflora; 49, 1889.

Abundant in all the collections, and in excellent fruit. (Konyam Bay, Port Clarence, Bering Island.)

Analipus fusiformis Kjellm. Kjellman, Beringshafvets Algflora; 49, pl. 7, f. 5–12, 1889.

There is a considerable quantity of this species in the collections brought back by President Jordan. The material is in excellent fruit also, so that there can be no doubt but that these specimens are of the same species as Kjellman's. When old and the tips of the upright fruiting portions are worn away, the plant looks very much like a bunch of short eroded fronds of *Scytosiphon lomentarius*, but they are, of course, provided with the characteristic basal layer, such as no *Scytosiphon* is known to possess. This, however, is sometimes so inconspicuous that at first sight a specimen might be passed over, when a thorough examination would reveal its identity. All the specimens examined possessed fine unilocular sporangia, which is unknown in *Scytosiphon*.

This locality extends the range of this species to the American side of the Bering Sea. (Bering Island.)

Laminaria longipes Bory. Ruprecht, Tange Och.; 232, 351, 1851. Kjellman, Beringshafvets Algflora, 43, 1889. (Plate XCV.)

This species receives its present specific name from J. G. Agardh (1867, pp. 26, 27), who, while uncertain, feels that it is the best thing to do under the circumstances. Kjellman has followed him, referring the species back again to the genus *Laminaria*, where it most certainly belongs if the plant which the writer has received and which agrees thoroughly with the descriptions of Agardh and of Areschoug (1883), especially with that of the latter, is the same as Kjellman's. The plant was well known to Ruprecht (1851, 232 and 351), who has given it two additional names, *Laminaria repens* and *Lessonia repens*, while Agardh has referred it to the genus *Arthrothamnus*. Our plant, however, is certainly not a member of this latter genus, for it lacks altogether the characteristic auricles at the base of the blade; and the folds (at the base of the blade) described by Agardh may very likely be nothing more than the products of imperfect drying. The plant has a most striking resemblance to *Laminaria sinclairii* in habit, so much so, that it can not be told from certain forms of that species until an investigation into the character and distribution of the muciferous canals is made. Then it is seen that there are no canals at all in the stipe, while those in the blade are large and frequent, as is shown in the figure of the cross section on the plate attached to this article. The habit is also well represented in the plate, and the rhizome shows especially well. It is the rhizome that gives it the particular resemblance to *Laminaria sinclairii*, and is a characteristic shared with it only by *L. japonica* and *L. rodriquezii* (cf. Bornet, 1888, p. 2), besides the species mentioned. Bornet mentions (l. c., p. 2) also *L. bongardiana*, but the writer has not seen any specimens of that species thus provided. Areschoug also includes this last species among the rhizomatous Laminariae, but only as to the "forma *subsessilis*." *L. longipes* was collected by Messrs. Greeley and Snodgrass, but the specimens are all sterile. (Bering Island.)

Laminaria digitata is credited by Ruprecht to St. Paul, but it is uncertain just which one of the digitate forms of modern writers he had before him (cf. also Kjellman, 1890, p. 170).

Agarum turneri P. and R. Ruprecht, Tange Och.; 244, 1851. Kjellman, Beringshafvets Algflora; 42, 1889.

A portion of a frond is present in the collection received from President Jordan and Ruprecht mentions it as well from St. Paul Island. (Konyam Bay; St. Lawrence Bay; St. Lawrence Island.)

Thalassiophyllum clathrus (Gmel.) P. and R. Kjellman, Beringshafvets Algflora; 42, 1889.

Only two specimens of this magnificent plant are known to me from St. Paul Island, one of which is in Herb. Eaton at Yale University and the other in Herb. Farlow at Harvard University. They were both procured for Professor Eaton by the Alaska Commercial Company in 1877. (Bering Island.)

Nereocystis luetkeana P. and R.

This species is unknown with certainty from the Bering Sea. Kjellmann does not mention it nor does Ruprecht in the Ochotsk flora, but Dall (1875, p. 166) speaks of the "Bull-Head Kelp" at the Pribilof Islands, with the suggestion that it is *Nereocystis*. It certainly extends as far north as Unalaska and may very likely range as far up as the Pribilof group.

Alaria praelonga Kjellm.? Kjellman, Beringshafvets Algflora; 38, Pl. 4, 1889.

A few specimens of an *Alaria* were collected by Mr. Townsend in 1895, which seem to belong to this species, although they have also the characters of *A. angusta*, *A. crispa*, and even of *A. lanceolata*; in fact, it is very difficult for the writer to determine how these four species differ essentially from one another. Ruprecht also mentions an *Alaria* as occurring at St. Paul (1851, p. 360), but without referring the forms to any now recognizable species. (Bering Island.)

Fucus platycarpus Thur. ?

A single specimen of *Fucus* exists in the Jordan collection and seems to the writer to come nearer to the species noted above than to any other. Yet it does not seem to be hermaphrodite, while *F. platycarpus*, usually plainly hermaphrodite, does seem at times to be dioecious. It certainly appears to be different from *F. evanescens*, the only species known with certainty from Bering Sea.

RHODOPHYCEAE.

Porphyra laciniata, var. **umbilicalis** Ag.

The specimens referred to this species are in the collection received from the *Albatross* expedition of 1895. There are several of them, but none of them are in fruit or show reproductive bodies of either kind. The fronds are conspicuously umbilicate, dark purple, monostromatic, with cells elongated perpendicularly to the surface of the frond. In every way they are different from *Diploderma variegatum* Kjellm. and agree exactly with the plate of C. Agardh (1828, Taf. 26), especially with figures a, d, and e; for a zone, just within the margin in our plants, is extremely deliques cent, and the cells thus loosened reproduce figure d exactly, as well as answer to the description given in the text. No form like this has been seen on the California coast by the writer, nor does Kjellman mention other than the species noted above, viz, *D. variegatum*, from Bering Sea.

Iridaea laminarioides forma parvula Kjellm. Kjellman, Beringshafvets Algflora; 31, 1889.

A number of specimens of a very dwarf form of this common species of the west coast of North America were found in the collections received from President Jordan, and although they were much gelatinized on account of their stay in the formalin, yet they still retained sufficient of their form and structure to be readily recognizable as belonging to the particular form described by Kjellman. This form is not found upon the California coast. Both cystocarpic and tetrasporic specimens are in the collection from St. Paul. (Bering Island.)

Chondrus platynus (Ag.) J. Ag. ? Kjellman, Beringshafvets Algflora; 32, 1889.

A considerable number of specimens of a Chondrus were collected by Messrs. Greeley and Snodgrass and all are in cystocarpic condition. They answer fairly well the description given for *C. platynus* in J. G. Agardh's Species Algarum (1876, p. 178). It is also the species reported by Kjellman from the northern part of the Bering Sea. (Konyam Bay and Port Clarence.)

Gymnogongrus fastigiatus, var. **crassior** Rupr. Ruprecht, Tange Och.; 326, 1851.

The only information regarding this plant comes from the reference quoted above and what Schmitz (1893, p. 394) has to say of it in connection with *Sterrocolax crassior*. It seems certainly allied to *Ahnfeldtia plicata*, but is, perhaps, distinct.

Callophyllis variegata (Bory) Kuetz ? Ruprecht, Tange Och.; 262, 1851.

Ruprecht says (l. c.) that a *Callophyllis* occurs at St. Paul Island which is near to this species.

Rhodophyllis dichotoma (Lepech.) Gobi. Kjellman, Beringshafvets Algflora; 27, 1889.
Ciliaria fusca Rupr,, Tange Och.; 251, 1851.

Known to occur at St. Paul only through Ruprecht's reference. (Bering Island.)

Ptilota asplenioides (Turn.) Ag. No. 82. Farlow, Anderson, and Eaton, Alg. Exsicc. Am. Bor., No. 82. Kjellman, Beringshafvets Algflora; 32, 1889.
Plumaria asplenioides Rupr., Tange Och.; 232, 1851.

This largest, coarsest, and deepest-colored species of all the genus occurs in all the collections from St. Paul and is further credited to it by Ruprecht. It must be abundant along its shores and constitute its most characteristic species. (Bering Island.)

Ptilota pectinata (Gunn.) Kjellm. Kjellman, Beringshafvets Algflora; 32, 1889.

Specimens of this species occur in the collection made for Prof. D. C. Eaton by the Alaska Commercial Company in 1877. (St. Lawrence Island.)

Ptilota filicina (Rupr.) J. Ag.

A few specimens of what seems to be this species occur both in the collections of the *Albatross* and those received from President Jordan. It is not always easy to tell this species from *P. plumosa* or *P. serrata*.

Odonthalia kamtschatica (Rupr.) J. Ag. Kjellman, Beringshafvets Algflora; 23, 1889.
Atomaria kamtschatica Rupr., Tange Och.; 214, 232, 1851.

Known to occur at St. Paul only through the reference in Ruprecht.

Rhodomela floccosa (Esp.) Ag. Kjellmann, Beringshafvets Algflora; 24, 1889.

The forms referred to this species from St. Paul are by no means near the type of the species. They are very much more slender than the ordinary Californian form, resembling *R. lycopodioides* in this respect, but approaching *R. larix* in others, so that the species as now understood and ranging from San Diego to Bering Island presents an infinite variety of forms as regards coarseness or fineness and even as regards the flattening of its branches, the character upon which its claim to specific rank principally rests. (Bering Island.)

Rhodomela larix (Turn.) Ag. Kjellman, Beringshafvets Algflora; 24, 1889.
Fuscaria larix Ruprecht, Tange Och.; 219, 1851.

Known from St. Paul only through this reference of Ruprecht's. (St. Lawrence Island and Port Clarence.)

Nitophyllum ruprechtianum J. Ag.?

Two more or less imperfect specimens of a large *Nitophyllum* of the *Botryoglossum* section, but provided with neither cystocarps nor sori, probably belong here. In the absence of any kind of reproductive bodies, however, it is impossible to tell with certainty. They were collected by Messrs. Greeley and Snodgrass.

Nitophyllum ruthenicum (P. and R.) Kjellm. Kjellman, Beringshafvets Algflora; 25, Pl. I, f. 11, 12, 1889.

The specimens referred to this species were seen in Herb. Farlow at Harvard University and were collected at St. Paul Island by Mr. White. They are young and more or less incomplete plants; consequently they do not show the habit very well. This is, however, quite variable, judging from Kjellman's figures (l. c.). The specimens of Mr. White are tetrasporic and have microscopic veins, at least at the base. With the exception of the veins, they resemble very closely *N. spectabile* D. C. Eaton, of the Californian coast. (Bering Island.)

Delesseria crassifolia Rupr. Ruprecht, Tange Och.; 232, 1851. Farlow, Proc. Amer. Acad., 21; 473, 1886.

D. crassifolia is a large and apparently characteristic species of the Pribilof

Islands, available to the writer in all three collections, viz, from the collection sent to Professor Eaton in 1877 by the Alaska Commercial Company, by the *Albatross* expedition of 1895, and also by a considerable number of specimens in the collection procured by President Jordan. It seems to the writer that the chief danger in connection with this species might possibly be in confusing it with *D. middendorfii* Rupr., as the Greely and Snodgrass specimens are generally proliferate from the midrib and often fasciculately so. The lateral nerves, however, are much more prominent than seems to be the case in *D. middendorfii.*

Delesseria spinulosa (Rupr.) J. Ag.

D. beringiana, var. spinulosa Ruprecht, Tange Och.; 244, 1851.

Ruprecht's reference is all that is known concerning the occurrence of this species at St. Paul Island. It grows upon the blade of *Agarum turneri.*

Delesseria complanata Rupr. Ruprecht, Tange Och.; 245, 1851.

Grows on *Ptilota asplenioides*, at St. Paul Island, according to Ruprecht.

Delesseria juergensii J. Ag. Farlow, Proc. Amer. Acad., 21; 473, 1886.

Farlow says (l. c.) that this species occurs in the collections sent to Professor Eaton in 1877.

Constantinea rosa marina (Gmel.) P. and R. Ruprecht, Tange Och.; 232, 1851. Kjellman, Beringshafvets Algflora; 30, 1889.

This interesting form occurs from St. Paul Island, in the collection sent to Professor Eaton. The specimens do not answer exactly to the description in J. Agardh's "Epicrisis," but they do answer to Gmelin's figure. (Bering Island.)

Amphiroa cretacea (P. and R.) Aresch. Kjellman, Beringshafvets Algflora; 20, 1889.

Although Dall (1875, p. 166) speaks of a Coralline zone about the islands, the collections contain only few and imperfect specimens of these forms. Consequently it has been impossible to give any satisfactory account of the species of this family. The present determinations must be looked upon as unsatisfactory, but as the best at present possible. Only two specimens of *A. cretacea* are available to the writer, and these are both imperfect and sterile. (Port Clarence; St. Lawrence Island; Bering Island.)

Arthrocardia frondescens (P. and R.) Aresch. Kjellman, Beringshafvets Algflora; 20, 1889.

Only two or three fragments are available, consequently the exact determination must remain in doubt. (Bering Island.)

Lithophyllum ———.

Several specimens of a species of this genus occur on the specimens of *Arthrocardia* mentioned above, but they are all sterile.

Lithothamnion ———.

Several specimens of this genus are present in the collection obtained by President Jordan, but they are young and sterile, so that no certain disposition can be made of them. They grew upon pebbles.

University of California,
Berkeley, Cal., December 9, 1898.

EXPLANATION OF PLATE XCV.

A clump of plants of *Laminaria longipes* Bory about natural size and a transverse section through the blade of one of the largest specimens, much magnified. This shows the shape, relative size, and characteristic position of the large muciferous canals.

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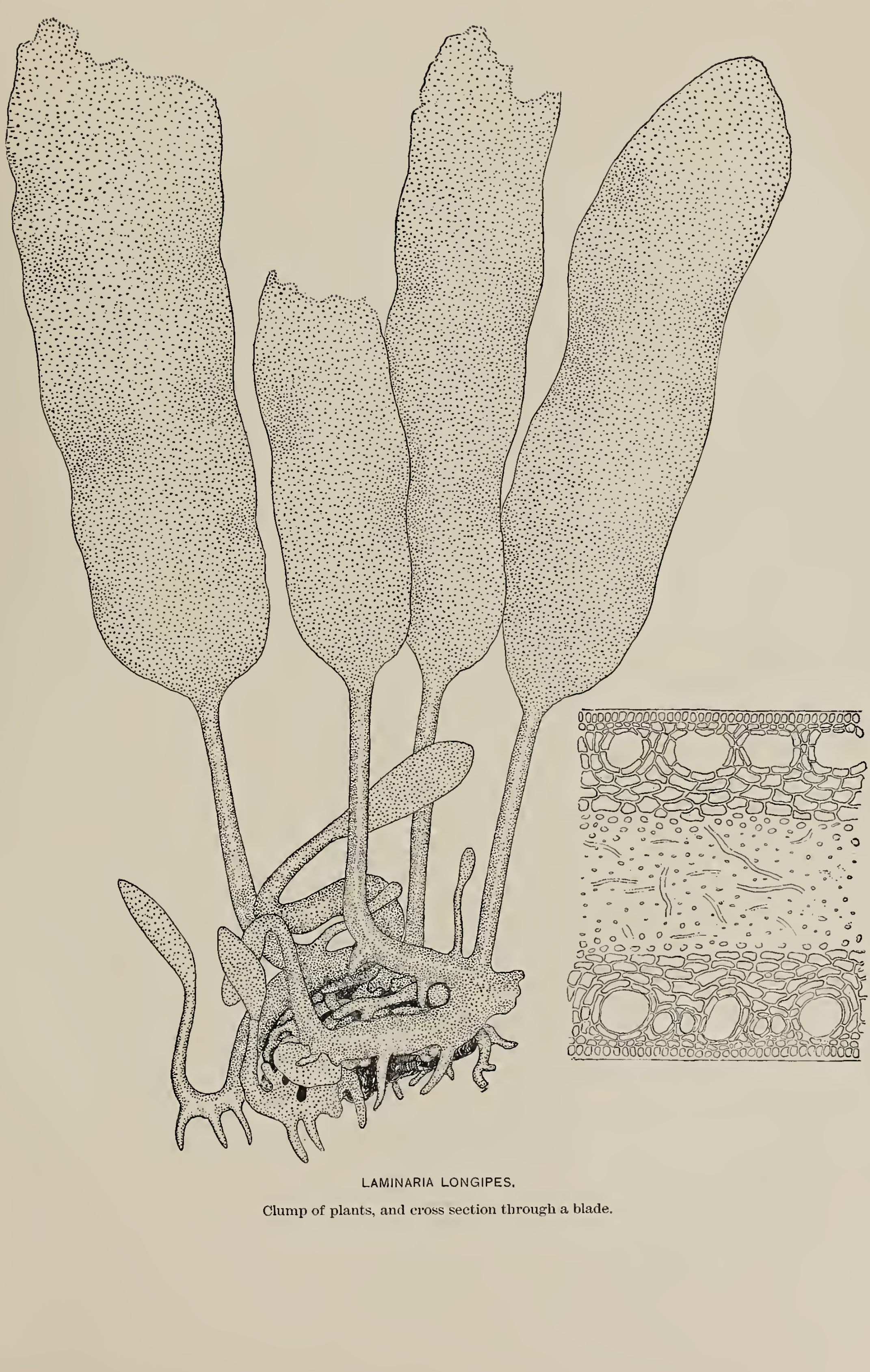

LAMINARIA LONGIPES.

Clump of plants, and cross section through a blade.

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