BULLETIN

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT

HARVARD COLLEGE, IN CAMBRIDGE.

VOL. I. — 2

(Nos. 1-13.)

(1863-1871)

CAMBRIDGE, MASS., U. S. A.
1863-1869.

UNIVERSITY PRESS: WELCH, BIGELOW, & CO.,
CAMBRIDGE.

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BULLETIN

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CAMBRIDGE, MASSACHUSETTS, U. S. A.

March 1, 1863.

In order to leave no doubt respecting the authority of the names adopted in our collections, as well as to explain various changes in the nomenclature of the specimens sent to other institutions by the Museum of Comparative Zoölogy, rendered necessary by the careful investigation to which they were submitted while arranging our own series, it is proposed from time to time to issue a Bulletin, calling attention to the evidence upon which the names adopted may rest. This will render the duplicates available for exchanges before a full account of the results thus reached can be published. Although the responsibility is left to those who may sign them, it is proper that I should add, that, in almost every instance, I have satisfied myself, by a direct revision, of the accuracy of the identifications.

Much important scientific work has been stored up with the specimens in the galleries of the Museum, during the past years, and left unpublished; but, in order to give proper credit to all those connected with our progress, it is recorded in this Bulletin with the date at which the investigation was made, though no claim of priority is thus intended. It is merely a matter of justice to those concerned in the arrangement of the collections.

L. AGASSIZ,
Director of the Museum.

Pœcilichthys spectabilis AGASSIZ, Am. Journ. Sci. Arts, (2e) XVII p. 304, 1854.

Microperca PUTNAM, MS. 1860. (Nov. gen.)

Body much compressed; tail long and broad; scales very large; no lateral line; first dorsal fin composed of six to seven rays; anal fin deep; pectorals and ventrals long; caudal slightly rounded.

Microperca punctulata PUTNAM, MS. 1860. (Nov. sp.)

This is the only known species of the genus, and is the smallest one in the family; the average length of the specimens being only an inch and a half. The color is buff, with dark brown zigzag markings. All the fins spotted, except the ventrals. Pectorals, and ventrals, reaching the commencement of second dorsal. We have received specimens from various points in Michigan, Wisconsin, Illinois, and Alabama.

Hololepis AGASSIZ, MS. 1860. (Nov. gen.)

Body much compressed; lateral line strongly arched over the pectorals; dorsal fins of nearly equal size; caudal fin slightly rounded; head covered with small scales. Only two species known.

Hololepis Barratti AGASSIZ, MS. 1860.

SYN. *Boleosoma tenue* AGASSIZ, 1850, without description; *Boleosoma Barratti* HOLBROOK, Journ. Philad. Acad. Nat. Sci. (New Series,) III. p. 56, 1855.

Hololepis fusiformis PUTNAM, MS. 1860.

SYN. *Boleosoma fusiforme* GIRARD, Proc. Bost. Soc. N. H. V. p. 41, 1854.

Boleichthys exilis GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 103. 1859.

Boleichthys Warreni GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 104 1859.

Etheostoma blennioides RAFINESQUE, Ichth. Ohien. p. 37. 1820.

SYN. *Diplesion blennioides* GIRARD, 1859.

Hadropterus nigrofasciatus AGASSIZ, Am. Journ. Sci. Arts, (2e) XVII. p. 303. 1854.

Hadropterus variatus AGASSIZ, MS. 1860.

SYN. *Etheostoma variatum* KIRTLAND, Zoöl. Ohio, pp. 168, 192, 1838; *Etheostoma notatum* AGASSIZ, 1850; *Pœcilosoma variatum* AGASSIZ, 1850; *Pœcilichthys variatus*, AGASSIZ, 1854.

Hadropterus maculatus GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 100 1859.

SYN. *Alvordius maculatus* GIRARD, 1859.

Cottogaster PUTNAM, MS. 1860. (Nov. gen.)

General form of body, and position of mouth, as in *Boleosoma;* lateral line, straight; first dorsal fin with ten rays, lower than the second, which is of the same size and coterminal with the anal; caudal fin slightly forked.

Cottogaster tessellatus Putnam, MS. 1860.

Syn. *Boleosoma tessellatum* Thompson, App. Hist. Vt. p. 31, 1853. (Not of DeKay.)

Boleosoma Olmstedi Agassiz, Lake Sup. pp. 299, 304. 1850.

Syn. *Etheostoma Olmstedi* Storer, 1842; *Perca* (*Percina*) *minima* Haldeman, 1842; *Boleosoma tessellatum* DeKay, 1842; *Boleosoma tessellatum* Agassiz, 1850; *Boleosoma maculatum* Agassiz, 1850; *Boleosoma Olmstedi* Storer, 1853; *Arlina effulgens* Girard, 1859; *Estrella atromaculata* Girard, 1859.

Hyostoma transversum Putnam, MS. 1860.

Syn. *Pœcilosoma transversum* Abbott, Proc. Philad. Acad. Nat. Sci. XII. p. 326. 1860.

Percina caprodes Girard, Proc. Philad. Acad. Nat. Sci. XI. p. 66. 1859.

Syn. *Sciæna caprodes* Rafinesque, 1818; *Etheostoma caprodes* Rafinesque, 1820; *Perca* (*Percina*) *nebulosa* Haldeman, 1842; *Pileoma semifasciatum* DeKay, 1842; *Percina bimaculata* Haldeman, 1843; *Etheostoma nebulosum* Storer, 1846; *Etheostoma semifasciatum* Storer, 1846; *Etheostoma bimaculatum* Storer, 1846; *Pileoma caprodes* Agassiz, 1850; *Pileoma Zebra* Agassiz, 1850; *Etheostoma Zebra* Agassiz, 1850; *Percina nebulosa* Girard, 1859; *Percina semifasciata* Girard, 1859; *Percina Zebra* Girard, 1859.

Pleurolepis Agassiz, MS. 1860. (Nov. gen.)

Body cylindrical, flattened above, and slightly tapering to the base of the caudal. Mouth terminal. Dorsal fins distinctly separated, of equal height, first longer than the second. Anal fin as large as the second dorsal, and placed opposite. Caudal slightly emarginate. Pectorals and ventrals long and pointed. Scales deeply imbedded and placed wide apart. The row containing the lateral line and the one each side of it are the most conspicuous. Cheeks and operculum covered with scales. Lateral line straight. The following is the only known species: —

Pleurolepis pellucidus Agassiz, MS. 1860. (Nov. sp.)

Syn. *Etheostoma pellucidum* Baird, MS. 1853.

From ten to fourteen small square olive blotches on the back and on each side, the rest of the body of a light cream-color; fins unicolored.

The last twenty species mentioned belong to the Etheostomata, a family of small fishes inhabiting the fresh waters of North America east of the Rocky Mountains, no species of which has thus far been discovered elsewhere. This family was first characterized by Professor Agassiz, in 1850, in "Lake Superior," p. 298.

Amblodon grunniens Rafinesque, Ichth. Ohien. p. 24. 1820.

Amblodon lineatus Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 307. 1854.

Perca flavescens Cuv. & Val. Hist. Nat. Poiss. (4° ed.) II. p. 33. 1828.

Merone americana Gill, Proc. Philad. Acad. Nat. Sci. XI. p. 115. 1860.

Syn. *Perca americana* Gmelin, 1788; *Merone rufa* Mitchill, 1814; *Bodianus rufus* Mitchill, 1814; *Labrax mucronatus* Cuv. & Val. 1828; *Labrax rufus* DeKay, 1842; *Labrax americanus* Holbrook, 1855.

Grystes nobilis Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 298. 1854.

Pomoxis hexacanthus Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 299. 1854.

Centrarchus irideus Cuv. & Val. Hist. Nat. Poiss. III. (4° ed.) p. 66. 1829.

Calliurus gulosus Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 300. 1854.

Ichthelis incisor Holbrook, Ichth. S. Car. I. p. 12. 1860.

Ichthelis rubricauda Holbrook, Ichth. S. Car. I. p. 15. 1860.

Bryttus obesus Girard, Proc. Philad. Acad. Nat. Sci. XI. p. 64. 1859.

Pomotis auritus Rafinesque, Ichth. Ohien. p. 29. 1820.

Syn. *Perca fluviatilis gibbosa* Catesby, II. Pl. 8, f. 3, 1742; *Labrus auritus* Linnæus, 1766; ? *Merone maculata* Mitchill, 1814; *Ichthelis (Pomotis) aurita* Rafinesque, 1820; *Pomotis Catesbei* Cuv. & Val. 1831; *Pomotis vulgaris* of all authors except Cuv. & Val.

There seems to have been such a general misunderstanding in regard to this, our most common species of the genus, that a few words of explanation are necessary to show the reason for restoring the specific name of *auritus* to the species in question.

In the tenth edition of the "Systema Naturæ," Linnæus mentions a fish from Philadelphia under the name of *Labrus auritus*. This fish is undoubtedly a *Pomotis*; but from the short description given it would be impossible to refer the species with precision to any of the many that inhabit our fresh waters, were it not for the reference in the twelfth edition of the "Systema Naturæ" to the figure of Catesby, which unquestionably represents our common "Bream," or "Pond-fish," — thus settling the species which Linnæus had in mind, though we think he confounded with it some other species sent him by Dr. Garden from South Carolina, probably the *Ichthelis rubricauda* of Holbrook.

In 1820, Rafinesque described the species in question under the specific name given by Linnæus, referring it to his sub-genus *Pomotis*.

In the third volume of the "Histoire Naturelle des Poissons," the authors, overlooking the description by Rafinesque, describe and figure a species of the genus under the name of *Pomotis vulgaris*, referring the *Labrus auritus* of Linnæus to it. This species is very different from the one figured by Catesby, and is probably identical with the *Labrus appendix* of Mitchill (*Pomotis appendix* DeKay), though in the second edition of the "Règne

Animal" Cuvier refers the figure of Catesby to it. In this mistake Cuvier and Valenciennes have been followed by all subsequent authors, who seem to have taken it for granted that the species bearing the name of *vulgaris* must be the common one, or, omitting to look up the authority of the specific name *auritus*, have considered that name as obsolete. In the seventh volume of the "Histoire Naturelle des Poissons," referring to the figure in Catesby, the authors have again described the *Labrus auritus* under the name of *Pomotis Catesbei*. In the illustrated edition of the "Règne Animal," the *Pomotis auritus* is very well figured under the name of *Pomotis vulgaris*.

Percopsis guttatus AGASSIZ, Lake Sup. p. 286. 1850.
SYN. *Salmoperca pellucida* THOMPSON, 1853.

Esox reticulatus LESUEUR, Journ. Philad. Acad. Nat. Sci. I. p. 414. 1818.

Esox fasciatus DEKAY, Fishes of N. York, p. 224. 1842.
SYN. *Esox ornatus* GIRARD, 1854.

Amblyopsis spelæus DEKAY, Fishes of N. York, p. 187. 1842.
This is the well-known "Blind-fish" of the Mammoth Cave, Kentucky.

Fundulus multifasciatus CUV. & VAL. Hist. Nat. Poiss. (4° ed.) XVIII. p. 150. 1846.

Hydrargyra catenata AGASSIZ, Am. Journ. Sci. Arts, (2°) XVII. p. 353. 1854.

Plargyrus americanus PUTNAM, MS. 1861.
SYN. *Cyprinus americanus* LINNÆUS, 1766 (not of the 10th ed. Syst. Nat.); *Cyprinus americanus* LACÉPÈDE, 1803; *Cyprinus chrysoleucus* MITCHILL, 1815; (*Rutilus*) *Plargyrus chrysoleucus* RAFINESQUE, 1820; (*Cyprinus*) *Leuciscus chrysoleucus* RICHARDSON, 1837; *Leuciscus chrysoleucus* STORER, 1839; *Stilbe chrysoleucus* DEKAY, 1842; *Abramis versicolor* DEKAY, 1842; *Leuciscus Boscii* CUV. & VAL. 1844; *Leuciscus americanus* STORER, 1846; *Leucosomus americanus* GIRARD, 1853; *Luxilus americanus* GIRARD, 1856.

Hypsolepis cornutus AGASSIZ, Am. Journ. Sci. Arts, (2°) XVII. p. 359. 1854.
SYN. *Cyprinus cornutus* MITCHILL, 1817; *Leuciscus cornutus* STORER, 1842; *Plargyrus cornutus* GIRARD, 1856.

Hypsolepis frontalis AGASSIZ, Am. Journ. Sci. Arts, (2°) XVII. p. 356. 1854.
SYN. *Leuciscus frontalis* AGASSIZ, (male,) 1850; *Leuciscus gracilis* AGASSIZ, (female,) 1850; *Plargyrus frontalis* GIRARD, 1856; *Plargyrus gracilis* GIRARD, 1856.

Hypsolepis diplemius PUTNAM, MS. 1861.
SYN. *Semotilus diplemius* RAFINESQUE, Ichth. Ohien. p. 50, 1820; *Leuciscus diplemius* KIRTLAND, 1845.

Semotilus argenteus Putnam, MS. 1861.

Syn. *Leuciscus argenteus* Storer, (young,) Rep. Fishes of Mass. p. 90, 1839; *Leuciscus pulchellus* Storer, (adult,) 1839; ? *Leucosomus argenteus* Heckel, 1841; ? *Leucosomus chrysoleucus* Heckel, 1841; ? *Leuciscus nitidus* DeKay, 1842 (young?); *Leuciscus Storeri* Cuv. & Val. 1844; *Cheilomenus pulchellus* Girard (in Storer), 1855; *Leucosomus pulchellus* Girard, 1856; ? *Hybognathus nitidus* Girard, 1856 (young?).

Semotilus corporalis Abbott, Proc. Philad. Acad. Nat. Sci. XIII. p. 154. 1861.

Syn. *Cyprinus corporalis* Mitchill, 1817; *Cyprinus atromaculatus* Mitchill, 1817; *Semotilus dorsalis* Rafinesque, 1820; *Semotilus cephalus* Rafinesque, 1820; *Leuciscus atromaculatus* DeKay, 1842; *Leuciscus iris* Cuv. & Val. 1844; *Semotilus atromaculatus* Girard, 1856; *Semotilus corporalis* Putnam, MS. 1861; *Semotilus corporalis* Abbott, 1861; *Semotilus atromaculatus* Abbott, 1861; *Leucosomus rhotheus* Cope, 1861; *Leucosomus atromaculatus* Cope, 1861.

Gobio plumbeus Agassiz, Lake Sup. p. 366. 1850.

Syn. *Leucosomus plumbeus* Girard, 1856.

As Professor Agassiz has stated in "Lake Superior," this species differs generically from the true genus *Gobio;* but as it has not yet been referred to its proper genus, we send it under the original name of the describer.

Ceratichthys biguttatus Baird; Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 112. 1856.

Syn. *Semotilus biguttatus* Kirtland, 1840; *Leuciscus biguttatus* DeKay, 1842.

Chrosomus erythrogaster Rafinesque, Ichth. Ohien. p. 47. 1820.

Syn. ? *Rutilus ruber* Rafinesque, 1820; *Luxilus erythrogaster* Kirtland, 1842; *Leuciscus erythrogaster* Storer, 1846.

Pimephales promelas Rafinesque, Ichth. Ohien. p. 53. 1820.

Syn. ? *Pimephales maculosus* Girard, 1856; *Pimephales fasciatus* Girard, 1856; *Plargyrus melanocephalus* Abbott, 1860.

Exoglossum maxillingua Haldeman, in Rupp., Hist. Lanc. Co. Pa. p. 474. 1844.

Syn. *Cyprinus maxillingua* LeSueur, 1817; *Exoglossum LeSueurianum* Rafinesque, 1818; *Catostomus maxillingua* DeKay, 1842.

Campostoma anomalum Agassiz, Am. Journ. Sci. Arts, (2^{e}) XIX. p. 219. 1855.

Syn. *Rutilus anomalus* Rafinesque, 1820; *Exoglossum dubium* Kirtland, 1838; *Exoglossum spinicephalum* Cuv. & Val. 1844; *Leuciscus prolixus* Storer, 1845; *Chondrostoma prolixum* Agassiz, 1854; *Chondrostoma pullum* Agassiz, 1854.

Hybognathus nuchalis Agassiz, Am. Journ. Sci. Arts, (2^e) XIX. p. 224. 1855.

Clinostomus elongatus Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 112. 1856.

Syn. *Luxilus elongatus* Kirtland, 1838; *Leuciscus elongatus* DeKay, 1842; ? *Leuciscus productus* Storer, 1846; *Alburnus pleuriticus* Agassiz, MS. 1854.

Hybopsis Storerianus Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 358. 1854.

Syn. *Rutilus Storerianus* Kirtland, 1842; *Leuciscus Storerianus* Kirtland, 1845.

Hybopsis dorsalis Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 358. 1854.

Hybopsis hudsonius Putnam, MS. 1861.

Syn. *Clupea hudsonia* Clinton, Ann. Lyc. Nat. Hist. N. Y. I. p. 49, 1824; *Leuciscus hudsonius* DeKay, 1842; *Hudsonius fluviatilis* Girard, 1856.

Alburnus rubellus Agassiz, Lake Sup. p. 364. 1850.

Alburnus lineolatus Agassiz, MS. 1854. (Nov. sp.)

Body light brown with a broad silvery band having dark points, extending from the head to the caudal fin. Average length, two and a half inches. From the Osage River. Collected by Mr. G. Stolley.

Alburnus zonatus Agassiz, MS. 1854. (Nov. sp.)

Brown upon the back; a silvery band from the nose across the eye to the caudal fin, beneath this a slightly broader dark band, which extends from the snout to the tip of the central rays of the caudal fin; silvery below the dark band. Head large and rounded. Average length of specimens, three inches. Osage River, Mr. Stolley.

Alburnus formosus Putnam, MS. 1861. (Nov. sp.)

Specimens of this species were collected near Mobile, Alabama, by Judge LeSene and Albert Stein, Esq. The body is more arched, the scales are larger, and the anal fin is longer and deeper, than in any other species of the genus with which we are acquainted. Color brown above, with a lighter shade bordering the broad chocolate band on the side; light brown below. Average length, two inches.

Rhinichthys atronasus Agassiz, Lake Sup. p. 354. 1850.

Syn. *Cyprinus atronasus* Mitchill, 1815; *Argyreus atronasus* Heckel, 1841; ? *Argyreus rubripinnis* Heckel, 1841; *Leuciscus atronasus* Cuv. & Val. 1844.

Rhinichthys nasutus Agassiz, Lake Sup. p. 354. 1850.

Syn. *Leuciscus nasutus* Ayres, 1843; *Argyreus nasutus* Girard; Storer, 1855.

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Rhinichthys obtusus Agassiz, Am. Journ. Sci. Arts, (2e) XVII. p. 357. 1854.
  Syn. *Argyreus obtusus* Girard, 1856.

Rhinichthys marmoratus Agassiz, Lake Sup. p. 354. 1850.
  Syn. *Argyreus marmoratus* Girard, 1856.

Bubalichthys Urus Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 194. 1855

Ichthyobus Rauchii Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 197. 1855.

Ptychostomus aureolus Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 205. 1855.

Hylomyzon nigricans Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 207. 1855.

Moxostoma oblongum Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 203. 1855.

Moxostoma tenue Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 203. 1855.

Moxostoma Sucetta Agassiz, Am. Journ. Sci. Arts, (2e) XIX. p. 203. 1855.

Catostomus bostoniensis LeSueur, Journ. Philad. Acad. Nat. Sci. I. p. 106 1817.

Catostomus Fosterianus Agassiz, Lake Sup. p. 358. 1850.

Catostomus aurora Agassiz, Lake Sup. p. 360. 1850.

From the Atlantic Coast of North America and the West Indies.

Myxine limosa Girard, Proc. Philad. Acad. Nat. Sci. X. p. 223. 1858.

This Myzont is very abundant, at certain seasons, on the coast of Grand Menan. It has never been compared, as far as we are aware, with *Myxine glutinosa* Linnæus, and as we are doubtful of its being distinct, specimens from the Old World, or at least the results of a comparison, would be very acceptable to the Museum.

Mustelus Canis DeKay, Fishes of New York, p. 355. 1842.

Acanthias americanus Storer, Synop. Fishes N. A. p. 254. 1846.

This species is viviparous. We send young taken from the mother.

Raja lævis Mitchill, Am. Month. Mag. II. p. 327. 1817.

The synonymy of the genus *Raja* is in such a confused state, that we are not certain about the identification of a single species found on our coast.

Cyclopterus lumpus Linnæus, Syst. Nat. (12 ed.) I. p. 414. 1766.

We have not been able to compare this with the species of the same name on the European coast, and therefore cannot answer for its identity. We should be happy to receive specimens from Europe.

Murænoides mucronatus Gill, Proc. Philad. Acad. Nat. Sci. XIII. App. p. 45. 1861.
  Syn. *Gunnellus mucronatus* Cuv. & Val. 1836.

Anarrhichas vomerinus AGASSIZ; STORER, Mem. Am. Acad. (2^{s}) V. p. 265. 1855.

Zoarces anguillaris STORER, Rep. Fishes of Mass. p. 66. 1839.

Gasterosteus biaculeatus MITCHILL, Trans. Lit. Phil. Soc. N. Y. I. p. 430. 1815.

The specimens included under this name are undoubtedly representatives of Mitchill's *Gasterosteus biaculeatus*, but it remains to be proved that the *G. biaculeatus* of Shaw and Mitchill are identical. There are two, if not three species, of two-spined *Gasterostei* inhabiting the Atlantic coast of North America.

Pygosteus DeKayi BREVOORT; GILL, Proc. Philad. Acad. Nat. Sci. XIII. App. p. 45. 1861.

SYN. *Gasterosteus occidentalis* DEKAY, 1842 (not of Cuv. & Val.); *Gasterosteus DeKayi* AGASSIZ, 1850.

Cryptacanthodes maculatus STORER, Rep. Fishes of Mass. p. 28. 1839.

Cottus grœnlandicus CUV. & VAL. Hist. Nat. Poiss. (4° ed.) IV. p. 135. 1829.

SYN. *Acanthocottus grœnlandicus* GIRARD, 1850.

We doubt the distinction of *Cottus variabilis* AYRES.

Cottus octodecimspinosus MITCHILL, Trans. Lit. Phil. Soc. N. Y. I. p. 380. 1815.

SYN. *Cottus virginianus* STORER, 1839; *Acanthocottus virginianus* GIRARD, 1850.

Hemitripterus acadianus STORER, Mem. Am. Acad. (2^{s}) V. p. 83. 1855.

Sebastes norvegicus CUV. & VAL. Hist. Nat. Poiss. (4° ed.) IV. p. 240. 1829.

Prionotus palmipes STORER, Mem. Am. Acad. (2^{s}) V. p. 66. 1855.

? *Trigla carolina* LINNÆUS.

Ephippus faber CUVIER, Règne An. II. p. 190. 1829.

Holacanthus ciliaris LACÉPÈDE, Hist. Nat. Poiss. IV. p. 367. 1802.

Chætodon striatus LINNÆUS, Syst. Nat. (10 ed.) I. p. 275. 1758.

Mesoprion chrysurus CUV. & VAL. Hist. Nat. Poiss. (4° ed.) II. p. 347. 1828.

Mesoprion uninotatus CUV. & VAL. Hist. Nat. Poiss. (4° ed.) II. p. 339. 1828.

Diplectrum fasciculare HOLBROOK, Ichth. S. Car. I. p. 32. 1855.

Holocentrum longipinne CUV. & VAL. Hist. Nat. Poiss. (4° ed.) III. p. 138. 1829.

The *Holocentrus sogho* BLOCH is a distinct species.

Centropristes nigricans CUV. & VAL. Hist. Nat. Poiss. (4° ed.) III. p. 28. 1829.

Centropristes atrarius HOLBROOK, Ichth. S. Car. I. p. 42. 1855.

Centropristes trifurcus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) III. p. 32 1829.

Homoprion xanthurus Holbrook, Ichth. S. Car. I. p. 170. 1855.

? *Perca punctatus* Linnæus, 1766. (Sic!!)

Considerable confusion exists in regard to this species. We send it under the name given by Dr. Holbrook, though he may be wrong in considering it as identical with LaCépède's *Liostomus xanthurus.*

Liostomus obliquus DeKay, Fishes of N. Y. p. 69. 1842.

Johnius ocellatus Girard, Ichth. Mex. Bound. II. p. 14. 1859.

Syn. *Corvina ocellata* Cuv. & Val. 1830.

Otolithus carolinensis Cuv. & Val. Hist. Nat. Poiss. (4° ed.) IX. p. 351. 1833.

Otolithus regalis Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 50. 1830.

Pogonias fasciatus LaCépède, Hist. Nat. Poiss. III. p. 138. 1802.

Umbrina alburnus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 133. 1830.

Umbrina littoralis Holbrook, Ichth. S. Car. I. p. 142. 1855.

Micropogon undulatus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 163. 1830.

Larimus fasciatus Holbrook, Ichth. S. Car. I. p. 153. 1855.

Orthopristis duplex Girard, Ichth. Mex. Bound. II. p. 15. 1859.

Orthopristis fulvomaculatus Gill, Proc. Philad. Acad. Nat. Sci. XIII. App. p. 32. 1861.

Hæmylum formosum Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 174. 1830.

In accordance with its etymology, the name *Hæmulon* is changed to *Hæmylum,* as stated in the "Nomenclator Zoölogicus."

Hæmylum elegans Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 169. 1830.

Hæmylum Arara Poey, Mém. de Cuba, II. p. 177. 1860.

Diabasis albus Scudder, MS. Apr. 1862.

Syn. *Hæmulon album* Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 179, 1830.

Anarmostus flavolineatus Scudder, MS. Apr. 1862.

Syn. *Diabasis flavolineatus* Desmarest, Decade Ichth. p. 35, 1823; *Hæmulon heterodon* Cuv. & Val. 1829.

Anarmostus serratus Scudder, MS. Apr. 1862.

Syn. ? *Hæmulon serratus* Poey, Mém. de Cuba, II. p. 181, 1860.

Bathystoma melanurum Scudder, MS. Apr. 1862.

Syn. *Perca melanura* Linnæus, Syst. Nat. (10 ed.) I. p. 292, 1758

Bathystoma Jeniguarno Scudder, MS. Apr. 1862.

Syn. *Hæmulon Jeniguarno* Poey, Mém. de Cuba, II. p. 183, 1860.

Bathystoma chrysopterum Scudder, MS. Apr. 1862.
Syn. *Hæmulon chrysopteron* Cuv. & Val. Hist. Nat. Poiss. (4° ed.) V. p. 179, 1830.

Ctenolabrus Burgall Cuv. & Val. Hist. Nat. Poiss. (4° ed.) XIII. p. 172. 1839.
Syn. *Ctenolabrus cœruleus* DeKay, 1842.

Pleuronectes maculatus Mitchill, Rep. Fishes of N. Y. p. 9. 1814.

Platessa oblonga DeKay, Fishes of N. York, p. 299. 1842.

Platessa plana Storer, Rep. Fishes of Mass. p. 140. 1839.

Achirus mollis Cuvier, Règne An. II. p. 343. 1829.

Scomber vernalis Mitchill, Trans. Lit. Phil. Soc. N. Y. I. p. 423. 1815.

Peprilus triacanthus Storer, Rep. Fishes of Mass. p. 60. 1839.

Temnodon Saltator Cuvier, Règne An. II. p. 207. 1829.

Atherina notata Mitchill, Trans. Lit. Phil. Soc. N. Y. I. p. 446. 1815.

Ammodytes americanus DeKay, Fishes of N. York, p. 317. 1842.

Phycis americanus Storer, Rep. Fishes of Mass. p. 138. 1839.

Phycis filamentosus Storer, Mem. Am. Acad. VI. p. 367. 1859.

Merluccius albidus DeKay, Fishes of N. York, p. 280. 1842.

Merlangus purpureus Storer, Rep. Fishes of Mass. p. 130. 1839.

Morrhua americana, Storer, Rep. Fishes of Mass. p. 120. 1839.

Gadus Æglefinus Linnæus, Syst. Nat. (10 ed.) I. p. 251. 1758.

Clupea elongata LeSueur, Journ. Philad. Acad. Nat. Sci. I. p. 234. 1818.

Alausa Menhaden Storer, Rep. Fishes of Mass. p. 117. 1839.

Osmerus viridescens LeSueur, Journ. Philad. Acad. Nat. Sci. I. p. 230. 1818.

Mallotus villosus Cuvier, Règne An. II. p. 306. 1829.

Fundulus pisculentus Cuv. & Val. Hist. Nat. Poiss. (4° ed.) XVIII. p. 143. 1846.

Fundulus heteroclitus Cuvier, Règne An. II. p. 280. 1829.
Syn. *Cobitis heteroclita* Linnæus, 1766; *Fundulus cœnicolus* Cuv. & Val. 1846.

Fundulus spilotus Holbrook, (MS. ?) 1854.
Syn. *Fundulus guttatus* Agassiz, MS. 1854 (female).

Hydrargyra majalis Cuv. & Val. Hist. Nat. Poiss. (4° ed.) XVIII. p. 155. 1846.
Syn. *Hydrargyra flavula* Storer, 1839.

Hydrargyra similis Baird & Girard, Proc. Philad. Acad. Nat. Sci. VI. p. 389. 1853.

Zygonectes chrysotus AGASSIZ, MS. 1861.

SYN. *Fundulus chrysotus* AGASSIZ; HOLBROOK, 1853 (MS.?).

Cyprinodon variegatus LACÉPÈDE, Hist. Nat. Poiss. V. p. 487. 1803.

Pœcilia latipinna AGASSIZ, MS. 1858.

SYN. *Mollinesia latipinna* LESUEUR, (male); *Pœcilia multilineata* LESUEUR, (female,) Journ. Philad. Acad. Nat. Sci. II. pp. 3, 4, 1821.

Gambusia Holbrookii GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 61. 1859.

SYN. *Heterandria Holbrookii* AGASSIZ, 1853.

Girardinus formosus GIRARD, Proc. Philad. Acad. Nat. Sci. XI. p. 62. 1859.

SYN. *Heterandria formosa* AGASSIZ, 1853.

These last three species are viviparous. *G. formosus* is the smallest known Vertebrate.

From the Pacific Coast of North America.

Triacis semifasciata GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 196. 1854.

SYN. *Mustelus Felis* AYRES, 1854.

Triacis Henlei PUTNAM.

SYN. *Isoplagiodon* sp. GILL, 1862; *Rhinotriacis Henlei* GILL. Proc. Philad. Acad. Nat. Sci. XIV. p. 486, 1862.

The characters given by Mr. Gill to the genus *Rhinotriacis* are, in our estimation, only of specific value. Mr. Gill's specimen being immature probably accounts for the apparent difference between the teeth of this species and those of *T. semifasciata*, for in our numerous examinations we have found teeth on both jaws having two distinct notches on each side of the central point, although these five-lobed teeth are more numerous in the lower than in the upper jaw. *T. Henlei* differs principally from *T. semifasciata* in its longer, flattened, and pointed snout; in its scales not being so strongly tri-lobed, and in the color, which is of a uniform brownish gray above, becoming lighter below. In young individuals the color is redder above and white below. In all specimens the two dorsals and the caudal are tipped with black. *T. Henlei* is more slender than *T. semifasciata*, but attains about the same length.

Acanthias Suckleyi GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 196. 1854.

Porichthys notatus GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 141. 1854.

Leptocottus armatus GIRARD, Proc. Philad. Acad. Nat. Sci. VII. p. 131. 1854.

Scorpænichthys marmoratus Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 131. 1854.

Ambloplites interruptus Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 129. 1854.

Genyonemus lineatus Gill, Proc. Philad. Acad. Nat. Sci. XIII. p. 87. 1861.
Syn. *Leiostomus lineatus* Ayres, 1855.

Embiotoca Jacksoni Agassiz, Am. Journ. Sci. Arts, (2^e) XVI. p. 387. 1853.
Syn. *Holconotus fuliginosus* Gibbons, 1854; *Embiotoca Cassidyi* Girard, 1854; *Embiotoca Webbi* Girard, 1855.

Hypsurus Caryi A. Agassiz, Proc. Boston Soc. Nat. Hist. VIII. p. 133. 1861.
Syn. *Embiotoca Caryi* Agassiz, 1853; *Holconotus Gibbonsii* Cal. Acad. Nat. Sci. 1854.

Tæniotoca lateralis A. Agassiz, Proc. Boston Soc. Nat. Hist. VIII. p. 133. 1861.
Syn. *Embiotoca lateralis* Agassiz, 1854; *Holconotus Agassizi* Gibbons, 1854; *Embiotoca lineata* Girard, 1854; *Embiotoca ornata* Girard, 1855; *Embiotoca perspicabilis* Girard, 1855; *Damalichthys lateralis* Gill, 1862.
This species is, without doubt, congeneric with Ditrema of the "Fauna Japonica."

Damalichthys Vacca Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 321. 1855.

Cymatogaster aggregatus Gibbons, Proc. Cal. Acad. Nat. Sci. May 18, 1854.
Syn. *Micrometrus aggregatus* Gibbons, 1854; *Holconotus rhodoterus* Girard, 1854 (not of Agassiz); *Metrogaster lineolatus* Agassiz, MS.

Micrometrus minimus Gibbons, Proc. Cal. Acad. Nat. Sci. May 30, 1854.
Syn. *Cymatogaster minimus* Gibbons, 1854; *Holconotus Trowbridgii* Girard, 1854; *Abeona Trowbridgii* Girard, 1855; *Abeona minima* Gill, 1862.

Rhacochilus toxotes Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 367. 1854.
Syn. *Pachylabrus variegatus* Gibbons, 1854.

Amphistichus argenteus Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 367. 1854.
Syn. *Mytilophagus fasciatus* Gibbons, 1854; *Amphistichus similis* Girard, 1854.

Holconotus rhodoterus Agassiz, Am. Journ. Sci. Arts, (2^e) XVII. p. 368. 1854 (not of Girard).
Syn. *Cymatogaster Larkinsii* Gibbons, 1854; ? *Cymatogaster ellipticus* Gibbons, 1854; *Amphistichus Hermanni* Girard, 1854; *Ennichthys Hermanni* Girard, 1855.

Hyperprosopon argenteum Gibbons, Proc. Cal. Acad. Nat. Sci. May 18, 1854.

Syn. *Holconotus megalops* Girard, 1854; *Ennichthys megalops* Girard, 1855; *Bramopsis Mento* Agassiz, MS.

Hyperprosopon arcuatum Gibbons, Proc. Cal. Acad. Nat. Sci. May 30, 1854.

Syn. *Hyperprosopon argenteum* var. *punctatum* Gibbons, 1854; *Hyperprosopon Agassizi* Gill, 1862.

For a full revision of the Synonymy of the Holconoti, see *Notes on the Described Species of Holconoti found on the Western Coast of North America*, by A. Agassiz, in the Proc. Boston Soc. Nat. Hist. Vol. VIII. p. 122. 1861.

Platichthys rugosus Girard, Proc. Philad. Acad. Nat. Sci. VII. p. 139. 1854.

We send both natural and reversed specimens of this species.

From the East Indies.

Pegasus natans Linnæus, Syst. Nat. (12 ed.) I. p. 418. 1766.

Scatophagus Argus Cuv. & Val. Hist. Nat. Poiss. VII. p. 103. 1831.

From Europe.

Trachinus Vipera Cuv. & Val. Hist. Nat. Poiss. (4° ed.) III. p. 189. 1829.

Agonus cataphractus Bloch, Syst. Ichth. ed. Schn. p. 104. 1801.

Tinca vulgaris Cuvier, Règne An. II. p. 193. 1817.

Gobio fluviatilis Agassiz, Mem. Soc. Neuch. I. p. 36. 1834.

Leuciscus rodens Agassiz, Mem. Soc. Neuch. I. p. 39. 1834.

Leuciscus prasinus Agassiz, Mem. Soc. Neuch. I. p. 46. 1834.

Published, April 28, 1863.

No. 2. — List of the Echinoderms sent to different Institutions in Exchange for other Specimens, with Annotations. By A. AGASSIZ.*

Phyllacanthus BR. Prod. (emend.). — *Leiocidaris* DESOR, Synop.

Phyllacanthus imperialis BR.

Under the name of *Cidaris imperialis* two very distinct species have been confounded, one of which (*Ph. fustigerus* A. AG.) is found in New Holland and the East India Islands, while the other species (*Ph. imperialis*), of which a good figure is given by Seba, is found at Zanzibar and Mozambique.

Cidaris KLEIN, Disp. Nat. Echin. (emend.).

This genus is here limited in such a way as to include only the following and allied species: —

Cidaris Thouarsii VAL. Ag. Cat. Rais. — Panama.

Cidaris tribuloides LAMK. An. s. Vert. — Red Sea.

Cidaris annulata GRAY, Proc. Zoöl. Soc. 1855. — Florida.

Cidaris baculosa LAMK. An. s. Vert. (non Mich.). — Red Sea.

A good figure of this species is given by Savigny, Descrip. Egypt. Zool., Pl. 7, fig. 1, which is very different from the figure given by Michelin, Mag. Zool., IV., Pl. 8. The last is a *Prionocidaris*, and probably the *C. pistillaris* LAMK.

Gymnocidaris A. AG.

Gymnocidaris metularia A. AG.

SYN. *Cidaris metularia* LAMK. An. s. Vert. — Zanzibar.

Gymnocidaris minor A. AG.

This species, which is found at the Sandwich and Kingsmills Islands, differs from the *G. metularia* in the proportions of the ovarian and ocular plates. The genital plates are much smaller than in the *C. metularia*, in which they cover nearly the whole of the abactinal system.

Orthocidaris AG.

Orthocidaris hystrix AG.

SYN. *Cidaris hystrix* LAMK. An. s. Vert. — Nice.

Orthocidaris affinis AG.

SYN. *Cidaris affinis* PHIL. Wieg. Archiv., 1845; *Cidaris Stokesi* AG. Cat. Rais. — Mediterranean.

To this genus belongs also *Cidaris papillata* FLEM.

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* Descriptions of the new genera based upon species already known may be found in the "Illustrated Catalogue of the Museum." — L. AGASSIZ.

Temnocidaris A. Ag.

Unlike the other genera allied to *Cidaris*, the abactinal system of this genus is deeply notched in the angles of the interambulacral plates.

Temnocidaris canaliculata A. Ag.

The spines of this species resemble those of *Orthocidaris hystrix;* they are very short, hardly equal in length to the diameter of the test. Coronal plates high, tubercles with a large scrobicular circle sunk below the level of the miliaries. — Caroline Islands.

Prionocidaris A. Ag.

Prionocidaris pistillaris A. Ag.

Syn. *Cidaris pistillaris* Lamk. An. s. Vert. — Zanzibar.

Stephanocidaris A. Ag.

Stephanocidaris tubaria A. Ag.

Syn. *Cidaris tubaria* Lamk. An. s. Vert. — New Holland.

Chondrocidaris A. Ag.

The whole test, with the exception of the scrobicular circle, covered with very small, closely-packed granules, supporting minute spines. Spines resembling those of the genus *Rhabdocidaris*. Median ambulacral area convex.

Chondrocidaris gigantea A. Ag.

The scrobicular circle is small, not occupying more than half the length of the plate. Plates of actinal system covered with long, narrow spines. Median ambulacral space containing eight rows of small tubercles, of uniform size. The primary spines are large, with a tendency of the angles of the grooves to run into thin, sharp lamellæ, and spread, fan-shaped, at the extremity. — Sandwich Islands.

Goniocidaris Ag. Cat. Rais.

Goniocidaris geranioides Ag. Cat. Rais. — Hobart Town.

Astropyga Gray, Ann. Phil. 1828.

Astropyga radiata Gray, Ann. Phil. 1828. — Zanzibar.

Syn. *Astropyga Mossambica* Pet. Seeig. v. Moss.

Garelia Gray, Proc. Zoöl. S. Lond. 1855. — *Savignya* Des. Syn.

Garelia subularis A. Ag.

Syn. *Astropyga subularis* Ag. Cat. Rais.; *Echinothrix subularis* Pet. Seeig. v. Mossambique; *Savignya subularis* Des. — Red Sea.

Garelia cincta A. Ag.

Interambulacral space with six vertical rows of large tubercles, four vertical rows of small tubercles in ambulacral space, which increases regularly in width towards the abactinal region, where it is slightly petaloid. Poriferous zone broad. Spines of interambulacra equalling in length two thirds of the diameter of the test; polar diameter depressed. This species may be the *Echinothrix turcarum* of Peters, which is undoubtedly a *Garelia*, and not an *Echinothrix*. — Kingsmills and Sandwich Islands.

Echinothrix Pet. Secig. v. Moss. (emend.). — *Savignya* Des. Syn.

This genus has been restricted in such a manner, that the species, such as *Diadema subulare* Ag., *D. turcarum* Rumph., placed by Peters in this genus, have been removed to the genus *Garelia* of Gray, containing species which can at once be distinguished from *Echinothrix* by their short and longitudinally striated spines, while the genus *Echinothrix*, as limited here, contains species having broad ambulacra, and spines resembling those of *Diadema*.

Echinothrix annellata Pet. Secig. v. Moss. — Zanzibar.

Echinothrix aperta A. Ag.

Eight rows of large tubercles in interambulacral space; bare space of interambulacrum extending below the equatorial line of test. Anal membrane very large; genital and ocular plates small; anal plates very small, disconnected. The spines vary much in color; in some specimens they are yellowish, in others perfectly black, in others whitish mixed with black. — Society Islands.

Echinothrix scutata A. Ag.

Ambulacra more pointed towards the abactinal region than in the preceding species. Spines shorter and more slender in proportion to the test. Can at once be distinguished by the large size of the genital and ocular plates, and the coating of prominent plates over the greater part of the anal membrane, which is quite small. One row of small tubercles extending along the poriferous zone in interambulacral space. — Sandwich Islands.

Diadema Gray, Ann. Phil. 1828.

Diadema antillarum Phil. Wieg. Archiv. 1845. — Florida.

Syn. *Cidaris diadema* Lamk. An. s. Vert. (non *Diadema turcarum* Rumph.).

Diadema Savignyii Mich. Guér. Mag. Zool. 1845; Ag. Cat. Rais. 1847. — Zanzibar.

Diadema paucispinum A. Ag.

Outline, when seen from above, pentagonal; ambulacra very prominent, large openings for suckers, poriferous zone narrow near actinostome. Cuts of actinal system deep. Interambulacral tubercles arranged in six rows, four large and two small median rows; high coronal plates, which gives this species the appearance of being but sparingly covered with spines; spines stout, equalling in length diameter of test. — Sandwich Islands.

Diadema mexicanum A. Ag.

Abactinal system much smaller in proportion to actinal than in any other species of the genus. Spines exceedingly long, equalling in length twice the diameter of test, moderately stout. Outline of spherosome perfectly circular, regularly arched in profile. Cuts of actinal system slight. The large tubercles extend almost to abactinal system. — Acapulco.

Diadema globulosum A. Ag.

This is a small species, perfectly globular, with only four rows of large tubercles in interambulacrum; abactinal system depressed. Remarkable for the great length and extreme slenderness of the spines; they are at least three times the diameter of test; actinal portion of test very convex. — Kingsmills and Society Islands.

Echinocidaris Desml. Etud. Echin. (emend.). — *Agarites* Ag. Cat. Rais.

Echinocidaris punctulata Desml. Etud. Echin.

Syn. *Echinocidaris* (*Agarites*) *punctulata* Ag. Cat. Rais. — Charleston, South Carolina.

Echinocidaris Davisii Ag.

Differs from the South Carolina species in having a greater number of tubercles closely packed together. Spines quite short, granulation round the primary tubercles very prominent. Color of test and spines dark violet, almost black. Tubercles very crowded in ambulacral space. — Naushon, Massachusetts, south of Cape Cod.

Echinocidaris incisa A. Ag.

Abactinal system very prominent, sutures between the plates well marked; tubercles large, spines short, stout, color yellowish-brown. — Guayamas, Panama.

Arbacia Gray (non Ag.). — *Tetrapygus* Ag. Cat. Rais.

Arbacia nigra Gray.

Syn. *Echinocidaris* (*Tetrapygus*) *nigra* Ag. Cat. Rais. — Mejillones.

Arbacia æquituberculata Gray.

Syn. *Echinocidaris* (*Tetrapygus*) *æquituberculata* Ag. Cat. Rais. — Fayal.

Echinostrephus A. Ag.

Small sea-urchins with tubercles resembling those of *Holopneustes* in their arrangement, with narrow poriferous zones, pores arranged in arcs. Abactinal system raised above level of abactinal part of test. Large genital plates occupying nearly the whole of this system. Actinal system large, circular, no indentations. Spines long, slender, longitudinally striated. Test convex near actinal portion, flattened above, the greatest diameter being nearer the abactinal pole. Auricles of medium size, with a large opening and no connecting ridge. Teeth provided with transverse arc.

Echinostrephus aciculatus A. Ag.

Tubercles of ambulacral and interambulacral space of the same size. Spines long, equalling diameter of test. Anal system small, pores arranged in arcs of four pairs. — Kingsmills and Sandwich Islands.

Heterocentrotus Br. Prod. (emend.)

Heterocentrotus mammillatus Br. Prod.

Syn. *Heterocentrotus carinatus* Br. Prod.; *H. Postellsii* Br.; *Acrocladia mammillata* Ag. Cat. Rais.; *A. hastifera* Ag. Cat. Rais. — Sandwich Islands.

Acrocladia Ag. (emend.)

Acrocladia trigonaria Ag. Cat. Rais. — Kingsmills Islands.

Acrocladia cuspidata A. Ag.

Syn. *Acrocladia trigonaria* Mich. Faune de Maurice (non Ag.)

Circular outline of test, uniform size of tubercles, distinctness of ocular and genital plates, distinguish this species. Spines triangular, rather short, tapering rapidly. — Mauritius.

Podophora Ag. Cat. Rais. (emend.).

Podophora atrata Ag. Cat. Rais. — Mauritius.

Podophora Quoyi A. Ag.

Syn. *Echinometra Quoyi* Bl. non *P. Quoyi* Ag. — Sandwich Islands.

Colobocentrotus Leskei Br. belongs to a different genus. *Podophora* has, therefore, been retained for the preceding species, although Brandt included the *P. atrata* in his genus *Colobocentrotus*. (See Cat. Echin. N. P. Ex. Ex.)

Echinometra Breyn.

Echinometra Michelini Des., Ag. Cat. Rais. — Florida.

It is with some doubt that the common *Echinometra* of Florida is referred to this species.

Echinometra oblonga Bl. Dict. Sc. Nat. — Sandwich Islands.

Echinometra acufera Bl. Dict. Sc. Nat. — Zanzibar.

Echinometra lucunter Lamk.

Echinometra Mathœi Ag. Cat. Rais. p. p. (non Bl.) — Sandwich, Society, and Kingsmills Islands.

Echinometra VanBrunti A. Ag.

Remarkable for its flatness, the height of its tubercles, and the narrowness of the poriferous zone. Spines long and slender, of uniform size, color dark violet. — Acapulco.

Echinometra rupicola A. Ag.

Closely allied to *E. VanBrunti;* differs from it by the smaller number of tubercles, the great difference in size between the ambulacral and interambulacral tubercles, large ocular and genital plates, smaller spines, and broad poriferous zone. — Panama.

Echinometra microtuberculata A. AG.

Can easily be distinguished from *E. lucunter*, to which it is closely allied, by the great height of the polar diameter, the large number and uniform size of the small tubercles, the arched test, and short, stout spines. Color light green. — Sandwich and Kingsmills Islands.

Echinometra viridis A. AG.

The genital plates are greatly developed, smooth, occupying nearly the whole of the abactinal area. Tubercles very prominent. Spines short, stout. Color generally light green. — Florida.

Echinometra plana A. AG.

Flat species with a circular outline; abactinal region less covered with spines than rest of test. Spines long, sharp, equalling in length the diameter of test. Tubercles distant, not numerous. — Hayti.

Parasalenia A. AG.

Resembles *Salenia* in having the abactinal system raised. There are only four anal plates, as in *Echinocidaris*, otherwise resembles *Echinometra*. The genital and ocular plates are smooth. Pores in pairs, forming an irregular vertical line.

Parasalenia gratiosa A. AG.

Outline elliptical. Tubercles arranged in two vertical rows in ambulacral and interambulacral spaces. Spines moderately long, tapering gradually. Tubercles of ambulacra closely crowded; miliaries small, not numerous. — Kingsmills and Society Islands.

Heliocidaris DESML. (emend.).

Heliocidaris variolaris DESML. Etud. Echin. — Zanzibar.

Toxocidaris A. AG.

Toxocidaris Delalandi A. AG.

SYN. *Heliocidaris Delalandi* AG. Cat. Rais. — Port Jackson.

Toxocidaris mexicana A. AG.

SYN. *Heliocidaris mexicana* AG. Cat. Rais. — Acapulco.

Toxocidaris franciscana A. AG.

This species grows to a very large size. High coronal plates, large openings for suckers. Pores arranged in arcs of nine pairs. Two very prominent rows of large tubercles in interambulacral space. The large tubercles of ambulacra of same size as secondary of interambulacra. Spines long, tapering gradually, equalling in length two thirds the diameter of test. — San Francisco.

Toxopneustes Ag. Cat. Rais. (emend.).

Toxopneustes drobachiensis Ag. Cat. Rais.
Syn. *E. drobachiensis* Müll. Zool. Dan.; *E. chlorocentrotus* Br. Prod.; *E. granularis* Say, Journ. Phil. Ac. v. 182; *E. granulatus* Gould, Invert. Mass.; *E. neglectus* Lamk. An. s. Vert. — Massachusetts Bay, Grand Menan, Puget Sound.

Toxopneustes lividus Ag. Cat. Rais. — Fayal.

Loxechinus Des. Synops. Echin. Foss.

Loxechinus albus Des. Synops.
Syn. *E. albus* Mol.; Ag. Cat. Rais. — Mejillones.

Loxechinus purpuratus A. Ag.
Syn. *E. purpuratus* Stimps. Crust. Echin. Pacif. Sh. N. A. — San Francisco.

Psammechinus Ag. Cat. Rais. (emend.).

Psammechinus miliaris Ag. Cat. Rais. — Norway.

Psammechinus microtuberculatus Ag. Cat. Rais. — Mediterranean.

Psammechinus chloroticus A. Ag.
Syn. *Heliocidaris chloroticus* Ag. Cat. Rais.; *Psammechinus asteroides* Gir. Proc. Bost. Soc. — New Zealand.

Echinus L. (Des. emend.)

Echinus esculentus L.
Syn. *Echinus sphæra* Müll. Zool. Dan. — Norway.

Echinus melo Lamk. An. s. Vert. — Nice.

Echinus Flemingii Ball, Forb. Brit. Starfishes. — Great Britain.

Sphærechinus Des. Synops. Echin. Foss.

Sphærechinus brevispinosus Des. Synops.
Syn. *Echinus brevispinosus* Risso, Hist. Nat. Eur. Mér. — Nice.

Sphærechinus granularis A. Ag.
Syn. *Echinus granularis* Lamk. An. s. Vert. — Fayal.

Temnopleurus Ag. Cat. Rais.

Temnopleurus toreumaticus Ag. Cat. Rais. — East India.

Temnopleurus Reevesii A. Ag.
Syn. *Toreumatica Reevesii* Gray, Proc. Zoöl. Soc. 1855. — Hong-Kong.

Toreumatica Gray.

Toreumatica concava Gray, Proc. Zoöl. Soc. 1855. — Hong-Kong.

Salmacis Ag. Cat. Rais.

Salmacis bicolor Ag. Cat. Rais. — Zanzibar.

Melobosis Gir. Proc. Bost. Soc. Nat. Hist. 1850.

Melobosis rarispinus A. Ag.

Syn. *Salmacis rarispinus* Ag. Cat. Rais. — East India.

Lytechinus Ag. — *Psammechinus* Ag. p. p.

Lytechinus carolinus Ag.

Syn. *Echinus variegatus* Rav. (non Lamk.), Cat. Echin. So. Car. — South Carolina, Georgia, and Florida.

Lytechinus variegatus A. Ag.

Syn. *Echinus variegatus* Lamk. (non Rav.); *Psammechinus variegatus* Ag. Cat. Rais. — Cienfuegos, Hayti.

Lytechinus atlanticus A. Ag.

Readily distinguished from the South Carolina species by the large number of tubercles in each vertical row, and from the *L. variegatus* by the smaller size of its spines. — Bermudas.

Boletia Ag. Cat. Rais. — *Hemiechinus* Gir. Proc. Bost. Soc. N. H. 1850.

Boletia granulata A. Ag.

Remarkable for its comparatively long spines. Tubercles uniform in size, very closely crowded together. — Sandwich Islands.

Boletia rosea A. Ag.

Spines exceedingly short and stout; the exterior row of tubercles in ambulacral and interambulacral space of greater size. — Acapulco.

Tripneustes Ag. Cat. Rais. (emend.)

Tripneustes ventricosus Ag. Cat. Rais. — Florida.

Syn. *Heliechinus Gouldii* Gir. Proc. Bost. Soc. Nat. Hist. 1850.

The genus is here limited to species in which the median ambulacral and interambulacral space is covered with tubercles. There is in the collection of the Smithsonian a species from Guayamas, *T. depressus* A. Ag., closely allied to *T. ventricosus*, which differs from it in the flatness of the test, the large and uniform size of the tubercles, and the stoutness of its spines.

Hipponoë Gray, 1841; Proc. Zoöl. Soc. 1855.

Hipponoë sardica Gray, Proc. Zoöl. Soc. 1855.

Syn. *Tripneustes sardicus* Ag. Cat. Rais. — Zanzibar.

Hipponoë violacea A. Ag.

Tubercles small, numerous, of uniform size; abactinal portion of test regularly arched. Spines short, slender; color of test dark violet. — Sandwich and Kingsmills Islands.

Hipponoë nigricans A. Ag.

Row of large tubercles in interambulacral space near the oral area other tubercles small. Ambulacral zone broad near abactinal region, with double concave outline near the middle of test. Color of test black; spines of same color mixed with spines of straw-color. — Society Islands.

Echinoneus Van Phel.

Echinoneus elegans Des. Monog. des Galérites. — Hayti.

Echinocyamus Van Phel.

Echinocyamus angulosus Leske, Addiment. ad Klein. Ech. — Norway.

Fibularia Lamk.

Fibularia volva Ag. Cat. Rais. — Red Sea.

Clypeaster Lamk. (emend.). — *Echinanthus* Gray (non Des.).

Clypeaster rosaceus Lamk. An. s. Vert. — Florida.

Stolonoclypus Ag.

Stolonoclypus placunarius Ag.

Syn. *Clypeaster placunarius* Lamk. An. s. Vert. — Red Sea.

Stolonoclypus prostratus Ag.

Syn. *Clypeaster prostratus* Rav. Cat. Echin. So. Car. — Florida.

Stolonoclypus rotundus A. Ag.

Closely allied to *S. prostratus*, from which it differs by its almost circular outline, its thin edge, the great size of the ambulacral rosette, and width of the ambulacral system. — Acapulco.

Rhaphidoclypus A. Ag.

Rhaphidoclypus scutiformis A. Ag.

Syn. *Clypeaster scutiformis* Lamk. An. s. Vert. — Red Sea.

Rhaphidoclypus microtuberculatus A. Ag.

Differs from *R. scutiformis* by its elongated ambulacral rosette, and the great number and small size of the closely crowded tubercles. — Kingsmills Islands.

Rumphia Des. Synop. Echin. Foss. — *Polyaster* Mich. Guér. Rev. de Zool. 1859. — *Michelinia* Duj. et Hupé, Echin.

Rumphia Lesueuri A. Ag.

Syn. *Laganum Lesueuri* Ag. Cat. Rais.; *Polyaster elegans* Mich. Guér. Rev. de Zool.; *Michelinia elegans* Duj. et Hupé.

This species is mentioned by Professor Agassiz as coming from Guadeloupe; this is probably a mistake. There are no specimens of his *L. Lesueuri* in the Museum, and the present species is identified with the figures in his Monog. des Scutelles. It is undoubtedly the *Polyaster elegans* of Michelin. — Hong-Kong.

Laganum Kl. Nat. Disp. Echin.

Laganum depressum Less., Ag. Cat. Rais.

Syn. *Laganum attenuatum* Ag.; *Laganum pentagonum* Ag. MS. — Kingsmills Islands.

Echinarachnius Van Phels.

Echinarachnius parma Gray, An. Phil. 1825.

Syn. *Echinarachnius atlanticus* Gray; Ag. Cat. Rais. — New England, Grand Menan.

Dendraster Ag. Cat. Rais.

Dendraster excentricus Ag. Cat. Rais. — San Francisco.

Echinodiscus Breyn. (Gray, non Desor), Brit. Mus. Cat. (emend.).*

Echinodiscus biforus Gray, Cat. Brit. Mus.

Syn. *Lobophora bifora* Ag. Cat. Rais. — Madagascar.

Lobophora Ag. Cat. Rais. (emend.).

Lobophora bifissa Ag. Cat. Rais. — Zanzibar.

Echinoglycus Van Phels. (Gray), Brit. Mus. Cat. (emend.).

Echinoglycus Stokesi Gray, Cat. Brit. Mus.

Syn. *Lobophora Stokesi* Ag. — Panama.

Encope Ag. Cat. Rais. — *Echinoglycus* Gr. p. p.

Encope Valenciennesii Ag. Cat. Rais. — Cumana.

Encope grandis Ag. Cat. Rais. — Gulf of California.

Encope Michelini Ag. Cat. Rais. — Tampa Bay, Florida.

Rotula Kl. Nat. Disp. Echin.

Rotula Rumphii Kl. Nat. Disp. Echin. — Cape Palmas.

Rotula Augustii Kl. Nat. Disp. Echin. — Cape Palmas.

Mellita Kl.

Mellita testudinata Kl. Nat. Disp. Echin. — South Carolina, Florida, Texas.

Mellita quinquefora Ag. Cat. Rais. — Cumana.

Mellita hexapora Ag. Cat. Rais. — West Indies, Florida.

Mellita longifissa Mich. Rev. Mag. Zool. 1858. — Panama.

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* In order not to introduce additional names, the old genera *Echinodiscus* and *Echinoglycus*, as adopted by Gray, have been circumscribed so as to include the species which are here separated from *Lobophora* and *Encope* of Agassiz, as representatives of new genera.

Pygorhynchus Ag.

Pygorhynchus pacificus Ag.

This species is a living representative of the genus *Pygorhynchus*, thus far only known as fossil. It resembles in outline *Echinolampas*. The vent is transverse, supra-marginal. The lower side is almost flat, the edges of the test being slightly raised. The very broad, smooth band, shaped like a dagger, extending entirely round the mouth and reaching the anterior and posterior edge of the test, and the rosette of large pores round the mouth, are characters of the genus which are not easily seen in fossil specimens. As specific, whole upper surface covered with short silk-like spines. Tubercles of lower side large, sunken, increasing in size as they approach the smooth band. Spines long, sharp, very slightly arched, comparatively much stouter than on upper part of test. — Acapulco.

Spatangus Kl.

Spatangus purpureus Müll. Zool. Dan. — North Europe.

Spatangus meridionalis Risso, Hist. Nat. Eur. Mérid. — Mediterranean.

Maretia Gray, Cat. Brit. Mus.

Maretia planulata Gray, Cat. Brit. Mus.

Syn. *Spatangus planulatus* Lamk. An. s. Vert.; *Trichoproctus tenui* Ag. MS. — Kingsmills Islands.

Lovenia Ag. Cat. Rais.

Lovenia hystrix Ag. Cat. Rais. — Zanzibar.

Echinocardium Gray, Cat. Brit. Mus. (emend.). — *Amphidetus* Ag. Cat. Rais. p. p.

Echinocardium cordatum Gray, Cat. Brit. Mus.

Syn. *Amphidetus cordatus* Ag. Cat. Rais. — North Europe.

Amphidetus Ag. (emend.)

Amphidetus ovatus Ag. Cat. Rais. — North Europe.

Brissus Klein (Ag. Cat. Rais.).

Brissus carinatus Lamk. (non Ag.), An. s. Vert. — Sandwich Islands.

Brissus columbaris Ag. Cat. Rais. — Florida.

Kleinia Gray, Ann. & Mag. 1851.

Kleinia nigra A. Ag.

Test rather depressed, ambulacral rosette narrow, long; peripetalous fasciole extending almost to the circumference; spines rather short, sharp, stout, black. — Acapulco.

It is with some doubt that this species is referred to the genus *Kleinia*; should it prove a different genus, I would suggest the name *Rhyssobrissus* for it.

Xanthobrissus A. Ag.

This genus is closely allied to *Meoma* of Gray; differs from it by the position of the vertex, which is near the anterior extremity. Lateral ambulacra of equal size, anterior ambulacrum in a deep groove. Subanal fasciole heart-shaped, with lateral branches extending to the side of the anal system.

Xanthobrissus Garretti A. Ag.

Syn. *Brissopsis Garretti* Ag. MS.

Anal system large, pointed at both extremities. Posterior ambulacra arched exteriorly; few large tubercles near the apex of rosette on both sides of anterior ambulacra. Tubercles numerous, small. Spines very slender, quite long. — Kingsmills Islands.

Brissopsis Ag. Cat. Rais.

Brissopsis lyrifera Ag. Cat. Rais. — North Europe.

Agassizia Val., Ag. Cat. Rais.

Agassizia scrobiculata Val., Ag. Cat. Rais. — Panama.

Mœra Mich. Rev. et Mag. de Zool. 1855. — *Schizaster* Ag. p. p.

Mœra atropos Mich. Rev. et Mag. de Zool.

Syn. *Schizaster atropos* Ag. Cat. Rais.; *Schizaster lachesis* Gir. Proc. Bost. Soc. Nat. Hist. 1850. — Charleston, S. C., and Texas.

Published August 15, 1863.

No. 3. — List of the Polyps and Corals sent by the Museum of Comparative Zoölogy to other Institutions in Exchange, with Annotations. *By* A. E. Verrill.

ALCYONARIA.

Renilla reniformis Cuvier, Règne An. 2d ed. III. p. 319, 1830 (non Herklotz).

Syn. *Pennatula reniformis* Pallas, Elench. Zooph. 1766; *Renilla americana* Lamarck, 1816; *Renilla reniformis* Agassiz, Proc. Amer. Assoc. 1850. — Charleston, South Carolina; L. Agassiz.

Renilla Danæ Verrill, MS. 1861.

Syn. *Renilla americana* (*pars*) Dana, Zoöph. Pl. 57, f. 1; *Renilla reniformis* Herklotz.

This differs widely from *R. reniformis* in its broad, rounded form, it being wider than long, while the preceding is longer than broad; in its much deeper sinus and overlapping posterior lobes; in its costate and granulous under surface, which in the other is nearly smooth with lighter radiating lines; in its more crowded and smaller polyps; and in having much more prominent spicula on the upper surface around the cells. Its color, also, is darker purple. — Rio Janeiro; J. D. Dana, U. S. Expl. Exp.

Renilla peltata Verrill.

This is a very large species, readily distinguished by its very broad, thick frond, nearly straight on the outer margin, shallow sinus, and central position of the peduncle. The cells are larger than in any other known species, and armed with five prominent spicula. Color of alcoholic specimens, light purple. — Breton Island, near the mouth of the Mississippi River; C. T. Pierce.

Renilla patula Verrill.

Very large and thin, with a broadly reniform frond, regularly rounded at the outer margin; sinus very deep, dividing the frond beyond the middle, with the posterior lobes considerably overlapping. Cells rather small, with five slightly prominent lobes. Polyps very long when expanded. Lower surface slightly scabrous, marked with scarcely raised radiating lines. Peduncle attached close to the margin of the sinus. — Cumana, Ven., South America; J. P. Couthouy.

Renilla amethystina Verrill.

Broad reniform, wider than long; sinus narrow; peduncle inserted near its edge. Under surface rough, with numerous large spicula. Cells small and crowded. Color deep purple; spicula amethystine. — Panama; T. Rowell.

Stylatula Verrill.

Elongated, slender, nearly cylindrical; near the base naked, bulbous at the end. Pinnæ short, supported by numerous strong radiating spines, the polyps clustered on their upper surface. Axis sub-cylindrical, extending through nearly the whole length.

Stylatula gracilis Verrill.

Very slender, nearly cylindrical above; base swollen. Pinnæ at first very narrow, leaving a linear naked space between the two rows on both sides; higher up they overlap and are much crowded, thirty-two in an inch. Length, a foot or more; diameter, .12 inch. Cape St. Lucas, California; J. Xantus.

Stylatula elongata Verrill.

Syn. *Virgularia elongata* W. M. Gabb, Proc. California Acad. Nat. Sci. II. 167, 1863.

Larger and stouter than the preceding. Pinnæ broader and more overlapping, leaving a naked space between the rows for only a short distance; in the middle, twenty occupy an inch. The spines are also larger and fewer. — San Francisco, California; A. Agassiz.

Funiculina Forbesii Verrill.

Syn. *Pavonaria quadrangularis* (*pars*) Johnson.

A careful examination of several perfect specimens of this species, collected on the coast of Scotland by Mr. Stimpson, proves it to be distinct from that of the Mediterranean, first figured and described by Bohadsch, and afterwards named *Pennatula quadrangularis* by Pallas.

It is much more slender than the latter, with far less numerous and crowded polyps; these are arranged in oblique series of two or three, instead of five; the outer ones are the largest, those occupying the central region being rudimentary and papilliform, but all are disproportionately smaller than those of *F. quadrangularis*. — Near Oban, Scotland; Wm. Stimpson.

Pteroides Putnami Verrill.

Small and delicate; the pinnate portion broad oval in outline. Peduncle a little more than half the whole length, smooth, slender-pointed. Pinnæ rather broad, with a wide base, supported by five or six clusters of strong spines, radiating from the base, eight or ten spines in each group. These give a strongly-lobed appearance to the edges of the pinnæ. — Hong Kong, China; Capt. W. H. A. Putnam.

Pterogorgia setosa Ehrenberg, Corall. roth. Meer. 1834.

Syn. *Gorgonia setosa* (*pars*) Linn. *Pterogorgia setosa* Dana, Zoöph.

This species and the following have been more or less confounded by nearly all authors, but when large series are examined they appear quite distinct. — Florida and West Indies; L. Agassiz.

Pterogorgia acerosa EHR. 1834.

SYN. *Gorgonia acerosa* (*pars*) PALLAS, Elench. Zooph. p. 172, 1766; *Gorgonia setosa* ESPER, Gorg. Tab. 17, fig. 1–3; *Pterogorgia acerosa* DANA, Zoöph. p. 649; *Pterogorgia pinnata* M. EDW. Corall. I. p. 168.

The *Gorgonia pinnata* of Linnæus seems to apply more particularly to a European species, entirely distinct from this. — Florida, West Indies, and Bermuda; L. Agassiz, D. F. Weinland.

Pterogorgia americana EHR. 1834.

SYN. *Gorgonia americana* GMELIN; *Pterogorgia turgida* (?) EHR. Corall. roth. Meer. p. 146, 1834; *Pterogorgia pinnata* DANA, Zoöph.; *Pterogorgia Ellisiana* M. EDW. Corall. p. 169.

The *Gorgonia americana* of Gmelin was based upon the figure of Ellis and Solander (Pl. 14, fig. 3), which is a good representation of the species when preserved in alcohol with the polyps expanded. The polyps are much larger than in the two preceding species, and are arranged somewhat irregularly, in two or three rows on each side of the large and nearly cylindrical branchlets. — Florida; L. Agassiz.

Pterogorgia bipinnata VERRILL.

Coral broad, flabelliform, branching in a plane. The primary branches arising nearly opposite on the sides of the principal stalk, and about one fourth of an inch apart, spread at a large angle; the principal ones are again pinnate, with their branchlets similarly arranged, and about one and a half inches long. Branchlets slender, strongly compressed, a few of them sometimes coalescing, forming rectangular openings. Cells very small, in two alternating series on the edges of the branches. Color violet or bright yellow. — Cumana, Ven., South America; J. P. Couthouy.

Leptogorgia virgulata M. EDW. Coralliaires. 1857.

SYN. *Gorgonia virgulata* LAMK. 1816; *Gorgonia Olivierii* LAMX. Polyp. Flex. 1817; *Plexaura virgulata* VAL.; *Plexaura viminea* VAL. 1855. — Charleston, South Carolina; L. Agassiz. — Beaufort, North Carolina; A. S. Bickmore.

Leptogorgia purpurea M. EDW. 1857.

SYN. *Gorgonia purpurea* PAL., 1766; *Leptogorgia purpurea* M. EDW., Corall. p. 164; *Leptogorgia purpuracea* M. EDW. l. c. p. 164.

This species is very distinct from the preceding in its longer, slender, rounded branches, arising in a fasciculate manner, nearly in a plane. Color purple, red, or orange. — Florida; G. Wurdemann.

Leptogorgia sanguinolenta VERRILL.

SYN. *Gorgonia sanguinolenta* PAL., Elench. Zooph. 1766.

Low, densely branching, somewhat in a plane. Several principal branches, arising near the base, give off from each side in a pinnate manner, numerous, crowded, obtuse branchlets, many of which again divide in a similar way, and even their subdivisions are sometimes pinnate. Color variable, often yellow or whitish with purple cells; axis yellowish, subtransparent, compressed. — Hayti, W. I.; D. F. Weinland.

Leptogorgia rigida Verrill.

Arborescent, rather tall, branching numerously and irregularly, somewhat in a plane. Principal branches long, irregular, often crooked, subpinnate, giving off lateral branches at irregular intervals of similar character. Very variable in form and color; often deep bluish purple, less frequently orange, ferruginous, or white; axis black, amber colored near the ends. — Acapulco, Mexico; A. Agassiz, D. B. Vanbrunt. — Cape St. Lucas, California; J. Xantus. — Panama; J. H. Sternberg.

Leptogorgia ampla Verrill.

Very large flabelliform. Several large, nearly equal branches, springing close to the base, curve outward at first and then ascend nearly parallel, giving off, usually at intervals of two or three inches, long and rather thick branches and branchlets of nearly uniform size, which at first spread nearly at right angles and then rise abruptly, parallel to the main branches. The largest specimen is 20 inches high; 16 broad. Color bright lemon-yellow. — Margarita Bay, Lower California (?); A. Garret. Possibly from the Bonin Islands.

Rhipidogorgia flabellum Valenciennes, Comptes-rendus, XLI. p. 13. 1855.

Syn. *Gorgonia flabellum* Linn. — Florida, West Indies, and Bermuda; L. Agassiz, A. S. Bickmore.

Rhipidogorgia stenobrachis Val. 1855.

Syn. *Gorgonia stenobrachis* Val. Voyage de la Vénus, Pl. 12, fig. 1; *Rhipidogorgia Engelmanni* Horn, Proc. Phil. Acad. Nat. Sci. 1860, p. 233.

I have satisfied myself, by an examination of the original specimen of Horn, that the species last quoted was founded on a small and bad specimen of *R. stenobrachis*. In the Museum there are large numbers of specimens, both dry and in alcohol, from different localities on the Pacific coast showing a complete series between the extreme forms, which, indeed, seem to depend more on age than any other cause. — Acapulco, Mexico; D. B. Vanbrunt, A. Agassiz. — Panama; A. Agassiz, J. H. Sternberg.

Rhipidogorgia Agassizii Verrill.

Fronds broader than high, very finely and evenly reticulated, the openings nearly square or pentagonal, about .12 of an inch in diameter. The very short thick base divides at once into numerous small and nearly equal branches, which subdivide so evenly and rapidly that the principal branches cannot usually be traced more than half across the frond. Terminal branchlets free for about one fourth of an inch. Cells small, crowded, a little raised. Color purple, light red, or yellowish. — Acapulco; A. Agassiz, D. B. Vanbrunt. — Panama; J. H. Sternberg.

I have named this fine species in honor of its discoverer, Mr. A. Agassiz, who has greatly contributed to our knowledge of the Marine Faunæ of the Pacific coast of North America.

Rhipidogorgia media Verrill.

Fronds low, broader than high, intermediate between the two preceding species in the size of its reticulations; these are usually square or pentagonal, quite irregular, generally about one quarter of an inch wide and nearly the same in height. Several large branches usually radiate from the base across the frond. Cells numerous on the sides, a little prominent. Color red with yellow cells, or uniform red or purple. — Acapulco, Mexico; A. Agassiz, D. B. Vanbrunt.

Xiphigorgia anceps M. Edw. Coralliaires. 1857.

Syn. *Gorgonia anceps* Pal. *Pterogorgia anceps* Ehr., 1834; *Pterogorgia Guadalupensis* Duch. et Mich., 1850. — Florida and West Indies; L. Agassiz, G. Wurdemann.

Xiphigorgia citrina Verrill.

Syn. ? *Gorgonia citrina* Esp. 1790; *Gorgonia anceps* (*pars*) Esp. Planz. t. II. p. 38, tab. VII. 1788; *Gorgonia* (*Pterogorgia*) *citrina* Dana, Zoöph. 1846; *Pterogorgia fasciolaris* Ehr., Corall. roth. Meer. p. 145, 1834; ? *Pterogorgia Sancti-Thomæ* Ehr. l. c. p. 145.

This species is unquestionably *P. citrina* Dana, but if, as is possible, the *Gorgonia citrina* of Esper should prove to be a distinct species, the name *X. fasciolaris* (Ehr.) will be next in order.

It is a smaller and more branching species than *X. anceps*, forming low, broad corals, branching somewhat in a plane, with much compressed slender branchlets, three or four inches long; these are rarely triangular, — a form very frequent in *X. anceps*. Color violet, or bright yellow with purple cells. — Florida; L. Agassiz. — St. Thomas; Dr. Otis.

Gorgonia verrucosa Pallas. — Nice; J. Burkhardt.

Gorgonia ramulus Val. — Panama; A. Agassiz, J. H. Sternberg. — Acapulco; D. B. Vanbrunt.

Gorgonia aurantiaca Verrill.

Syn. *Lophogorgia aurantiaca* Horn, Proc. Phil. Acad. Nat. Sci. 1860, p. 233.

This is a very branching species, with short irregular branchlets, verruciform, bilobed cells, and a distinct median groove. Color brick-red, or yellowish. Axis somewhat compressed. — Acapulco, Mexico; A. Agassiz.

Lophogorgia palma M. Edw.

Syn. *Gorgonia palma* Pal. 1766; *Gorgonia flammea* Ellis and Sol. 1786. — Cape of Good Hope.

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Plexaura homomalla Lamouroux, Polyp. Flex. 1816.

Syn. *Gorgonia homomalla* Esper. — Florida; L. Agassiz. — Bermuda; A. S. Bickmore.

The cells of this species sometimes have the borders prominent.

Plexaura flexuosa Lamx. Polyp. Flex. 1816.

Syn. *Eunicea furcata* Ehr. 1834; *Gorgonia anguiculus* Dana, 1846: ? *Plexaura rhipidalis* Val. 1855; *Plexaura salicornoides* M. Edw. 1857.

This species varies greatly in form and color, as well as in the degree of prominence of the cells, which depends upon the state of contraction of the polyps when dried. The color is most commonly either dull wine-red, or grayish yellow. — Florida and West Indies; L. Agassiz.

Plexaura crassa Lamx. Polyp. Flex. 1816.

Syn. *Gorgonia crassa* Ellis and Sol. p. 91, pl. 18, fig. 3, 1786 (non *Eunicea crassa* M. Edw., nec *Gorgonia crassa* Dana); *Gorgonia porosa* Esp. Planz. tab. X. (form with large cells); *Gorgonia antipathes* (*pars*) Esp. tab. XXIII. (1789); *Gorgonia vermiculata* Lamk. 1816; *Plexaura macrocythara* Lamx., l. c. p. 429, 1816; *Plexaura friabilis* (*pars*) Lamx., l. c. p. 430; do. Exp. Methodique, p. 35, pl. 18, fig. 3, 1821; *Plexaura antipathes* Ehr., 1834 (non *Gorgonia antipathes* Linn.); *Gorgonia vermiculata* Dana, 1846; *Plexaura arbusculum* Duch., An. rad. des Antilles (1850).

There is no American species known to us, except the present, to which the description of Ellis can apply, while it agrees perfectly with this. The character of having a very black axis, very small at the extremities, is especially characteristic, and, also, of having "long fleshy branches that bend a little out and then grow upright," and, in addition, the "violet flesh," and "scattered arrangement of the cells" can leave no question of its identity. The figure quoted above, of which Ellis gave no explanation, agrees perfectly with his description and with alcoholic specimens in the Museum. — Florida; L. Agassiz. — Bermuda; A. S. Bickmore.

Plexaura dichotoma Dana, Zoöph. 1846.

Syn. *Gorgonia dichotoma* Esp., Planz. Gorg. tab. XIV. (1788); *Gorgonia multicauda* (*pars*) Lamk. Hist. An. s. Vert. 1816; *Gorgonia heteropora* Lamk., l. c. 1816; *Plexaura heteropora* Lamx. Polyp. Flex. (1816); *Gorgonia* (*Plexaura*) *dichotoma* (*pars*) Dana, Zoöph. 1846; *Gorgonia crassa* Dana, Zoöph. 1846; *Gorgonia brevis* (young) Duchassaing, An. rad. des Ant. p. 20 (1850); *Eunicea multicauda* M. Edw. Corall. 1857; ? *Plexaura friabilis* M. Edw. l. c. I. p. 156, 1857. — Florida; L. Agassiz. — St. Thomas; Dr. Otis.

This species varies greatly in appearance according to the mode of preservation and the state of contraction of the cells, and for this reason much confusion has arisen in regard to its synonymy. In the Museum there is a specimen labelled *Gorgonia dichotoma* by Dana, with the exterior in great part removed, which is almost a fac-simile of the specimen figured by Esper. Other specimens agree with the descriptions by Lamarck and Milne Edwards. The axis in the present species is always gray or fuscous, looking more like wood than horn, differing greatly, in this respect and several others, from *G. crassa* Ellis.

The character of having cells flat or slightly prominent is entirely insufficient to separate *Plexaura* and *Eunicea*, since all the species of *Plexaura* have, in certain states of preservation, cells with raised borders, and there are often to be seen on the same specimen flat cells and others which are quite prominent. For this reason the genera *Rhinogorgia* and *Gonidora*, proposed by Gray, are not admissible (Ann. and Mag. 1859, p. 442).

Plexaura turgida Verrill.

Syn. *Eunicea turgida* Ehr. 1834; ? *Eunicea crassa* M. Edw. Coralliaires I. p. 148, 1857 (non *Gorgonia crassa* Ellis and Sol.).

This is one of the largest known species, growing to the height of two or three feet, with the branches one half an inch or more in diameter.

In the structure of the polyps I have been unable to detect any difference between this species and *P. dichotoma*, the type of *Plexaura* Lamx., or *P. homomalla* and *P. flexuosa*, uniformly referred to this genus by authors. — Florida Reefs; L. Agassiz.

Plexaura flavida Val. 1855.

Syn. *Gorgonia flavida* Lamk. 1816.

The color of this species is often dark violet, with the surface merely tinged with yellow. — Hayti; D. F. Weinland.

Plexaura fucosa Val. 1855.

Syn. *Gorgonia fucosa* Val. Voyage de la Vénus. — San Francisco, California; T. G. Cary.

Plexaura suffruticosa M. Edw. 1857.

Syn. *Gorgonia suffruticosa* Dana, Zoöph. 1846. — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Eunicea limiformis Lamx. Polyp. Flex. 1816.

Syn. *Eunicea quincuncialis* Ehr. 1834; *Gorgonia quincuncialis* Dana, 1846. — Florida and West Indies; L. Agassiz.

Eunicea calyculata Lamx. 1816.

Syn. *Gorgonia caliculata* Ellis and Sol., p. 95, pl. 18, fig. 2, 1786; *Eunicea clavaria* Lamx. 1821. — Florida; L. Agassiz.

Eunicea laxispica M. Edw. 1857.

Syn. *Gorgonia laxispica* Lamk.; *Eunicea mammosa* Lamx.; *Gorgonia papillosa* Dana. — Florida; L. Agassiz.

Eunicea plantaginea Val. 1855.

Syn. *Gorgonia plantaginea* Lamk. — Florida; L. Agassiz.

Eunicea ramulosa Ehr. 1834.

Syn. *Gorgonia spicifera* Dana, 1846. — Florida; L. Agassiz.

Eunicea Tourneforti M. Edw. 1857. — Florida and West Indies; G. Wurdemann.

Eunicea Rousseaui M. Edw. 1857. — Turk's Island, W. I.; J. E. Webber.

Muricea spicifera Lamx. 1821.

Syn. *Gorgonia muricata* (*pars*) Pallas. — Florida and West Indies; L. Agassiz.

Muricea lima M. Edw. 1857.

Syn. *Gorgonia lima* Lamk. — Florida; L. Agassiz.

Muricea elongata Lamx. 1821. — Florida and West Indies; L. Agassiz.

Muricea laxa Verrill.

Very slender, with long flexuous branches. This is closely allied to *M elongata*, but has longer and very acute verrucæ, which are much more loosely arranged and armed with very long, sharp spicula. Axis nearly terete, somewhat compressed at the axils. Color light yellow. — Florida; L. Agassiz.

Muricea elegans Ag. MS.

A large erect species, irregularly pinnate and bipinnate, branching nearly in a plane. Trunk stout and nearly erect, transversely compressed; branches very numerous, curved, often pendulous. Verrucæ broad, conical, spreading, armed with large spicula. Color orange. — Off Charleston, South Carolina; L. Agassiz.

Muricea echinata Val. Comptes-rendus. 1855. (No description.)

Syn. *Muricea echinata* M. Edw. Coralliaires, 1857. — Panama; C. F. Davis, J. H. Sternberg.

Muricea robusta Verrill.

This is a low, stout species, branching very irregularly in a subdichoto mous manner, with thick, clavate, crooked branches. Cells crowded, large, open, little prominent, especially towards the base, where they open outward. Spicula numerous, short and thick. Color brownish yellow or purple. — Acapulco, Mexico; A. Agassiz.

Muricea hebes Verrill.

The specimens of this species, which are probably young, have erect, simple, or sparingly dichotomous stalks, three or four inches high, slender at the base, but thick and clavate above. The verrucæ are crowded, broad, and prominent, armed with numerous rather sharp spicula. Color deep reddish purple, or dark brown. It resembles *Gonigoria clavata* Gray, which should be referred to the genus *Muricea*, but the latter is stouter, with shorter and more crowded cells. The axis is also described as black, while in the present species it is fuscous. — Acapulco, Mexico; A. Agassiz.

Muricea appressa Verrill.

Corallum broad, flabelliform, very branching, even to the base. The trunk divides at about half an inch from the base into two, three, or more principal branches, which rapidly diverge and subdivide in an irregularly dichotomous or subpinnate manner. Branchlets slender, cylindrical or slightly clavate, with obtuse tips, one or two inches long and one eighth of an inch in diameter. Cells small, thickly crowded on all sides of the branches, rounded, closely appressed, the summits curved inward; exterior densely covered by small oblong spicula. Color, in alcohol, dark umber-brown. — Panama; J. H. Sternberg.

Primnoa reseda Verrill.

Syn. *Gorgonia reseda* Pallas, Elench. Zooph. 1766; *Gorgonia lepadifera* Linn. Syst. Nat. ed. XII. 1767; Ellis and Sol. 1786; *Primnoa lepadifera* Lamx. Polyp. Flex. 1816. — St. George's Bank; C. H. Fifield.

Callogorgia verticillaris Gray.

Syn. *Primnoa verticillaris* Ehr. 1834. — Fayal, Azores; Chas. Dabney.

Gorgonella umbraculum Verrill, MS. 1862.

Syn. *Gorgonia umbraculum* Ellis and Sol. 1786; *Rhipidogorgia umbraculum* Val. 1855; *Umbracella umbraculum* Gray. — East Indies.

Gorgonella stricta Verrill, MS. 1862.

Syn. ? *Gorgonia stricta* Lamk. 1816; ? *Rhipidogorgia stricta* M. Edw. 1857.

This species agrees in all its external characters with the species quoted, but has a calcareous axis. — Cape of Good Hope.

Juncella juncea Val. 1855.

Syn. *Ellisella juncea* Gray. — Indian Ocean.

Juncella extans Verrill.

Tall and simple, with the very prominent verrucæ curved inward and arranged crowdedly in a band on each side of the axis, leaving a wide naked space on each side. Color white. Axis grayish white, stony and rigid. — Fayal, Azores; C. Dabney.

Isis hippuris Linn. — East Indies.

Parisis Verrill.

Corallum irregularly branching, nearly in a plane. The axis consists alternately of calcareous and suberous segments, of uniform thickness, traversed by numerous narrow sulcations. The branches originate from the calcareous segments. Cœnenchyma persistent, rather thin, somewhat membranous, with a rough surface. Cells prominent, arranged irregularly on all sides of the branchlets, but often absent on the median surfaces of the larger branches.

Parisis fruticosa Verrill.

Large, flabelliform; the principal branches arising irregularly along the sides of the trunk, divide and subdivide rapidly into other smaller branches and branchlets, producing a densely ramulous frond. The branches ascend and diverge usually at an angle of about 50°; the branchlets often spread at right angles, and do not coalesce. Papillæ numerous, crowded on the branchlets, elongated, conical. Color grayish yellow; axis white; internodes yellowish brown. — Sooloo Sea; J. D. Dana, U. S. Expl. Exp.

Melitodes ochracea Verrill.

Syn. *Isis ochracea* Linn.; *Melitæa ochracea* Lamx. 1812. — Singapore, Capt. W. H. A. Putnam.

The name *Melitæa* having been used for a genus of Insects by Fabricius in 1808, four years before it was employed by Lamouroux, we have adopted *Melitodes* for this genus, as restricted by Gray. (See Proc. Zoöl. Soc. Lond. 1859, p. 485.)

Melitodes virgata Verrill.

Syn. *Melitæa ochracea* (*pars*) Dana (from Feejee Islands).

A comparison of the specimens collected by the U. S. Exploring Expedition at the Feejee Islands with several hundred specimens of all forms and sizes from Singapore, in the collection of the Museum, proves that they are unquestionably distinct, though closely resembling one another in general appearance.

The principal branches in *M. virgata* rise nearly parallel, and are much more elongated, tapering and subdividing far less rapidly than in *M. ochracea*. The calcareous segments are also longer, and the general appearance of the coral is more open. — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Mopsella elongata Verrill.

Syn. *Melitella elongata* Gray. Proc. Zoöl. Soc. Lond. 1859, p. 485. — Singapore; Capt. W. H. A. Putnam.

Mopsella dichotoma Gray, Proc. Zoöl. Soc. Lond. 1857, p. 284.

Syn. *Isis dichotoma* Linn.; *Mopsea dichotoma* Lamx. 1816. — Cape Town; J. D. Dana, U. S. Expl. Exp.

I am unable to find any generic differences between this species, which is the type of *Mopsella* Gray, and those subsequently referred by him to *Melitella*, and have, therefore, united the two genera.

Mopsella aurantia Verrill.

Syn. *Isis aurantia* Esper, 1797; *Melitæa retifera* Lamk. 1816; M. Edwards, 1857; *Melitella retifera* Gray, Proc. Zoöl. Soc. Lond. 1859, p. 486. — Australia; A. Garret.

Mopsella textiformis Verrill.

Syn. *Melitæa textiformis* Lamk.; *Melitella retifera* (*pars*) Gray, l. c. 1859. — Australia; A. Garret.

Mopsella tenella Verrill.

Syn. *Melitæa tenella* Dana; *Melitella? tenella* Gray. — Sandwich Islands; J. D. Dana, U. S. Expl. Exp.

Briareum asbestinum Agassiz, MS.

Syn. *Alcyonium asbestinum* Pallas, 1766; *Gorgonia briareus* Ellis and Sol. 1786; *Briareum gorgonideum* Blainville, 1830; *Lobularia asbestina* Ehr. 1834; *Lobularia capitata* Duchassaing, 1850. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Briareum plexaureum Blainv. 1830.

Syn. *Alcyonium plexaureum* Lamx. Expos. Meth. p. 68, pl. 76, figs. 2, 3, 4, 1821. — Florida; L. Agassiz.

Titanideum Agassiz, MS.

This genus is closely allied to *Briareum*, but has a more distinct axis, which is spongy and very spiculose, but firm and less porous than that of the latter. The cells are scattered on all sides, and not prominent.

Titanideum suberosum Agassiz, MS.

Syn. *Gorgonia suberosa* Ellis and Sol. p. 93, 1786; Ellis, Corallines, Tab. 26, figs. P, Q, R; *Briareum suberosum* Dana, Zoöph. p. 463, 1846. — Charleston, South Carolina; L. Agassiz. — Beaufort, North Carolina; Wm. Stimpson. — Stono Inlet; Dr. J. W. Page, U. S. A.

Alcyonium digitatum Linn.

Coast of England; Free Public Museum of Liverpool.

Alcyonium carneum Agassiz, Proc. Amer. Assoc. 1850.

Coast of New England; L. Agassiz.

Sarcophytum glaucum Verrill.

Syn. *Alcyonium glaucum* Quoy et Gaimard; Dana, Zoöph. p. 623, pl. 58, figs. 4 and 5. — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Sarcophytum latum Verrill.

Syn. *Alcyonium latum* Dana, Zoöph. p. 623, pl. 58, figs. 6 and 7. — Tonga-Tabu; J. D. Dana, U. S. Expl. Exp.

Ammothea nitida Verrill.

This species grows in groups consisting of several smooth, subcylindrical stalks connected together at the base, undivided for about three inches, when they suddenly divide and subdivide into a cluster of numerous slender branchlets. Cells small, prominent, rather loosely scattered along the branchlets. — Zanzibar; C. Cooke.

Spongodes arborescens Dana.

Syn. *Spoggodia celosia, var. arborescens* Dana, Zoöph. p. 626, pl. 59, fig. 4 (non *S. celosia* Lesson). — Feejee Islands; J. D. Dana, U. S. Expl. Exp.

Spongodes capitata Verrill.

Large and very ramulous; the thick naked trunk subdividing in a dichotomous manner from near the base into short, capitate, terminal branches, having a dense cluster of very short branchlets at the ends on which the cells are closely crowded. Spicula white, not very conspicuous, the large ones not very numerous. Color in alcohol yellowish gray. — Hong Kong, China; Capt. W. H. A. Putnam.

Spongodes gigantea Verrill.

Grows in a manner similar to the preceding, but stouter and more arborescent, with larger and less crowded polyps and very large, conspicuous, white spicula. Color in alcohol dark brownish red. — Hong Kong, China; Wm. Stimpson, N. Pacif. Expl. Exp.

Telesto fruticulosa Dana.

Charleston, South Carolina; L. Agassiz. — Stono Inlet; Dr. J. W. Page.

Cœlogorgia palmosa M. Edw. 1857.

Syn. *Lobularia palmosa* Val. MS. — Zanzibar; C. Cooke.

Tubipora purpurea Pallas. — Singapore; Capt. W. H. A. Putnam.

Tubipora musica Linn. — East Indies; Capt. W. H. A. Putnam.

ZOANTHARIA.

Madrepora cervicornis Lamarck. — Florida and West Indies; L. Agassiz.

Madrepora robusta Dana. — Feejee Islands; J. D. Dana.

Madrepora gravida Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora nobilis Dana.

Syn. *Madrepora secunda* Dana. — Singapore; Capt. W. H. A. Putnam.

A careful comparison of the types of Dana with the extensive series of specimens in the Museum shows conclusively that *Madrepora nobilis* and *M. secunda* are but variable forms of one species.

Madrepora arbuscula Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora prolifera Lamarck. — Florida and West Indies; L. Agassiz.

Madrepora acuminata Verrill.

A large species allied to *M. nobilis*, but having much longer, regularly tapering, often curved branches, which are an inch in diameter, evenly rounded and thickly covered by spreading, nearly uniform, cylindrical, dimidiate corallites.* Surface of corallum between the cells and exterior of the corallites covered with minute spines, the latter subcostate. Septa

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* We use the word *corallite* as the English equivalent of *polypiérite* employed by Milne-Edwards, as his *polypier* corresponds to *corallum* of Dana.

rudimentary, only the two largest usually distinct. A few rudimentary corallites, often opening downward, are scattered among the others. — Kingsmills Islands; A. Garret.

Madrepora diffusa Verrill.

Corallum low arborescent, much branched; branchlets widely spreading or divaricate, curved, gradually tapering to the acute extremities, about a third of an inch in diameter, and two or three long. Corallites broad tubo-nariform, short, scarcely compressed, widely open, the exterior closely striate, the costæ consisting of numerous, distinct points; intercellular tissue firm, reticulated, the surface spinose. Septa narrow, the six primary ones distinct, the inner one broadest. Terminal corallite exsert, scarcely larger than the lateral. This species resembles *M. arbuscula* and *M. formosa* in its mode of branching, but the cells are entirely different. — Kingsmills Islands; A. Garret.

Madrepora parvistella Verrill.

Arborescent, numerously branched; branchlets spreading, curved, neatly rounded and tapering, about half an inch in diameter and three or four long. Corallites evenly crowded, very small, short, tubular, opening obliquely upward; exterior costate, scabrous; cells small, broad oval, stellate; twelve septa distinct, the two largest nearly meeting in the centre. — Singapore; Capt. W. H. A. Putnam.

Madrepora horrida Dana. — Feejee Islands; J. D. Dana.

Madrepora abrotanoides Lamarck. — Feejee Islands; J. D. Dana.

Madrepora virgata Dana. — Feejee Islands; J. D. Dana.

Madrepora hebes Dana. — Feejee Islands; J. D. Dana.

Madrepora austera Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora implicata Dana. — Feejee Islands; J. D. Dana.

Madrepora tortuosa Dana. — Feejee Islands; J. D. Dana.

Madrepora formosa Dana. — Feejee Islands; J. D. Dana.

Madrepora brachiata Dana. — Sooloo Sea; J. D. Dana.

Madrepora echinata Dana. — Feejee Islands; J. D. Dana.

Madrepora longicyathus M. Edw. — Singapore; Capt. W. H. A. Putnam.

Madrepora tubigera Horn, Proc. Phil. Acad. Nat. Sci. 1860, p. 435.

Syn. ? *Madrepora corymbosa* Lamk. — Singapore; Capt. W. H. A. Putnam.

Madrepora Danæ Verrill.

Syn. *Madrepora deformis* Dana (non Michlin). — Tahiti; J. D. Dana, A. Garret.

Madrepora cuspidata Dana. — Tahiti; A. Garret.

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Madrepora plantaginea Lamarck (non Dana).

Syn. *M. acervata* Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora cerealis Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora nasuta Dana. — Tahiti; J. D. Dana, A. Garret.

Madrepora globiceps Dana. — Tahiti; J. D. Dana, A. Garret.

Madrepora millepora Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora convexa Dana.

Syn. *Madrepora corymbosa* Dana (non Lamk.), the young. — Singapore; Capt. W. H. A. Putnam.

Madrepora surculosa Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora turbinata Dana.

Syn. *Madrepora surculosa, var. turbinata* Dana.

This species is perfectly distinct from *M. surculosa*. Unbleached specimens are delicate rose-colored. — Tahiti; J. D. Dana, A. Garret.

Madrepora appressa Dana.

Syn. *Heteropora appressa* Ehr. 1834; ? *H. imbricata* Ehr.; *Madrepora plantaginea* Dana (non Lamarck); ? *M. echidnæa* Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora paxilligera Dana. — Tahiti; A. Garret.

Madrepora cytherea Dana. — Tahiti; J. D. Dana, A. Garret.

Madrepora spicifera Dana. — Singapore; Capt. W. H. A. Putnam.

Madrepora palmata Lamarck.

Syn. *Madrepora perampla* Horn, Proc. Phil. Acad. Nat. Sci. 1860, p. 435. — Florida and West Indies; L. Agassiz, D. P. Woodbury.

Porites furcata Lamarck. — Florida and West Indies; L. Agassiz.

Porites clavaria Lamarck. — Florida and West Indies; L. Agassiz.

Porites compressa Dana. — Sandwich Islands; A. Garret.

Porites mordax Dana. — Sandwich Islands; A. Garret.

Porites lobata Dana. — Sandwich Islands; A. Garret.

Porites astræoides Lamarck. — Florida and West Indies; L. Agassiz.

Synaræa Verrill.

Corallum irregularly branched or glomerate. Cells without distinct walls, the septa rudimentary; six prominent paliform lobes surround the central cavity, which has a rudimentary or very small, tubercular columella; outside of the pali are other similar points, or granulations, scattered between the cells, which are not distinctly circumscribed, but often separated for some distance by a porous cœnenchyma.

This genus includes *Porites erosa*, *P. informis*, and *P. monticulosa* of

Dana, together with the following. The existence of generic characters distinct from *Porites* in these species was suggested by Milne-Edwards, although he had not been able to examine specimens of them.

Synaræa Danæ Verrill.

Syn. *Porites contigua* Dana; *Porites Danæ* M. Edw. and Haime. — Feejee Islands; J. D. Dana.

Synaræa irregularis Verrill.

This species forms large irregular masses, consisting of numerous angular, clavate, uneven and crowded branches, often nodose at the ends, and much coalesced, giving a rough, eroded appearance to the mass. Cells larger than in the following species; pali prominent, slender; columella rudimentary, often wanting. Surface covered with slender, prominent, often toothed granulations, which are rather loosely arranged. Color, deep umber brown. — Sandwich Islands; A. Garret.

Synaræa convexa Verrill.

Corallum forming rounded hemispherical clumps, composed of numerous closely crowded, slender branches, very much divided, angular, and often flabelliform at the summits, much coalesced near the ends, leaving the tips free for about one third of an inch. Cells closely arranged even on the sides of the branches, small and shallow; pali short, thick, obtuse, surrounded by short, obtuse granulations, which are crowded over the whole surface between the cells. Color, dark ash. — Society Islands; A. Garret.

Synaræa solida Verrill.

Corallum convex and glomerate, arising from a narrow base, formed by numerous very irregular stout branches, coalesced nearly throughout into a solid mass, leaving only the ends free for about half an inch; these are often one half an inch thick, angular and proliferous. Cells rather open and distinct, numerous; pali distinct, not very prominent; septa apparent, but imperfect; columella generally wanting; granulations of the surface rough, irregular, not crowded. Color, grayish brown. — Society Islands; A. Garret.

Alveopora excelsa Verrill.

Coral incrusting at base, massive, gibbous, rising into long subcylindrical lobes, rounded at the summits. Cells deep, neatly polygonal, nearly uniform in size, averaging about .08 of an inch in diameter, with, occasionally, much larger ones intermingled; septa in two cycles, represented by twelve vertical series of slender spines, uniting at the middle into a loose rudimentary columella; walls thin, pierced by numerous rounded pores. — Singapore; Capt. W. H. A. Putnam.

Alveopora retusa Verrill.

Corallum irregularly lobed or gibbous; the lobes thick, clavate, often compressed or subfurcate at the ends. Cells deep, unequal in size, the largest about one tenth of an inch in diameter, with others not half as large intermingled; septa represented in the large cells by three cycles of spines, uniting into an imperfect columella; walls rather stout, with large oval pores in vertical series. — Singapore; Capt. W. H. A. Putnam.

Montipora capitata M. Edw. and Haime.
Syn. *Manopora capitata* Dana. — Sandwich Islands; A. Garret.

Montipora effusa M. Edw. and Haime.
Syn. *Manopora effusa* Dana. — Society Islands; A. Garret.

Montipora nodosa M. Edw. and Haime.
Syn. *Manopora nodosa* Dana. — Feejee Islands; J. D. Dana.

Montipora erosa M. Edw. and Haime.
Syn. *Manopora erosa* Dana. — Feejee Islands; J. D. Dana.

Montipora hispida M. Edw. and Haime.
Syn. *Manopora hispida* and *M. spumosa* Dana (non Lamk.). — Singapore; Capt. W. H. A. Putnam.

Endopachys Maclurii M. Edw. and Haime. 1848.
Syn. *Turbinolia Maclurii* Lea. 1833. — Tertiary, Alabama.

Balanophyllia elegans Verrill, Report on the Polyps of the Northwest Boundary Survey, 1861 (not yet published).

Corallum attached by a broad base, low, subturbinate. Calyx broad, oval, deep. Epitheca well developed, covering more than half the height of the wall, which is thin and very porous. Septa thin, forming five complete cycles, the principal ones a little exsert, strongly toothed at the summit, finely dentate below; those of the last order unite together near the columella, and are joined near their middle by those of the preceding order; columella porous, little developed. Height .4 of an inch; greatest diameter of the calyx .48, shortest .4. Color of the living polyp, bright orange. — Crescent City and Mendocino, California; A. Agassiz.

Balanophyllia scabrosa Verrill.
Syn. *Dendrophyllia scabrosa* Dana, 1846; *Balanophyllia Cumingii* M. Edw. and Haime, 1848; *Dendrophyllia ? scabrosa* M. Edw. Coralliares. — Singapore; J. D. Dana.

Cœnopsammia equiserialis M. Edw. Coralliaires. 1857.
Singapore; Capt. W. H. A. Putnam.

Cœnopsammia tenuilamellosa M. Edw. and Haime.
Monographie des Eupsammides, 1848. — Panama and Acapulco; A. Agassiz.

Cœnopsammia radiata Verrill.
Similar to the preceding species, but having a much smaller, spongy col-

umella, more conical and less open cells, and the six primary septa much broader and thicker than the others, with rounded nearly entire edges. — Society Islands; A. Garret.

Stylophora digitata M. Edw. and Haime. 1850.

Syn. *Madrepora digitata* Pallas, Elench. Zooph. p. 326, 1766; *Porites scabra* and *elongata* Lamk. 1816; *Sideropora digitata* and *elongata* Blainville, 1830; Dana, 1846; *Porites digitata* Ehr. 1834. — Singapore; Capt. W. H. A. Putman.

Stylophora Danæ M. Edw. and Haime. 1850.

Syn. *Sideropora palmata* Dana, 1846 (non Lamk.). — Singapore; Capt. W. H. A. Putnam.

This approaches the preceding very closely in some of its forms, and may not be distinct.

Stylophora stellata Verrill.

Corallum forming even rounded clumps, a foot or more in diameter, consisting of numerous, evenly crowded branches, which are rounded, about one half an inch in diameter, furcate, often flattened at the ends. Cells evenly crowded over the surface, arranged somewhat in spiral lines, the upper edges prominent, rather stout. Septa forming three cycles, the last two often rudimentary or wanting; primary septa a little exsert, rather narrow, the inner edges vertical, scarcely traceable to the columella, which is small, papilliform. This species resembles *S. digitata* in form, but the cells are entirely different. — Kingsmills Islands; A. Garret.

Madracis decactis Verrill.

Syn. *Astrea decactis* Lyman, Proc. Bost. Soc. Nat. Hist. VI. p. 260, 1857. — Florida; L. Agassiz.

Stylaster roseus Gray, Zoöl. Misc. 1836.

Syn. *Madrepora rosea* Pallas, 1766; *Oculina rosea* Lamk. 1816; *Allopora rosea* Dana, 1846; *Stylaster roseus* Agassiz, Florida Reefs, with fig. (unpublished). — Florida; L. Agassiz.

Stylaster elegans Verrill.

Corallum flabelliform, the principal branches large, compressed, rapidly dividing into smaller branches and branchlets, the ultimate divisions very slender and delicate, rarely coalescent. Cells very small, a little prominent, mostly arranged on the edges of the branchlets, but a few are scattered over the sides; septa narrow, about sixteen distinct; columella minute, styliform. Color, bright rose, lighter on the large branches. — Ebon Island; A. Garret.

Stylaster tenuis Verrill.

Corallum similar to the preceding in its mode of branching, but the branches are not compressed. Cells one third larger, about .02 of an inch in diameter, arranged in simple longitudinal series on the edges of the branchlets, deep at the centre, with a minute slender columella, which is often wanting; septa twelve or fourteen, a little exsert, about one third as broad as the cells. Color, light red, with small irregular spots of white; sides of the branchlets thickly covered with small verrucæ.— Upolu, Navigator Islands; J. D. Hague.

Distichopora nitida Verrill.

Corallum flabelliform, branching dichotomously in a plane. Branches round or flattened transversely; the branchlets obtuse, often compressed at the tips; surface very minutely granular, appearing almost smooth, with scattered patches of rounded verrucæ, having rudimentary septa and pits surrounding them, and therefore probably corresponding to the enlarged columellæ of cells without solid walls. Three rows of minute pits are arranged closely in regular series along the edges of the branches; those of the central, larger row are circular and often have a slender columella in the centre. The lateral ones are much smaller, and generally irregular in form; a transverse section shows that the central pits correspond to the central open space in the cells of *Stylaster*, while the lateral ones are interseptal chambers, the greater part of which have been obliterated by the thickening of the septa; in some of the cells, twelve septa may be traced. Color bright red, with the tips of the branches yellowish white; other specimens are light orange. — Ebon Island; A. Garret.

Distichopora coccinea Gray. 1860. — Australia?; A. Garret.

Errina aspera Gray, Trans. Zoöl. Soc. 1835.

Syn. *Millepora aspera*, Linn. Ed. XII. 1767. — Fayal; Chas. Dabney.

An examination of the structure of this coral has convinced me that it is closely allied to *Distichopora*, and consequently to *Stylaster*, the process of filling up the cells being here carried to the last degree.

Oculina varicosa LeSueur. 1817. — St. Thomas, W. I.; Dr. G. H. Otis.

This species is unquestionably distinct from the next, with which it has been united by Milne-Edwards and Haime. It resembles more *O. Petiveri* M. Edw. and H.

Oculina diffusa Lamarck. — Florida; L. Agassiz, G. Wurdemann.

Oculina arbuscula Agassiz, MS., Rep. on the Florida Reefs, with fig. (unpublished).

Corallum arborescent; the trunk, arising from a flat, incrusting base, divides rapidly into spreading, round, tapering branches and branchlets. Corallites prominent, arranged somewhat in spiral lines; cells large (.06 inch), open, deep; septa in three cycles well developed, the principal ones exsert, rounded at the summits, vertical within; columella little developed.

Costæ scarcely apparent between the cells. — Off Charleston, South Carolina; L. Agassiz.

Oculina implicata Agassiz, MS., l. c., fig. (unpublished).

Corallum forming dense clumps of irregular, crowded, much coalesced branches. Corallites irregularly arranged, numerous, very slightly prominent, with nearly level interstices, marked by the scarcely prominent radiating costæ. Cells smaller than in the two preceding species and less open; columella rudimentary; septa very little exsert. — Off Cape Hatteras, North Carolina; L. Agassiz. — Beaufort, North Carolina; A. S. Bickmore.

Astrangia Danæ Agassiz, Smith. Contr., with 6 plates (unpublished); Proc. Amer. Assoc. Vol. II. p. 68, 1849 (non M. Edw. and Haime, 1850).

Syn. *Astrangia astreiformis* Leidy (non M. Edw. and Haime). — Long Island Sound; L. Agassiz.

Astrangia astreiformis M. Edw. and Haime. 1850.

Charleston, South Carolina; L. Agassiz.

Astrangia solitaria Verrill.

Syn. *Caryophyllia solitaria* LeSueur, Journal Phil. Acad. Nat. Sci. I. p. 180, pl. VIII. fig. 11, 1817. — Hayti; D. F. Weinland. — St. Thomas; Dr. G. H. Otis.

The corallites in this species are distantly scattered, but connected by a thin basal expansion; septa crowded, strongly denticulate.

Syndepas Gouldii Lyman, Proc. Bost. Soc. Nat. Hist. VI. p. 274. 1857. — Cumana, Venezuela, South America; J. P. Couthouy.

Phyllangia dispersa Verrill.

Corallites connected by a basal expansion, which is generally thin, but sometimes thickened, irregularly scattered, often one half an inch distant, about one fourth of an inch in diameter, and somewhat less in height. Primary and secondary septa much exsert, with narrow, subentire summits. Columella well developed, trabicular, and rudely papillose. — Panama; A. Agassiz.

Cladocora arbuscula M. Edw. and Haime. 1849.

Syn. *Caryophyllia arbuscula* LeSueur, 1820; Dana, 1846. *Cladocora arbuscula* Agassiz, Florida Reefs, with fig. (unpublished). — Florida; L. Agassiz, G. Wurdemann.

Orbicella cavernosa Agassiz, MS. l. c., fig. (unpublished).

Syn. *Madrepora cavernosa* Esp. 1797; *Favia cavernosa* Oken, 1815; *Astrea argus* Lamarck, 1816; *Orbicella argus* Dana, 1846; *Heliastrea cavernosa* M. Edw. 1857. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

The subgenus *Orbicella* of Dana is almost identical with *Heliastrea* of

Milne-Edwards, the first three species, at least, belonging to the latter genus; therefore there appears to be no sufficient reason for changing the earlier name.

Orbicella annularis DANA. 1846.

SYN. *Madrepora annularis* ELLIS and SOL. 1786; *Astrea annularis* LAMARCK; *Heliastrea annularis* M. EDW.; *Orbicella annularis* Agassiz, l. c., with fig. (unpublished). — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Goniastrea varia VERRILL.

SYN. *Astrea varia* DANA; *Prionastrea ? varia* M. EDW. and HAIME. — St. Thomas; Dr. G. H. Otis.

Favia ananas OKEN, Lehrb. der Nat. I. p. 67. 1815.

SYN. *Madrepora ananas (pars)* LINN. Ed. X. 1758; PALLAS, Elench. Zooph. 1766; *Astrea ananas* LAMARCK, 1816; *Parastrea ananas* M. EDW. and HAIME, 1850; *Favia ananas* M. EDW. Coralliaires, 1857. — Florida; L. Agassiz, D. P. Woodbury.

Cœloria dædalea M. EDW. and HAIME. 1851.

SYN. *Madrepora dœdalea* ELLIS and SOL. 1786; *Mœandrina dœdalea* LAMARCK, 1816; DANA, 1846; *Astroria dœdalea* M. EDW. and HAIME, 1849. — Singapore; P. Ellis.

Hydnophora exesa M. EDW. and HAIME. 1849.

SYN. *Madrepora exesa* PALLAS, 1766 (young); *Hydnophora Pallasii* and *H. Demidoffi* FISCHER, 1810; *Monticularia meandrina, M. folium*, and *? M. polygonata* LAMARCK, 1816; *Hydnophora Demidoffi* and *? H. polygonata* M. EDW. and HAIME, 1849. — Singapore; Capt. W. H. A. Putnam.

The extensive series of specimens in the Museum shows that the synonymes quoted refer to the various stages of growth of one species, as suggested by Milne-Edwards.

Diploria cerebriformis M. EDW. and HAIME. 1849.

SYN. *Mœandrina cerebriformis* LAMARCK. — Florida; L. Agassiz. — Bermuda; H. Hammond.

Manicina areolata (*pars*) EHR. 1834.

SYN. *Madrepora areolata* LINN. Ed. X. 1758; *Mœandrina areolata* LAMARCK; *? Manicina meandrites, M. hispida, M. prœrupta*, and *M. manica* EHR. 1834; *M. dilatata* DANA, 1846; *Manicina areolata* Agassiz, l. c., with fig. (unpublished). — Florida; L. Agassiz, G. Wurdemann. — St. Thomas; Dr. G. H. Otis.

Trachyphyllia amarantum M. EDW. and HAIME. 1849.

SYN. *Manicina amarantum* DANA, 1846. — Singapore; Capt. W. H. A. Putnam.

Mæandrina clivosa VERRILL.

SYN. *Madrepora clivosa* ELLIS and SOL. p. 163, 1786; *Madrepora* *filograna* ESP. Tab. XXII. 1789 (non *Mæandrina filograna* LAMARCK); *Mæandrina mammosa* DANA; ? *M. interrupta* DANA; ? *Mæandrina grandilobata* M. EDW. and HAIME. — Florida; L. Agassiz, D. P. Woodbury. — Hayti; D. F. Weinland.

Mæandrina strigosa DANA. 1846.

SYN. *Cœloria strigosa* M. EDW. Coralliaires. — Florida; L. Agassiz.

Mæandrina labyrinthiformis DANA. 1846.

SYN. *Madrepora labyrinthiformis* LINN. Ed. X. 1758; *Madrepora labyrinthica* ELLIS and SOL. 1786, pl. 46, figs. 3 and 4 (non *Mæandrina labyrinthica* LAMARCK, EHR., nec *Cœloria labyrinthiformis* M. EDW. and HAIME); *Mæandrina labyrinthica* DANA; *Mæandrina sinuosissima* M. EDW. and HAIME. — Florida; L. Agassiz. — St. Thomas; Dr. G. H. Otis.

Mæandrina sinuosa LESUEUR, Mém. du Mus. VI. p. 278, pl. 15, figs. 4-7, 1820 (non *Madrepora sinuosa* ELLIS and SOLANDER, nec *Mæandrina sinuosa* QUOY and GAIM.).

SYN. *Madrepora labyrinthiformis* (*pars*) LINN. Ed. X.; *Mæandrina labyrinthica* (*pars*) LAMARCK; LAMOUROUX; *Mæandrina crassa* (?) M. EDW. and HAIME. — Florida; L. Agassiz, G. Wurdemann.

Colpophyllia gyrosa M. EDW. and HAIME. 1849.

SYN. *Madrepora gyrosa* ELLIS and SOL. 1786; *Mæandrina gyrosa* LAMARCK; *Mussa gyrosa* DANA; *Colpophyllia gyrosa*, AGASSIZ, l. c., with fig. (unpublished). — Florida; L. Agassiz.

Tridacophyllia lactuca BLAINVILLE. 1830.

SYN. *Madrepora lactuca* PALLAS, 1766; *Pavonia lactuca* LAMARCK, 1816. — Singapore; Capt. W. H. A. Putnam.

Tridacophyllia Manicina DANA. 1846.

SYN. *Madrepora lactuca* ELLIS and SOL. pl. 44 (non PALLAS). — Singapore; Capt. W. H. A. Putnam.

Caulastrea furcata DANA. — Feejee Islands; J. D. Dana.

Symphyllia radians M. EDW. and HAIME. 1849.

SYN. *Mussa crispa* DANA (non LAMARCK). — Singapore; Capt. W. H. A. Putnam.

Mussa tenuidentata M. EDW. and HAIME. 1849.

SYN. *Mussa sinuosa* DANA. — Singapore; Capt. W. H. A. Putnam.

Mussa cytherea DANA. — Society Islands; A. Garret.

Mussa regalis DANA, Zoöphytes. 1846.

SYN. ? *Symphyllia Valenciennesi* M. EDW. and HAIME, 1849. — Singapore; Capt. W. H. A. Putnam.

Isophyllia dipsacea AGASSIZ, MS.

SYN. *Mussa dipsacea* DANA; *Symphyllia ? dipsacea* M. EDW. and

HAIME ; ? *Symphyllia guadulpensis* M. EDW. and HAIME, 1849. — Florida Reefs ; L. Agassiz. — Bermuda ; Frederic Rees, M. D.

Isophyllia sinuosa VERRILL.

SYN. *Madrepora sinuosa* ELLIS and SOL. 1786.

This species forms spreading rounded masses, often six inches in diameter and about two thick. Walls echino-costate exteriorly. The rather shallow, open cells are generally confluent in series of from two to five, but often simple. Septa very numerous, the edges divided into long, slender, subequal teeth. Columella well developed, papillose. It differs from the preceding in its broader growth, more numerous and thinner septa, much more shallow and narrow cells, which are about .7 of an inch, instead of an inch or more, in diameter. The ridges are narrow and sinuous, often with a groove at the top. — St. Thomas, West Indies ; Dr. G. H. Otis.

Isophyllia rigida VERRILL.

SYN. *Astrea rigida* DANA, Zoöph. 1846. — Florida ; L. Agassiz. — Bermuda ; T. C. Hill.

Euphyllia fimbriata M. EDW. Coralliaires. 1857.

SYN. *Euphyllia mœandrina* DANA, Zoöph. 1846. — Singapore ; Capt. W. H. A. Putnam.

Galaxea fascicularis OKEN. 1815.

SYN. *Madrepora fascicularis* LINN. Ed. X. 1758 ; *Anthophyllum fascicularis* DANA, 1846 ; *Galaxea fascicularis* M. EDW. and HAIME, 1851. — Singapore ; Capt. W. H. A. Putnam.

Galaxea cæspitosa VERRILL.

SYN. *Madrepora cæspitosa* ESPER. 1789 ; *Anthophyllum cæspitosum* DANA, 1846 ; *Galaxea Ellisii* M. EDW. and HAIME, 1851. — Singapore ; Capt. W. H. A. Putnam, J. D. Dana.

Fungia patella M. EDW. and HAIME. 1851.

SYN. *Madrepora patella* ELLIS and SOL. 1786 ; *Fungia agariciformis* and *patellaris* LAMARCK, 1801 ; *Fungia agariciformis* DANA. — Singapore ; Capt. W. H. A. Putnam.

Fungia repanda DANA. 1846. — Singapore ; Capt. W. H. A. Putnam.

Fungia dentata DANA. 1846. — Singapore ; Capt. W. H. A. Putnam.

Fungia Danæ M. EDW. and HAIME. 1851.

SYN. *Fungia echinata* DANA, Zoöph. (non PALLAS nec ESPER.). — Singapore ; Capt. W. H. A. Putnam.

Fungia confertifolia DANA. 1846 — Feejee Islands ; J. D. Dana.

Fungia concinna VERRILL.

Corallum strongly convex, with a deep, narrow central fosse. Septa very unequal, the principal ones nearly evenly exsert, broad, rather thick, the edges evenly dentate, with large, regular, acute teeth; latest ones narrow and thin, deep between the larger, the edges scarcely divided. Lower surface crowdedly costate, the costæ unequal, covered with obtuse papilliform spines. This species is allied to *F. repanda*, but is very distinct in the character of the septa. — Zanzibar; C. Cooke, E. D. Ropes.

Fungia serrulata VERRILL.

Corallum somewhat convex in the centre; fosse very narrow. Principal septa subequal, much narrower than in the preceding, the edges irregularly dentate, with small, very acute, unequal teeth; latest septa thin, much more narrow, the edges finely and regularly denticulate. Lower surface with the principal costæ about .5 of an inch distant, and many other finer ones between; all of them covered with prominent, obtuse, papilliform spines. — Kingsmills Islands; A. Garret.

Fungia Haimei VERRILL.

SYN. *Fungia discus* M. EDW. and HAIME, 1851 (non DANA).

This species differs from *F. discus* DANA, of which the original specimen is before me, in having stronger and nearly equal costæ, furnished with numerous sharp, curved spines, instead of scattered, irregular, obtuse ones, nearly obsolete on the central portion, and in having more equally developed septa, which are more finely and regularly serrated with small, acute, angular teeth. — Zanzibar; C. Cooke.

Fungia valida VERRILL.

Nearly circular, elevated at the centre. Septa very unequal, the principal ones very broad and thick, the last narrow and thin, all except those of the latest cycle strongly serrate with very large, broad, acute teeth. Costæ very unequal, the principal ones thick and prominent, with numerous strong, acute, often curved spines; between these are from three to five, scarcely distinct, except near the edge, and not spinose. Columella fine spongy. — Zanzibar; C. Cooke.

Ctenactis AGASSIZ, MS. 1860. — Type, *Fungia echinata* PALLAS.

This genus includes besides *Fungia Ehrenbergii* LEUCKART, and *F. crassa* DANA, the following: —

Ctenactis gigantea AGASSIZ, MS.

SYN. *Fungia gigantea* (*var.*) DANA, Zoöphytes, p. 303, pl. 19, fig. 12. — Feejee Islands; J. D. Dana.

Ctenactis echinata AGASSIZ, MS. 1860.

SYN. *Fungia echinata* PALLAS, 1766; *Fungia pectinata* EHR.; DANA; *Fungia Ehrenbergii* (*pars*) DANA; *Fungia echinata* M. EDW. and HAIME. — Singapore; Capt. W. H. A. Putnam.

Lobactis Agassiz, MS. 1860. — Type, *Fungia dentigera* Leuckart.

Lobactis Danæ Agassiz, MS. 1860.

Syn. *Fungia dentigera* Dana, Zoöphytes, p. 301, pl. 18, fig. 4, 1846 (non Leuckart). — Sandwich Islands; A. Garret.

Lobactis conferta Agassiz, MS.

Oblong oval, thick, massive, with even, closely crowded, rather thick, flexuous septa, evenly and finely serrate, with very small, acute, angular teeth, their sides strongly granulated. Tentacular lobes, much thickened, strongly exsert, angular, subacute. Lower surface thickly covered with rounded, slightly prominent papillæ. Length of a large specimen, 6.5 inches; breadth, 4; central fosse, 2.5 long. — Kingsmills Islands; A. Garret.

Pleuractis Agassiz, MS. 1860. — Type, *Fungia scutaria* Lamarck.

Pleuractis scutaria Agassiz, MS. 1860.

Syn. *Fungia scutaria* Lamarck, 1801; Dana; M. Edw. and Haime. — Singapore; Capt. W. H. A. Putnam.

Herpetolitha Limax Eschscholtz. 1825.

Syn. *Madrepora Limax* Esper; *Fungia limacina* Lamarck, 1816; *Haliglossa limacina* Ehr., 1834; *Herpetolithus limacinus* Dana, 1846. — Singapore; Capt. W. H. A. Putnam.

Herpetolitha ampla Agassiz, MS.

A large, spreading species, broad oblong in form, obtusely rounded at the ends; rather thin, about one inch in the middle, half as much near the edges. Septa thin, rounded, exsert, the median ones about an inch in length, the lateral half an inch; the edges evenly serrate with fine, acute, angular teeth. Lower surface crowdedly echinate, with short, conical, acute spines. A specimen 13 inches in length is 6 broad. — Zanzibar; C. Cooke.

Podabacia crustacea M. Edw. and Haime. 1851.

Syn. *Madrepora crustacea* Pallas, Elench. Zooph., p. 291, 1766; *Pavonia explanulata* Dana; *Podabacia cyathoides* M. Edw. and Haime, 1850. — Singapore; J. M. Barnard.

Cryptabacia talpina M. Edw. and Haime. 1851.

Syn. *Fungia talpina* Lamarck, 1801; *Polyphyllia talpa* Blainville; Dana. — Singapore; Capt. W. H. A. Putnam.

Halomitra clypeus Verrill.

Syn. *Halomitra pileus* (*pars*) Dana, Zoöphytes, p. 311, pl. 21, f. 2, 2 *a*, 1846 (non *Madrepora pileus* Linn. Ed. X., *Fungia pileus* Lamarck, 1801, nec *Halomitra pileus* M. Edw. and Haime). — Feejee Islands; J. D. Dana.

This is a very thick, massive species, quite distinct from that described by Milne-Edwards and Haime, which appears to be the true *Madrepora pileus* Linn.

Halomitra tiara AGASSIZ, MS.

Corallum solid, very convex above, much thinner than the preceding, about half an inch thick. Septo-costal plates thin, short, strongly incise-dentate, the teeth elongated, acute, granulated. Cells very distinct, irregularly scattered, but less remote than in the preceding, owing to the much shorter plates, which are .3 of an inch long near the centre, and about .6 near the margin. Lower surface very concave, with the costæ distinct to the centre, close, slightly thickened, covered with nearly equal, sharp, conical spines. — Kingsmills Islands; A. Garret.

Zoopilus echinatus DANA, Zoöphytes, p. 319, pl. 21, fig. 6. 1846.

Feejee Islands; J. D. Dana.

This genus is perfectly well founded, being closely allied to *Lithactinia*; not, as Milne-Edwards has supposed, a *Fungia*.

Trachypora VERRILL.

Corallum explanate, thin; below echinate and coarsely costate; above with scattered polyp centres destitute of walls, with one or two cycles of septa, radiating at the centres, but becoming subparallel between them, as in *Halomitra*, strongly dentate or lacerately lobed, the strongest lobes surrounding the polyp centres; columella loose, trabicular.

This genus is in several respects intermediate between *Halomitra* and *Echinopora;* in its mode of growth it resembles the latter, but not in its cells. It appears to include, besides the following, *Echinopora aspera* DANA (*Madrepora aspera* ELLIS and SOL.).

Trachypora lacera VERRILL.

Broadly explanate and gibbous, thin, with many irregular openings near the margin. Below coarsely and irregularly ribbed or costate, the principal costæ very thick, prominent, strongly echinate, the spines irregular, lacerately lobed, smaller intermediate costæ scarcely spinose. Upper surface covered by rather loose, very unequal septo-costal plates, which are deeply and irregularly divided into strong lacerate spines; the plates are nearly parallel, except close to the polyp centres, where they bend abruptly and unite with the columella. The spines around the centres are large and stout, often broad at the ends; centres irregularly scattered, from half an inch to an inch distant. — Singapore; J. M. Barnard.

Phyllastrea tubifex DANA. 1846.

SYN. *Mycedium tubifex* M. EDW. and HAIME, 1851. — Feejee Islands; J. D. Dana.

This genus is quite distinct from *Mycedium* in its coarse, spinose septa, and strong costæ beneath.

Phyllastrea explanata AGASSIZ, MS.

Differs from the preceding in its broadly explanate, thin, semicircular or subturbinate fronds, smooth below, with distant, strong costæ, and many smaller intermediate ones. The cells are smaller, less remote, with much thickened, lacerately toothed septa, which become very thin between the cells. Columella rudimentary. — Tahiti; A. Garret.

Echinopora flexuosa Verrill.

Corallum forming broad, thin, foliaceous, flexuous, and contorted plates, often growing upright, covered on both surfaces with circular, slightly prominent corallites about .12 of an inch in diameter, separated ordinarily about a quarter of an inch. Between the cells the septo-costal striæ are numerous, thin, divided into slender, sharp spines. There are two complete cycles of septa, with rudiments of a third; those of the first cycle are thickened exteriorly and divided into prominent teeth, which are themselves lacerate. Columella loose, trabicular, little developed. — Singapore; Capt. W. H. A. Putnam.

Echinopora reflexa Dana.

This differs from *E. rosularia* Lamk. in having *three* complete cycles of septa. — Feejee Islands; J. D. Dana.

Acanthopora Verrill. —Type, *Echinopora horrida* Dana.

Corallum ramose, solid, the cells being filled below as in *Oculina*. Costæ between the cells represented by series of spines. It differs also from *Echinopora* in its polyps.

Acanthopora horrida Verrill.

Syn. *Echinopora horrida* Dana, Zoöphytes, p. 282, pl. 17, f. 4, 4 a, 4 b, 4 c, 1846. — Feejee Islands; J. D. Dana.

Pavonia formosa Dana. — Tahiti; A. Garret.

The genus *Pavonia* was first established by Lamarck in 1801, in Système des Animaux sans Vertèbres, p. 372; therefore this name must be retained, instead of *Lophoseris* proposed by Milne-Edwards and Haime, since it was not employed among insects until 1816.

Pavonia prætorta Dana. — Tahiti; A. Garret.

Pavonia frondifera Lamarck.

Syn. *Pavonia frondifera (pars)* Dana; *Lophoseris frondifera* M. Edw. and Haime. — Singapore; Capt. W. H. A. Putnam.

This species is, possibly, *Madrepora ficoides* Ellis and Solander.

Pavonia loculata Dana.

Syn. *Pavonia crassa var. loculata* Dana; *Lophoseris? crassa (pars)* M. Edw. and Haime. — Singapore; Capt. W. H. A. Putnam.

This is, perhaps, *Madrepora acerosa* Ellis and Solander.

Pavonia venusta Dana.

Syn. *Lophoseris? venusta* M. Edw. and Haime. — Singapore; Capt. W. H. A. Putnam.

Pavonia Danæ Verrill.

Syn. *Pavonia boletiformis* Dana (non Lamk.); *Lophoseris Danai* M. Edw. and Haime. — Sooloo Sea; J. D. Dana.

Pavonia varians Verrill.

Corallum incrusting, varying in form according to the object upon which it grows, at times glomerate, massive, and gibbous, with short angular or convoluted crests rising from the surface. These sometimes become more elevated, with an acute edge, or, by incrusting the tubes of Serpulæ, rise into irregular ramose forms. Septa from twelve to sixteen, the primary ones thickened, strongly granulated. Cells rather small, open; columella small, papilliform, often wanting. — Sandwich Islands; A. Garret.

Leptoseris papyracea Verrill.

Syn. *Pavonia papyracea* Dana. — Sooloo Sea; J. D. Dana.

Mycedium fragile Dana; Agassiz MS., Florida Reefs, fig. — Florida; L. Agassiz.

Agaricia agaricites M. Edw. and Haime. 1851.

Syn. *Madrepora agaricites* Pallas, 1766; *Pavonia agaricites* Lamk.; *Agaricia* (*Mycedia*) *agaricites* Dana. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Agaricia purpurea LeSueur. — Hayti; D. F. Weinland.

Siderastrea radians Agassiz, MS. l. c., fig. (unpublished).

Syn. *Madrepora radians* Pallas, 1766; *Madrepora galaxea* Ellis and Sol. 1786; *Astrea galaxea* Lamk. 1801; *Siderastrea galaxea* Bainv. 1830; M. Edw. and H. 1850; *Siderina galaxea* Dana, 1846; *Astrea radians* M. Edw. 1857. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Professor Agassiz ascertained by an examination of the living polyps of this species, in 1850, that it is a *Fungian* closely allied to *Pavonia*, with which it also agrees in the structure of the coral; the name *Astrea*, therefore, cannot with propriety be retained for the genus, although it was one of the species originally included in that genus by Lamarck.

Siderastrea siderea Blainville. 1830.

Syn. *Madrepora siderea* Ellis and Sol. 1786; *Astrea siderea* Lamk. 1816; *Pavonia siderea* Dana, 1846. — Florida; L. Agassiz. — Hayti; D. F. Weinland.

Siderastrea clavus Verrill.

Syn. *Pavonia clavus* Dana, 1846; *Lophoseris ? clavus* M. Edw. — Feejee Islands; J. D. Dana.

Pachyseris fluctuosa Verrill.

Corallum forming large explanate plates, which are rather thin, somewhat semicircular in outline, attached by the central part of the lower edge. The upper surface concave, sometimes undulate near the margin; lower surface strongly striated, the costæ close and thickened, somewhat granulated. The transverse ridges of the upper surface are regular and often extend across the whole breadth of the surface, occasionally interrupted, mostly undulated or flexuous, about as high as broad. Centres of the polyp cells very minute, but distinct, not radiated; septo-costal striæ close and even; bent in a zigzag manner on the ridges. Breadth of a large specimen, 28 inches; height, 15; average thickness, .25; width of the valleys, .20. — Kingsmills Islands; A. Garret.

Merulina ampliata Ehrenberg. 1834.

Syn. *Madrepora ampliata* Ellis and Sol. 1786; *Agaricia ampliata* Lamk. 1801; *Merulina speciosa* Horn (non Dana) is the mature form with rising branches, Proc. Phil. Acad. Nat. Sci. 1860, p. 435. — Singapore; Capt. W. H. A. Putnam.

Merulina regalis Dana. 1846. — Feejee Islands; J. D. Dana.

Merulina speciosa Dana. 1846. — Feejee Islands; J. D. Dana.

Clavarina Verrill.

Corallum compact, branching. Cells imperfectly circumscribed, but not confounded in series. Septa and walls thickened, the former lacerate-toothed, with paliform teeth at the bases. Columella rudimentary.

Clavarina scabricula Verrill.

Syn. *Merulina scabricula* Dana, Zoöphytes, p. 275, pl. 16, f. 2, 2 a, 2 b, 1846. — Feejee Islands; J. D. Dana.

Zoanthus sociatus Lamarck. 1801.

Syn. *Actinia sociata* Ellis, Phil. Trans. 1767; Ellis and Sol. 1786; *Zoantha sociata* Lamk. Syst. An. sans Vert. 1801; *Zoantha Ellisii* Lamk. Hist. An. sans Vert. 1816; *Zoanthus sociatus* Ehr. 1834. — Florida; L. Agassiz.

Cerianthus americanus Agassiz, MS.

Body very long, often two feet when expanded, and upwards of an inch in diameter, tapering gradually to the base. Outer tentacles very numerous, one hundred and twenty or more, slender, about 1.5 inches long, very flexible; inner ones close to the mouth, about .75 of an inch long, often twisted together spirally. Color of column dark cinnamon brown, with darker lines of the same; marginal tentacles cinnamon color, lighter at the base; inner ones darker, marked with longitudinal white lines; outer portion of the disk yellow, with dark spots at the base of the tentacles. — Charleston, South Carolina, buried in mud; L. Agassiz.

The descriptions of the colors of this and other species of *Actinidæ* have been taken from a series of drawings which Professor Agassiz caused to be made from living specimens, in 1852.

Halcampa albida Agassiz, MS.

Syn. *Corynactis albida* Agassiz, Proc. Bost. Soc. Nat. Hist. VII. p. 24, 1859.

Column, in full expansion, long and slender, but very changeable in form; upper half covered with prominent suckers, arranged rather closely in longitudinal rows. Tentacles twenty, slender, with a rounded knob at the end. Length in expansion, about 3 inches; thickness, .4. Color light brownish yellow; tentacles lighter, with the ends dark brown. — Nantucket, Massachusetts, buried in sand; B. T. Morrison.

Dysactis pallida Verrill.

Syn. *Actinia pallida* Agassiz, MS. 1849; ? *Anthea flavidula* McCrady, Proc. Elliott Soc. of Charleston, S. C., I. p. 280 (without description).

Column short, subcylindrical, expanding above the middle to the margin of the broad disk, but varying somewhat in form according to the state of contraction. Inner tentacles an inch or more long, slender, those near the margin short, conical, with some of intermediate length between. Column sometimes 1.25 inches high; disk .75 broad. Color light yellowish brown; longest tentacles lighter, spotted with white. — Charleston, South Carolina; L. Agassiz.

Bunodes cavernata Verrill.

Syn. *Actinia cavernata* Bosc, Hist. nat. des Vers, 1802 (the young). — Charleston, South Carolina; L. Agassiz.

Rhodactinia Davisii Agassiz, Comptes-Rendus, XXV. p. 677, 1847; Revue zoologique Soc. Cuv. p. 394, 1847.

Syn. *Actinia obtruncata* Stimpson, Marine Invertebrata of Grand Menan, p. 7, 1853 (littoral variety). — Massachusetts Bay; L. Agassiz. — Eastport, Maine; A. E. Verrill.

The genus *Rhodactinia*, established by Professor Agassiz in 1847, is perfectly equivalent to *Tealia* recently proposed by Gosse, the type of the former, *R. Davisii*, being the American representative of *R. crassicornis* of Europe, to which it is very closely allied.

Aulactinia Agassiz, MS.

Column elongated, upper portion capable of involution. Walls with prominent verrucæ in longitudinal rows on the upper portion; the marginal ones larger, trilobed, the lobes again subdivided on the lower side. Tentacles short, subequal.

Aulactinia capitata Ag., MS. 1849.

Column much elongated; basal disk somewhat expanded. Suckers extending down about an inch from the summit, becoming obsolete below. Marginal tubercles well developed, lower surface lobed and papillose. Tentacles numerous, short, and thick. Color of the column greenish or purplish brown, with lighter lines; tentacles light yellowish green, with a dark longitudinal line on the inside, interrupted by white spots. — Charleston, South Carolina, buried in sand to the tentacles; L. Agassiz.

Metridium marginatum M. Edwards, Coralliaires. 1857.

Syn. *Actinia marginata* LeSueur, Journal Phil. Acad. Nat. Sci. I. p. 172, 1817; *Actinia dianthus* Dawson, Canadian Nat. and Geologist, Vol. III. p. 412, figs. 1 and 2, 1858. — Massachusetts Bay; L. Agassiz. — Bay of Fundy; A. E. Verrill.

This is the American representative of *M. dianthus* of Europe, which it closely resembles in colors and form. Living specimens of the two species, compared side by side in the Museum, however, have shown constant differences in the arrangement of the tentacles. The specimens of *M. dianthus* were forwarded from the Free Public Museum of Liverpool, through Capt. J. Anderson.

Cereus sol Agassiz, MS.

Syn. *Actinia sol* Agassiz, MS. 1849.

Very contractile and variable in form; when fully expanded usually elongated, narrowest in the middle, expanding both above and below. Tentacles very numerous, often four or five hundred, those of the primary cycles about half an inch long, scattered, placed about midway between the mouth and the margin of the disk, the outer ones becoming very crowded and small. Actinostome with seven folds on each side. Walls for a short distance below the tentacles covered with small suckers and pierced with loop-holes. Column with about eight broad stripes of cinnamon brown, alternating with narrower gray ones, the whole surface irregularly spotted with dark brown, darkest near the tentacles; mouth bright yellow, surrounded by a ring of deep crimson or purple; outside of this the disk is greenish blue, with darker radiating lines; inner tentacles with a white longitudinal line on each side and darker brown spots on the inside and at the base; others nearer the margin are tipped with red, then farther outward they become orange-yellow with red tips, while the outermost ones are nearly white. — Charleston, South Carolina, on shells inhabited by hermit crabs; L. Agassiz.

This species is closely allied to *C. Bellis* of Europe, the type of the genus *Cereus* of Oken; therefore I have restricted that name to this section of the genus *Sagartia* of Gosse.

Edwardsia sipunculoides Stimpson, MS.

Syn. *Actinia sipunculoides* Stimpson, Marine Inv. of G. Menan, p. 7, pl. 1, f. 2, 1853. — Eastport, Me.; A. E. Verrill.

HYDROIDEA.

Tabulata.

illepora alcicornis Linn. Ed. X. 1758; Agassiz, Florida Reefs, fig. (unpublished).

Florida; L. Agassiz, D. P. Woodbury. — Hayti; D. F. Weinland.

M. moniliformis Dana is a form of this species.

illepora pumila Dana, Zoöph. 1846. — Porto Cabello, South America; Coll. Harvard University.

illepora intricata M. Edwards. 1857. — Manilla; J. Russell.

illepora insignis Verrill.

Corallum forming large, meandering plates, giving off smaller plates at right angles to their surface; the edges are thick, obtuse, often lobed, and sometimes divided into short, irregular branches, obtuse at the ends; surface irregular, covered with small verrucæ. Cells large for the genus, the principal ones situated at the summit of slight prominences, surrounded by a circle of about six small ones. — Kingsmills Islands; A. Garret.

Heliopora cœrulea Blainville. 1830.

Syn. *Millepora cœrulea* Pallas, 1766; *Madrepora cœrulea* Esper; *Pocillopora cœrulea* Lamarck, 1816. — Singapore; Capt. W. H. A. Putnam.

Heliopora compressa Verrill.

Corallum forming a thick, massive or incrusting base, from which it rises into broad winding plates, thin at their edges, which give off from their sides smaller plates and compressed, lobe-like branches. Cells somewhat larger than in the preceding species and more distant; the minute secondary cells are also less numerous and smaller. Surface of the cœnenchyma covered with crowded papillæ, terminating in two or three points. — Kingsmills Islands; A. Garret.

Pocillopora cæspitosa Dana. — Sandwich Islands; A. Garret.

Pocillopora ligulata Dana. — Sandwich Islands; A. Garret.

Pocillopora nobilis Verrill.

Syn. *Pocillopora verrucosa* Dana, Zoöphytes, p. 529, pl. 50, fig. 3 (non Lamarck). — Sandwich Islands; A. Garret.

Pocillopora Danæ Verrill.

Syn. *Pocillopora favosa* Dana, l. c., pl. 50, fig. 1 (non Ehr.). — Feejee Islands; J. D. Dana.

Pocillopora squarrosa Dana. 1847. — Feejee Islands; J. D. Dana.

Pocillopora acuta Lamk. 1816. — Feejee Islands; J. D. Dana.

Pocillopora suffruticosa Verrill.

This species forms neat, densely-branched, rounded clumps, often eight inches in diameter, resembling those of *P. bulbosa*, with small, irregular, and very proliferous branches. The surface is more strongly echinate than that of the latter, with much deeper and less open cells. — Tahiti; A. Garret.

Pocillopora ramiculosa Verrill.

Branches very slender and elongated, much divided, forming rounded clumps less dense than the preceding, or *P. cæspitosa*, to which it is allied. Branchlets very small, often .1 of an inch in diameter, subacute, not crowded. Cells small and deep, nearly circular. Surface evenly and crowdedly echinulate. This species resembles *P. acuta* in its mode of branching, but is more slender and has much smaller cells than either that species or *P. cæspitosa*. — Kingsmills Islands; A. Garret.

Pocillopora stellata Verrill.

Corallum forming close clumps of long, moderately thick, subparallel branches, which are covered with rising, elongated, subacute, rather distant verrucæ; surface crowdedly echinulate. Cells distant, small, and deep with twelve prominent radiating plates, which give them a stellate appearance. This species resembles *P. damicornis* somewhat in the size of its branches and mode of growth, but is entirely distinct in the structure and small size of the cells. — Zanzibar; C. Cooke, Capt. Ashby.

Pocillopora damicornis Lamk. 1816.

Syn. *Madrepora damicornis* Esper. — Singapore; Capt. W. H. A. Putnam.

Pocillopora bulbosa Ehr. 1834. — Singapore; Capt. W. H. A. Putnam.

Pocillopora capitata Verrill.

The corallum consists of a cluster of large irregular branches, often an inch or more in diameter, covered with elongated, squarrose, subacute verrucæ, .3 of an inch long and .1 in diameter, about .2 of an inch distant. Branchlets spreading, often rounded and clavate at the end, where the verrucæ become obsolete; surface echinulate, the grains unequally scattered, most prominent immediately around the edges of the cells, which are small, circular, and very deep. This species, although very variable in the form and size of the branches, is very distinct from all the other species known, in the character of the surface and cells. — Acapulco, Mexico; A. Agassiz.

Published January, 1864.

No. 4. — List of the Brachiopoda from the Island of Anticosti, sent by the Museum of Comparative Zoölogy to different Institutions in Exchange for other Specimens, with Annotations. By N. S. SHALER.

Lingula BRUGIÈRE.

Lingula elegantula SHALER.

Shell large, oblong, transverse diameter a little over one half the distance from beak to border; margin opposite the beak evenly rounded; sides straight for over two thirds the height of shell, suddenly converging to the beaks; apical angle, 110°; cardinal edges straight; diameter at right angles to valves one fifth the height. Valves moderately, nearly equally, convex. Homologue of toothed valve most convex, depressed near the border; surface with fine concentric lines of growth accumulated in low plications on the sides, no radial striæ. The surface of all the specimens is of a beautiful iridescent blue color, apparently the original hue of the shell.

Height, 1.7 inches; width, 1 inch. — Upper twenty feet of Junction Cliff, west end of Anticosti.

Lingula Forbesi BILLINGS. New species of Lower-Silurian Fossils; Geol. Sur. Canada. June, 1862. — West end of Anticosti.

Strophomena (RAFINESQUE) BLAINVILLE.

Strophomena semiovalis SHALER.

Shell semi-oval, transverse diameter from one fifth to one seventh greater than from the beak to the border; hinge-line straight, slightly alate; sides slightly converging until a little below the middle, thence rapidly converging, sometimes slightly produced opposite the hinge-line. Socket-valve flat or slightly concave, over the surface of the visceral disk, which occupies from one half to two thirds the distance from beak to border, then rather sharply deflected; depth of valve equal to one third the length from beak to border. Surface covered with close-set, irregular radial striæ of several sizes, in irregular alternation, crossed by very fine concentric lines. Near the hinge-line are several irregular undulations, which do not extend to the middle of the visceral disk. Area of socket-valve narrow, almost linear, interrupted by a small cardinal process. Area of toothed valve rather broad, half a line wide in specimens measuring one inch from beak to border. Fissure narrow, with a V-shaped deltidium. — Ellis Bay, Anticosti. Division D, Canada Geological Survey.

Strophomena reticulata SHALER.

Sub-triangular, one third wider than high, greatest width at hinge-line. Toothed valve very convex, ventricose, flattened towards the extremities of the hinge-line, slightly alate, most convex point a little more than half the distance from beak to border, depth equal to one third the length of hinge-line, nearly evenly rounded from beak to border, beak minute, projecting a little beyond the hinge-ledge, area one and a half lines wide in a specimen twenty lines broad, fissure broad, without deltidium. Area of socket-valve about one fourth that of toothed valve; surface deflected to correspond with opposite valve. Surface covered with very numerous, minute, close-set radial striæ, crossed by numerous concentric undulations, which near the umbo are small and even; away from that point they are irregular and larger. — Ellis Bay, Anticosti. Division D, Canada Geological Survey.

Strophomena arcuata SHALER.

Shell obscurely trigonal; distance from beak to border two fifths less than length of hinge-line; greatest width at hinge-line; toothed valve slightly convex, or nearly flat near the beak, suddenly evenly deflected at two thirds the distance from the beak to border; surface covered with rather fine, irregular, radial striæ, branching several times from beak to border, five to seven in the space of one line on the border.

This species is a member of the same group with *Strophomena euglypha* of the Wenlock Lime. — Ellis Bay, Anticosti. Division D, Canada Geological Survey.

Strophomena anticostiensis SHALER.

SYN. *Strophomena alternata* BILLINGS.

Outline rather variable, usually evenly semi-oval; length of hinge-line usually a little greater than from beak to border; sides nearly straight for half the distance from the beak to border; rest of border gradually curved. Toothed valve slightly evenly convex; hinge-line narrow; teeth very slight. Socket-valve flat or nearly so; hinge-line narrow; cardinal process very slight; sockets bordered on the inside by a pointed tooth-like ridge. Muscular impressions at all ages indistinct and scarcely impressed. Surface covered with fine punctate markings. Surface of shell with fine striæ of two or three sizes, alternately disposed.

Very closely related to *S. alternata* CON., from which it differs in being far more regular; by the presence of ridges below the sockets; in wanting the tendency to a sudden deflection, and interior thickening of the borders of the valves. — Heath Point, Anticosti.

Strophomena alterniradiata Shaler.

Shell semi-oval; width at hinge-line about three eighths greater than from beak to border. Toothed valve distinctly convex near the umbo; remainder of valve flattened or slightly concave. Socket-valve slightly concave just below the umbo, slightly convex over the remainder of the surface. Surface of both valves with distinct rounded radii, one half of which originate at the beak, the others coming in by implantation at the border of the umbonal third of the valves; intervals very wide. Hinge area of toothed valve wide, — one line in specimens ten lines broad; that of socket-valve narrow, nearly linear. Fissure wider than high; teeth small and pointed. Brachial supports oblique, meeting at an angle of 90°. Cardinal process very small, slightly projecting. — Southwest Point, Anticosti.

Brachyprion Shaler.

Dental plates transversely much elongated; scarcely distinct from the remainder of the hinge-line; vertically serrated.

Type. — *Strophomena leda* Billings.

Brachyprion leda Shaler.

Syn. *Strophomena leda* Billings. — Near Beescie River Bay.

Brachyprion ventricosum Shaler.

Syn. *Strophomena Philomela* Billings ?

Sub-trigonal margin opposite the hinge-line rounded, strongly alate, one side being unusually more prolonged than the other; hinge-line two fifths longer than distance from beak to border; width on hinge-line, 2.30 inches; at one third the distance from beak to border, 1.33 inches; convexity of toothed valve equal to one third the distance from beak to border. Toothed valve strongly evenly convex, much compressed near the alations; highest point two thirds the distance from beak to border; hinge area narrow; fissure very small, triangular, not extending to the beak. Area of socket-valve narrow, cardinal process small. Surface covered with very fine linear radial striæ of two sizes, four or five of the smaller between each pair of larger; smaller striæ nearly microscopic; several indistinct concentric undulations near the hinge-line. — Near Southwest Point, Anticosti. Division E, Canada Geological Survey.

Brachyprion geniculatum Shaler.

Shell semi-elliptical or sub-trigonal; greatest width at hinge-line; hinge-line straight; about one third greater than from beak to border. Socket-valve plane or slightly concave over the visceral disk, suddenly deflected at two thirds the distance from beak to border. Surface of shell with a number of rounded radial striæ (twenty to fifty). Those on the centre much larger than those on the sides; between each pair from five to nine very fine striæ, two or three of which become larger than the others as they approach the border. The finest striæ are scarcely visible to the naked eye.—Jumper's Cliffs, near Southwest Point, Anticosti.

Plectambonites Pander.

Plectambonites glabra Shaler.

Syn. *Leptæna sericea* Billings, Can. Geol. Survey, 1853–56, p. 252.

Shell elongate semi-oval; distance from beak to border about one half as long as hinge-line; hinge-line usually equal to the greatest width of shell; outline evenly rounded. Toothed valve strongly convex; depth about two fifths (sometimes one half) the length from beak to border; most convex point one third the distance from beak to border; a little flattened near the lateral border; strongly ventricose in the middle; umbo rising above the hinge-line; slightly incurved; beak not distinct; area narrow; in the same plane with the lateral margin; teeth small, slightly projecting. Socket-valve curved to fit the toothed valve; area a little less in width.

Surface of valves, with very numerous nearly microscopic radial striæ, closely set, of nearly equal size, scarcely distinguishable upon the centre, but distinct upon the borders of the shell. The socket-valve has distinct radial striæ of a larger size interspersed among these, like the radii on the toothed valve.

This form differs from its representatives of the Lower Silurian by its great convexity, as well as by many other characters.—Ellis Bay, Anticosti.

Plectambonites arca Shaler.

Syn. *Leptæna transversalis* Billings.

Shell semi-elliptical; greatest width at hinge-line; hinge-line one third longer than from beak to border. Toothed valve in adult specimens very ventricose; depth equal to one third the length of hinge-line; area narrow, almost linear; fissure very small, equilaterally triangular; muscular impressions indistinct. Socket-valve concave, flattened towards the extremities of the hinge-line; area narrow, linear; cardinal process very small; muscular impressions very slight. Surface of shell with twelve to twenty distinct radii, with very fine radii between.—Near Southwest Point, Anticosti.

Plectambonites tenera Shaler.

Very closely allied to the form called by Hall *Leptæna transversalis*, from the Niagara Lime of New York; it is, however, less convex, and more flattened towards the extremities of the hinge-line. The area of the toothed valve is in the same plane as the margin. The umbo scarcely extends above the hinge-line in many of the specimens. Interior has not been compared.—Near Southwest Point, Anticosti.

Leptæna Dalman.

Leptæna Julia Shaler.

Syn. *Strophomena Julia* Billings.

This species possesses all the important characters of the group, — sudden deflection of the valves, corrugated surface, together with the ridge around the visceral disk on the internal surface of the socket-valve. — Near South-west Point, Anticosti.

Leptæna quadrilatera Shaler.

Syn. *Strophomena depressa* Billings.

Shell margin broadly semi-oval; greatest width at hinge-line, which is one half longer than from beak to border. Tooth-valve with the visceral disk nearly rectangular; laterally about two sevenths wider than from beak to point of deflection; disk convex near the umbo, concave near the deflected margin; umbo rather prominent, broadly rounded, scarcely rising above the hinge-line; radii fine, with even interspaces, somewhat irregular on the deflected margin; concentric undulations about six in number, wanting on a space about one fifth of an inch wide near the umbo; hinge area very narrow, almost linear near the extremities; socket-valve nearly flat or slightly convex over the visceral disk, usually with a distinct mesial sinus; hinge area narrow, not over one twenty-eighth of an inch in width; cardinal process minute.

This species may prove identical with the form from the Niagara group of New York, but there are several constant exterior differences. The interiors have not been examined. — Ellis Bay, Anticosti.

Orthis Dalman.

Orthis laurentina Billings, Report Can. G. S. for 1857, p. 297. — Junction Cliff, Anticosti.

Orthis media Shaler.

Syn. *Orthis elegantula* Billings.

Shell orbicular; hinge-line one half less than width of shell. Toothed valve evenly convex; depth in adult specimens about one fourth the height, in young specimens proportionately a little greater; umbo slightly elevated, rising above the hinge-line one eighth the distance from beak to border, slightly compressed, occupying at the hinge-line about one fourth the diameter of the valve; beak small, distinct, slightly recurved, a little overhanging the area; area small, rather broad. Fissure triangular, one third as wide as length of hinge-line. Socket-valve transversely flattened, a slight mesial depression dividing the surface into two lobations.

Differs from its European representatives, being more orbicular, having a less projecting umbo, less incurvation of beak, much finer radial striæ.

closer approximation of the brachial supports of the socket-valve, and less length of the adductor impressions in the same valve. — Southwest Point, Anticosti.

Orthis anticostiensis Shaler.

Syn. *Orthis porcata* Billings (*non* McCoy), Can. Geol. Sur., 1862, p. 135. — Ellis Bay.

Orthis æquivalva Shaler.

Syn. *Orthis hybrida* Billings.

Shell somewhat lenticular; one fifth wider than from beak to border; valves nearly equal in convexity; toothed valve a little the most prominent; hinge-line rather more than half the width of shell. Toothed valve strongly evenly convex, a little depressed opposite the umbo; umbo rising above the hinge-line about one sixth the distance from beak to border, a little laterally compressed; beak minute, scarcely projecting beyond the hinge-line, a little recurved; area about twice as wide as that of socket-valve; width one sixth of length; steeply sloping; most convex point of valve a little nearer the beak than border. Socket-valve nearly evenly convex; very slight mesial depression, extending from the umbo to the centre of valve, where it fades out, and is succeeded by a slight ridge, which extends to the border, beak distinct; not rising as far above the hinge-line as that of opposite valve by the width of socket-valve area. Surface with fine dichotomous striæ, with interspaces as wide as the ridges. — Junction Cliff, west end of Anticosti.

Orthis rhynconelliformis Shaler.

Form varying from sub-circular to pentagonal; usually with the transverse one fifth greater than the diameter from beak to border; hinge-line very short, scarcely one half the width of shell. Toothed valve moderately convex, with a very broad, shallow mesial sinus beginning near the centre, and rapidly widening to the border; umbo somewhat laterally compressed; rising above the hinge-line; acutely pointed; not recurved; beak minute, very distinct. Socket-valve evenly convex; highest point near the middle of valve; usually a faint mesial sinus near the beak, fading out in the centre of the shell. Fissure of toothed valve wider than long, sides curved; teeth small, laterally compressed; muscular impressions extending to or beyond the middle of valve, very lobate; lobes pointed.

Surface with numerous angular radii; bifurcating twice from beak to border; about four in the space of one line on the centre of border; interspaces about as wide as ridges. — Gull Cove, eastern end of Anticosti.

Orthis alata Shaler.

Shell nearly semi-oval, sometimes slightly quadrate; hinge-line a little less than diameter of shell; both valves slightly, nearly equally convex. Toothed valve a little the deepest. Transverse diameter a little greater than from beak to border. Area of both valves narrow. Muscular impressions of toothed valve broader than long, extending about one fifth the distance from beak to border. Surface with from eighteen to twenty-two heavy, rounded ribs; the interspaces on the border double as wide as the ridges.

This species may be identical with *O. flabellulum* var. HALL from New York, but is certainly distinct from the *O. flabellulum* SOW. — Salt Lake Bay, upper part of Division E, Canada Geological Survey.

Orthisina D'ORB.

Orthisina diversa SHALER.

SYN. *Orthisina Verneuilli* BILLINGS.

Toothed valve usually pentagonal; socket-valve quadrate; hinge-line usually equal to the greatest width of shell. Toothed valve very strongly projecting; depth about one half the width; deepest point about the height of hinge-line; umbo somewhat laterally compressed, usually rising high above the plane of the hinge-line, but very variable in this respect; umbo always laterally inclined, indifferently towards either extremity of the hinge-line. Surface near the extremities of the hinge-line a little depressed and slightly recurved; area very large, nearly half as wide as long. Fissure from one fourth to one third the width of hinge-line; deltidium large, massive, rarely central, with distinct circular or oval foramen. Socket-valve with a broad and shallow mesial fold.

This form is closely related to *O. Verneuilli* EICH., but differs from it in the size of the radial striæ, and in many important internal features.— Ellis Bay, Anticosti.

Platystrophia KING.

Platystrophia regularis SHALER.

Outline much the same as that of the other members of the group. Socket-valve one fourth more projecting than the toothed valve; hinge-line a little less than diameter of shell, three fifths greater than distance from beak to border. That portion of the margin occupied by the fold and sinus is re-entering, the depth of the incurvation being about equal to the elevation of the umbo above the hinge-line. The depression of the sinus is occupied by only two plications, and the ridge by three similar folds. On either side are from eight to nine plications. These numbers seem invariable.

The muscular impression of the toothed valve is long and narrow, length being three or four times its width, extending nearly to the centre of the valve, — a feature in which this species differs from its representatives. — Junction Cliff, Anticosti.

Atrypa Dalman.

Atrypa impressa Shaler.

Syn. *Atrypa reticularis* Billings.

Outline of shell obscurely quadrate, sometimes rather sub-orbicular; about as broad as high; diameter from valve to valve about one half the distance from beak to border; valves nearly equally convex, toothed valve usually a little the greater; hinge-line straight, nearly as great as width of shell. Tooth-valve rather convex, side slopes more abrupt than central, slightly flattened or depressed opposite the hinge-line. Point of greatest convexity at one third the distance from beak to border. Umbo projecting above the hinge-line about one ninth the distance from beak to border; laterally compressed; recurved; projecting beyond the hinge-line; beak minute, pointed, distinct. Socket-valve evenly convex; most projecting point a little nearer the hinge-line than border. Originating at the beak there is a distinct, rather abruptly depressed mesial furrow, which grows more shallow towards the centre of valve. Radii branching twice from beak to border, a little larger in the centre of valve than on the border.

The adult condition of this species differs strikingly from any other form included under the name of *Atrypa reticularis*. — Near Southwest Point, Anticosti.

Atrypa flabella Shaler.

Outline sub-orbicular; transverse diameter about one fifth greater than from beak to border; the slopes on either side of the beak form an angle of about 150° at the valve. Toothed valve convex; rather ridge-like in the centre; depressed on the border opposite the beak; slightly compressed near the umbo; most convex point one third the distance from beak to border; beak not distinct from hinge-line. Socket-valve slightly convex; a distinct mesial impression divides the surface into two lobes. Surface with from twelve to eighteen rounded, club-shaped, radial ridges. Near the border of some large specimens there are a few concentric, imbricating lines of growth.

It is not unlikely that this form is specifically identical with the *A. hemispherica* Hall, from the Clinton of New York. There are several points of difference between this form and the *A. hemisphærica* Murch. — Near Southwest Point, Anticosti, upper part of Division E, Canada Geological Survey.

Rhynconella Fischer.

Rhynconella fringilla Billings. New Species of Low. Sil. Fossils; Can. Geol. Sur., 1862, p. 141, Fig. 118. — Near Gull Cape, Anticosti.

Rhynconella anticostiensis Billings. New Species of Low. Sil. Fossils; Can. Geol. Sur., 1862, p. 142, Fig. 119. — English Head, Anticosti.

Rhynconella glacialis Billings. New Species of Low. Sil. Fossils; Can. Geol. Sur., 1862, p. 143, Fig. 120. — Ellis Bay, Anticosti.

Brachymerus Shaler.

Anterior (dorsal) valve the more convex. Dental lamellæ serrate or lobed on the outside. Septa of anterior valve with two broad, thin brachial plates projecting from them near their junction with the hinge-line; exterior surface plicated.

A member of the same family as Pentamerus, to which it is very closely allied.

Type. — *Pentamerus Verneuilli* Hall.

Brachymerus reversus Shaler.

Syn. *Pentamerus reversus* Billings; Canada Geol. Survey, 1857, p. 295. — Junction Cliff, Anticosti.

Pentamerus Sowerby.

Pentamerus Barrandii Billings; Canada Geol. Survey, 1857, p. 296. — Becscie River Bay.

Athyris McCoy.

Athyris turgida Shaler.

Shell sub-circular; transverse diameter equal to distance from beak to border; from valve to valve about four fifths the transverse diameter. Toothed valve very convex; most elevated at one third the distance from beak to border; umbo rising above the hinge-line for a distance equal to one fifth the transverse diameter; closely incurved; beak indistinct; socket-valve very convex; most elevated point one third the distance from beak to border; depth equal to one third of the diameter, about two thirds as great as that of opposite valve; umbo rising above the hinge-line a distance equal to one fifth the diameter of valve. Surface with numerous distinct concentric lines of growth. Toothed valve with a narrow, shallow mesial sinus, which produces a flattening for some distance from the border.

From beak to border, seven lines; transverse diameter, seven lines; valve to valve, five lines. — Ellis Bay, Anticosti.

Athyris umbonata Billings. New Species of Low. Sil. Fossils; Canada Geol. Survey, 1862, p. 144. — Junction Cliff, Anticosti.

Athyris prinstana Billings. New Species of Low. Sil. Fossils; Canada Geol. Survey, 1862, p. 145. — Prinsta Bay.

Athyris Julia Billings. New Species of Low. Sil. Fossils; Canada Geol Survey, 1862, p. 146. — Jumper's Cliff, Anticosti.

Camerella.

Camerella ops Billings. New Species of Low. Sil. Fossils; Can. Geol. Survey, 1862, p. 148.

Spirifer Sowerby.

Spirifer tenuistriatus Shaler.

Form about the same as *Spirifer radiatus* Sow.; hinge-line straight for four fifths of the diameter of shell, then gently rounding; transverse diameter a little greater than from umbo to border; socket-valve very convex, most prominent point about middle of valve; umbo rising above the hinge-line for a distance equal to one fifth the transverse diameter; strongly recurved; area indistinctly bounded. Socket-valve about two fifths as projecting as toothed valve; umbo rising a little above the hinge-line; evenly rounded; mesial sinus rather shallow; somewhat angular. Surface covered with very fine, almost microscopic radii; eight or nine in the space of one line on the border.

This species differs from *S. radiatus* in the minuteness of the radial striæ. It is possible that this form is identical with the *S. radiatus* of Hall, from the Niagara and Clinton of New York. No comparison of specimens has been made. — Near Southwest Point, upper part of Division F, Canada Geological Survey.

Published June, 1865.

No. 5. — *The Fossil Cephalopods of the Museum of Comparative Zoölogy.* By ALPHEUS HYATT.

This number of the Bulletin begins a series of notices upon the Cephalopoda, which besides fulfilling the common object of similar numbers already published, has some peculiar features of its own requiring a few explanatory remarks.

The Ammonoids, including all the Cephalopods with serrated or foliated septa, the Clymeniæ, Goniatites, Ceratites, and Ammonites proper, are separated by Professor L. Agassiz from the Nautiloids and Dibranchiate Cephalopods as a distinct order.

The typical group of this order is the so-called genus Ammonites.

De Montfort and De Haan both recognized a few new genera within the limits of this incongruous genus before Von Buch described the natural groups which continue to bear his names. Von Buch called these groups "families," but classified them under the "generic" name of Ammonites; thus plainly, although indirectly, announcing his opinion of their sub-generic value.

Professor L. Agassiz, for many years past, considered some of these groups as natural families, and deemed them capable of division into subordinate groups of generic importance.

He imparted this fundamental idea to me at the beginning of my studies upon these interesting fossils, and selected the five genera which are referred to his authority as examples of the manner in which I should treat this subject, at the time he recommended the investigation to me. Further than this, the work is my own.

I have pursued no special method in the classification, but have directed my whole attention to the verification of the groups defined by Von Buch and others, and the subsequent testing of the limits of the included genera by a careful comparison of all the minor divisions in each natural group.

The shells or mineral casts of every group have been first arranged in series of species, and the limits of these series determined the genera. The generic characteristics were selected from those peculiar to all the species of each series which were not common to the family or any more comprehensive division.

The materials in the possession of the Museum afford ample means for the successful completion of such a plan, which, more than any other, demands large numbers of specimens. They consist of collections purchased from Professors Bronn and L. de Koninck, MM. Boucault and Duval, Dr. A. Krantz, and others, besides those obtained by exchange, among which is a valuable collection, numbering many species, from the Museum of Stuttgart.

I am indebted to Professor L. Agassiz for the free use of all the specimens in these collections, and desire to express here my acknowledgment of the facilities for study given me both by himself and the Institution.

The position of the female Argonauta in its shelly case, and of the Nautilus in its shell, show conclusively that the periphery of the whorls of an Ammonite is the abdominal side, as stated by Richard Owen and Pictet. This view, therefore, has been adopted, and the outer side of the whorl is called "the abdominal," and the inner "the dorsal side," in accordance with their opinion.

No further changes have been made in the nomenclature generally employed, with the exception of the use of the words "pilæ" for ribs, and "geniculæ" for the knees of the ribs, these being found somewhat more convenient in the description of the species than the ordinary terms.

Lower Lias.

PSILOCERATIDÆ.

Shell smooth. Umbilicus open, exposing the sides of the whorls; sides depressed.

Psiloceras Hyatt.

Abdomen smooth; shell often folded; sides depressed; septa foliated. Whorls enveloped to the line of the superior lateral lobes.

Psiloceras psilonotum Hyatt.

Ammonites psilonotus Quens'dt, Die Ceph., p. 73, pl. 3, fig. 18.

Loc. Nellingen, Balingen, Rudern, and Semur; Coll. L. de Koninck, Prof. Fraas, Mus. of Stuttgart, L. Agassiz, and Boucault.

It is quite probable that *Amm. erugatus* Bean (Phil. Geol. York, p. 168, pl. 13, figs. 1–3) is identical with this species, and if so, it will become necessary to change the name to *Psil. erugatus*, and consider *Psil. psilonotus* as a synonyme.

Psiloceras planorbis Hyatt.

Amm. planorbis Sow., Min. Conch., v. 5, p. 69, pl. 448.

Loc. Semur; Coll. Boucault.

Psiloceras planilaterale Hyatt.

Loc. Semur; Coll. Boucault.

Sides flattened, but more convex than other species, and marked with transverse striæ; occasionally plicated at intervals, resembling in this respect plicated variety of *P. psilonotus*. Abdomen depressed, convex, smooth; the siphon merely indicated by a raised line in the adult. Umbilicus shallow, showing great breadth in the young.

Psiloceras acutidorsale Hyatt.

Loc. Semur; Coll. Boucault.

Closely allied to *P. psilonotus*, but with smaller whorls and a more acute abdomen. It is, also, not so gibbous, and has a greater number of whorls than either *P. planilateralis* or *P. planorbis*. The shell may be marked with very numerous plications, or smooth on the sides. Abdomen prominent, acute. Umbilicus shallow.

Note. It is probable that *Amm. latesulcatus* Hauer, Ueber d. Ceph. aus d. Lias d. Nordöstlichen Alpen, p. 44, pl. 9, figs. 1 – 3, is the type of another genus of this family, having a keeled and sulcated abdomen.

DISCOCERATIDÆ.*

Arnioceras† Agassiz.

Abdomen keeled and channelled, but both parts are variable, being sharply defined in some species and very shallow in others. Abdominal lobe shallow and broad; not so deep as the superior lateral lobe; deeper than the inferior lateral; both divided equally. Superior lateral cell equally divided. Inferior lateral cell unequally divided. The young retain the smooth character for some time during their growth, thus giving to the umbilicus a decidedly embryonic aspect. Envelopment extends laterally to the geniculæ.

Arnioceras cuneiforme Hyatt.

Loc. Semur; Coll. Boucault.

Sides regularly convex. Pilæ depressed, most prominent in the centre, and sloping gradually to either side; striæ of growth very fine and sharply bent. Abdomen obtusely angular; keel indicated by a ridge; channels obsolete or only indicated by shallow depressions. The auxiliary lobes near the umbilicus are hardly more than mere serrations.

* Equals Arietes.

† 'Αρνειός, a ram.

Arnioceras incipiens Hyatt.

Loc. Semur; Coll. Boucault.

Sides convex. Pilæ with prominent geniculæ. Abdomen obtusely angular; keel prominent, narrow; channels either absent or well defined by shallow, narrow depressions. Young, smooth as in *Arnioceras cuneiformis*, but the pilæ begin with a line of abdominal tubercles, which quickly spread into true pilæ.

Arnioceras semicostatum Hyatt.

Loc. Semur; Coll. Boucault.

Sides convex. Pilæ have square prominent geniculæ. Abdomen flattened. Keel may be a depressed ridge without channels, prominent without channels, or prominent with well-defined narrow channels; in the first variety the young retain the smooth character until a later period than in the second and third.

Arnioceras kridiforme Hyatt.

Amm. kridion D'Orb., Terr. Jurass., I., p. 205, pl. 51.

Loc. Whitby, Adnet, Semur; Coll. Prof. Bronn, Dr. Krantz, and M. Boucault.

This species differs from *A. semicostatus* in the larger number and narrowness of the whorls, and the prevalence of the deeply channelled variety. The ribs of the young are not as smooth as in *Arn. semicostatus*, and they are developed at an earlier period.

It differs also from *Amm. kridion* Ziet., in the absence of tubercles, and its contracted abdomen.

Arnioceras tardecrescens Hyatt.

Amm. tardecrescens Hauer, Die Ceph. d. Lias d. Nordöstlichen Alpen, p. 20, pl. 3.

Loc. Durrenberg, Ravensberg, Hildesheim, Thionville, and Whitby, Coll. Dr. Krantz, L. de Koninck, and Damon.

Arnioceras ceratitoides L. Agassiz.

Amm. ceratitoides Quens'dt, Die Ceph., p. 239, pl. 19, fig. 3.

Amm. ceras Giebel, Fauna der Vorwelt, Ceph., p. 757.

Amm. ceras Hauer, Die Ceph. d. Lias d. Nordöstlichen Alpen.

Loc. Whitby and Adnet; Coll. Prof. Bronn and Dr. Krantz.

Arnioceras falcaries Hyatt.

Amm. falcaries Quens'dt, Der Jura, p. 70, pl. 7, figs. 6, 7.

Loc. Bonnert, Semur, Raidwangen, and Basel; Coll. L. de Koninck, Boucault, Mus. of Stuttgart, and Prof. Bronn.

Ophioceras* Hyatt.

Keel constant, sometimes obscure. The shell has a greater number of whorls than in the preceding genus, because the young increase more slowly in size. Pilæ straight, depressed; appear at an early stage in the young, and are well defined upon the second whorl. Umbilicus open; sides exposed. Abdominal lobe deeper and narrower than the lateral lobes. Superior lateral lobes broad, shallow, and but very little longer than the inferior lateral. The auxiliary lateral lobes are cuneiform, and incline toward the umbilicus.

Ophioceras torus Hyatt.

Amm. torus D'Orb., Terr. Jurassique, I., p. 212, pl. 53.

Loc. Semur, Quedlinburg, Rinteln, and Schaumburg; Coll. Boucault, Dr. Krantz, and De Koninck.

Ophioceras raricostatum Hyatt.

Amm. raricostatus Ziet., Verst. Würt., p. 18, pl. 13, fig. 4.

Amm. raricostatus Quens'dt, Der Jura, p. 105, pl. 13, figs. 16 – 18.

Loc. Semur, Boll, and Balingen, Würtemberg; Coll. Boucault, Dr. Krantz, Mus. of Stuttgart, and De Koninck.

Ophioceras Johnstoni Hyatt.

Amm. Johnstoni Sow., Min. Conch., v. 5, p. 70, pl. 449.

Amm. arietis Ziet., Verst. Würt., p. 3, pl. 2, fig. 4, but not figs. 2 and 3.†

Amm. raricostatus D'Orb., Terr. Jurassique, I., p. 212, pl. 54.

Loc. Lyme Regis, Semur, and Balingen; Coll. Wright, Damon, Boucault, and De Koninck.

Ophioceras kridioides Hyatt.

Loc. Basle; Coll. Prof. Bronn.

Abdomen like that of *O. Johnstoni*, but rounder than in *O. raricostatus*, and the young increase more rapidly than in either of these species. The pilæ are most prominent near the abdomen, and in the young they are more numerous than in the adult, numbering about twenty-four on the third whorl, and about twenty on the fifth whorl.

Abdominal and superior lateral lobes broad and shallow, the latter equally divided. There are two pointed auxiliary lobes on each side, and the superior lateral cells are equally divided.

Ophioceras commiscens Hyatt.

Loc Lyme Regis; Coll. B. M. Wright.

* Ὄφις, a serpent.

† Figs. 2 and 3 are identical with Discoceras spiratissimus *Hyatt* (Amm. spiratissimus *Quens'dt*).

Sides convex; pilæ depressed. The pilæ and the form of the whorl in the young, greatly resemble those of adult *raricostatus*, but in the adult they closely resemble those of the adult shell of *O. Johnstoni.*

Septa unknown.

Ophioceras tortile Hyatt.

Amm. tortilis D'Orb., Terr. Jurassique, I., p. 201, pl. 49.

Loc. Semur; Coll. Boucault.

Ophioceras deciduum Hyatt.

Amm. Nodotianus Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 24, pl. 6, figs. 1–3.

Loc. Whitby; Coll. Dr. Krantz.

Amm. Nodotianus D'Orb. is probably generically different, since it has a more acute abdomen.

Discoceras* Agassiz.

Abdomen keeled and channelled. Both characters are constant, although the channels are sometimes nearly obsolete. Pilæ smooth. Geniculæ curved forwards. Umbilicus open. Sides flattened, exposed. Abdomen depressed. Abdominal lobe deep and narrow. Superior lateral, and inferior lateral, narrow and irregularly pointed with minor lobes.

Superior lateral cell equally divided. Inferior lateral, unequally divided. First auxiliary cell well developed, and nearly as long as the inferior lateral.

Discoceras? laqueus Hyatt.

Amm. laqueus Quens'dt, Der Jura, p. 43, pl. 3, fig. 5.

Loc. Nellingen, Würtemberg; Coll. Mus. of Stuttgart.

The abdomen of the specimen examined is so obscured by its matrix of limestone, that the reference of the species to this genus must be considered doubtful.

Discoceras ophioides Hyatt.

Ammonites ophioides D'Orb., Terr. Jurassique, p. 241, pl. 64.

Loc. Semur; Coll. Boucault.

Discoceras carusense Hyatt.

Amm. carusensis D'Orb., Terr. Jurassique, I., p. 284, pl. 8, figs. 3–6.

Amm. spiratissimus Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 18, pl. 3, figs. 1–3.

Loc. Semur, Palingen; Coll. Boucault, L. de Koninck, and Prof. Bronn.

* Δίσκος, a quoit.

Discoceras spiratissimum Hyatt.

Amm. arietis Ziet., Verst. Würt., p. 3, pl. 2, fig. 3, not figs. 2 and 4.*

Amm. spiratissimus Quens'dt, Hand. Pet., p. 355, pl. 27, fig. 9.

Loc. Filder, Vaihingen, Metzingen, Hohenheim, and Stuttgart; Coll. De Koninck, Dr. Krantz, Mus. of Stuttgart, and Boucault.

Discoceras Conybeari L. Agassiz.

Amm. Conybeari Sow., Min. Conch., v. 1, p. 70, pl. 131.

Amm. obliquecostatus Ziet., Verst. Würt., p. 20, pl. 15, fig. 1.

Amm. Conybeari Ziet., Verst. Würt., p. 35, pl. 26, fig. 2.

Amm. Conybeari D'Orb., Terr. Jurass., I., p. 202, pl. 50.

Amm. Conybeari Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 16, pl. 2, figs. 1 – 6.

Loc. Semur, Waltzing, and Balingen; Coll. Boucault and L. de Koninck.

Coroniceras† Hyatt.

Keels prominent, constant; channels well-defined. Pilæ tuberculated and bent. Umbilicus open. Sides of the whorls exposed.

Pilæ preceded by a line of tubercles in the young, which gradually elongate to form the tuberculated pilæ of the adult. Ventral lobe deep and narrow. Lateral lobes unequally divided. Superior lateral cell irregularly divided; abrupt on the siphonal side; sloping rapidly on the opposite side. Inferior lateral cell exceedingly variable in form, but unequally divided.

Coroniceras latum Hyatt.

Loc. Semur and Tübingen; Coll. Boucault and Dr. Krantz.

Abdomen very broad, overhanging. Tubercles prominent. Keel varies from thick to attenuated; and channels, from well-defined to almost obsolete. Septal lobes broad and shallow, irregularly divided. Superior lateral cell upon the abdomen. Inferior lateral cell broad and short.

Coroniceras kridion Hyatt.

Amm. kridion Hehl. Ziet., Verst. Würt., p. 4, pl. 3, fig. 2.

Amm. kridion Quens'dt, Der Jura, p. 70, pl. 7, fig. 8.

Loc. Semur and Stuttgart; Coll. Boucault and Mus. of Stuttgart.

Coroniceras bisulcatum Hyatt.

Amm. bisulcatus Brug., Ency. Meth., v. 1, p. 39, pl. 13.

Amm. bisulcatus D'Orb., Terr. Jurass., p. 187, pl. 43.

Loc. Semur and Balingen; Coll. Boucault and De Koninck.

* Figs. 2 and 4 have already been referred to Ophioceras Johnstoni.

† Κορωνίς, a crown.

Coroniceras multicostatum Hyatt.

Amm. multicostatus Sow., Min. Conch., v. 5, p. 76, pl. 454.

Amm. multicostatus Ziet., Verst. Würt., p. 35, pl. 26, fig. 3.

Amm. multicostatus Quens'dt, Der Jura, p. 67, pl. 7, fig. 2.

Loc. Leicestershire and Semur; Coll. Sir C. Lyell and M. Boucault.

Coroniceras coronaries Hyatt.

Amm. coronaries Quens'dt, Der Jura, p. 68, pl. 7, fig. 5.

Loc. Semur, Boll, Balingen, and Stuttgart; Coll. Boucault, Dr. Krantz, L. de Koninck, and Mus. of Stuttgart.

Coroniceras lyra Hyatt.

Loc. Balingen, Aalen, and Tübingen; Coll. L. de Koninck and Dr. Krantz.

Abdomen prominent, rounded. Keel and channels well defined. Tubercles well defined. Pilæ depressed laterally near the tubercles and swelling out below. Radial diameter of the whorl increases faster in proportion to the transverse than in *C. coronaries.* Superior lateral lobe unequally divided by deep, narrow minor lobes into three branches. Superior lateral cell on the abdomen. Inferior lateral cell long and deeply indented by minor lobes.

Coroniceras rotiforme Hyatt.

Amm. rotiformis Sow., Min. Conch., v. 5, p. 76, pl. 453.

Amm. rotiformis Ziet., Verst. Würt., p. 35, pl. 26, fig. 1.

Amm. rotiformis D'Orb., Terr. Jurass., 1, p. 293, pl. 89, figs. 1 – 3.

Amm. caprotinus D'Orb., Terr. Jurass., 1, p. 240, pl. 64, figs. 1, 2.

Loc. Semur, Vaihingen, and Stuttgart; Coll. Boucault, Mus. of Stuttgart, and L. de Koninck.

Coroniceras sinemuriense Hyatt.

Amm. sinemuriensis D'Orb., Terr. Jurass., p. 303, pl. 95, fig. 1.

Loc. Semur and Schaichof; Coll. Boucault and Mus. of Stuttgart.

The old of this species is frequently described as *Amm. Bucklandi.*

Coroniceras orbiculatum Hyatt.

Amm. Bucklandi Ziet., Verst. Würt., p. 35, pl. 27, fig. 1.

Amm. Bucklandi Quens'dt, Der Jura, p. 67, pl. 7, fig. 3.

Loc. Basel, Schippenstadt, and Balingen; Coll. Prof. Bronn, Dr. Krantz, and L. de Koninck.

Coroniceras Bucklandi Hyatt.

Amm. Bucklandi Sow., Min. Conch., v. 2, p. 69, pl. 130.

Amm. Bucklandi Phil. Geol. York., p. 1, pl. 14, fig. 13.

Loc. Lyme Regis and Semur; Coll. B. M. Wright and M. Boucault

Coroniceras Brookei Hyatt.

Amm. Brookei Sow., Min. Conch., v. 2, p. 203, pl. 190.

Loc. Lyme Regis; Coll. B. M. Wright.

Asteroceras* Hyatt.

Keel well defined, but varies from prominent and narrow to depressed and broad. Channels obscure to deep and well defined. Pilæ smooth, depressed; often bent on the sides, and appear in the young as lateral folds or large tubercles. Sides in some species not enveloped; in others, covered to fully one half of their breadth. Ventral lobes very deep. Lateral lobes very shallow. Superior and first auxiliary cells short and broad Inferior lateral cell very prominent.

Asteroceras tenue Hyatt.

Loc. Semur, Aargau, Aalen, and Göppingen; Coll. Prof. Bronn and Dr. Krantz.

Abdomen narrow. Dorsal region broad, angular at its junction with the sides. Keel narrow and prominent; channels large. Superior lateral cell almost obsolete. Inferior lateral unequally divided.

Asteroceras trigonatum Hyatt.

Amm. Brookei Ziet., Verst. Würt., p. 36, pl. 27, fig. 2.

Loc. Aalen; Coll. Dr. Krantz.

Transverse section of the whorl obtusely triangular. Pilæ prominent internally, decreasing gradually externally. Tubercles are not constantly found in the adult as in *Amm. Brookei*, and it differs, also, from the latter in the narrowness of the abdomen, the greater proportional breadth of the dorsal region, and the decided inclination of the sides of the adult whorls.

Asteroceras obtusum Hyatt.

Amm. obtusus Sow., Min. Conch., v. 2, p. 151, pl. 167.

Amm. redcarensis Young and Bird, Geol. York., pl. 14, fig. 15.

Amm. obtusus D'Orb., Terr. Jurass., p. 191, pl. 44.

Amm. stellaris D'Orb., Terr. Jurass., p. 191, pl. 45.

Amm. Turneri Ziet., Verst. Würt., p. 15, pl. 11, fig. 5.

Loc. Lyme Regis, Whitby, Robin Hood's Bay, Semur, Boll, Balingen, Bempflingen, Stuttgart, and Adnet; Coll. L. Agassiz, Robert Damon, Marder, B. M. Wright, L. de Koninck, Dr. Krantz, M. Boucault, and Mus. of Stuttgart.

The identification of Zieten's *Turneri* with *Amm. obtusus* Sow., was made with authentic specimens from Zieten's former collection sent to this Museum by the Museum of Stuttgart, and although the characteristics are

* Ἀστήρ, a star.

widely divergent, the series between the two forms showed them to be one species with only local differences.

Asteroceras stellare Hyatt.

Amm. stellaris Sow., Min. Conch., v. 1, p. 211, pl. 93.

Amm. Turneri Sow., Min. Conch., v. 5, p. 75, pl. 452.

Amm. stellaris Hauer, Ceph. d. Lias d. Nordöstlichen Alpen, p. 22, pl. 5, figs. 1, 2.

Loc. Lyme Regis, Gloucester, and Semur; Coll. B. M. Wright, Marder, Dr. Krantz, and M. Boucault.

Asteroceras Collenotii Hyatt.

Amm. Collenotii D'Orb., Terr. Jurass., 1, p. 305, pl. 95.

Loc. England and Semur; Coll. Marder and M. Boucault.

LIPAROCERATIDÆ Hyatt.

Microceras* Hyatt.

Abdomen flattened; sides rounded or flattened. The pilæ in the adult are undivided upon the abdomen, and are continuous with the large, single lateral pilæ, which last may be ornamented with either one or two rows of small tubercles, or be bare.

The envelopment only covers the abdomen of each internal whorl, reaching no farther than the first row of tubercles, umbilicus is consequently exposed in all the species. The increase of the radii is slow, the species have a greater number of whorls than in succeeding genera, and are also of smaller size. The septa are remarkable for their unequally divided lobes and cells, the large size of the abdominal lobe, the insignificant size of the two lateral lobes, especially the inf. lateral, and the great breadth of the cells.

Microceras biferum Hyatt.

Amm. bifer bispinosus Quens'dt, Der Jura, p. 104, pl. 13, figs. 10, 11, and 13.

Amm. bifer nudicosta Quens'dt, Der Jura, p. 104, pl. 13, fig. 14.

Loc. Gloucester, Pleinsbach, Balingen, Boll; Coll. L. de Koninck, Dr. Krantz, Mus. of Stuttgart.

Microceras confusum Hyatt.

Amm. confusus Quens'dt, Der Jura, p. 127, pl. 75, figs. 8, 9.

Loc. Lansdown Station, near Cheltenham, and Gloucester; Coll. L. de Koninck.

* Μικρός, small.

Microceras mixtum Hyatt.

Amm. polymorphus mixtus Quens'dt, Der Jura, p. 128, pl. 15, fig. 12.

Loc. Gloucester; Coll. L. de Koninck.

Is not the same as *polymorphus mixtus* Quens'dt, Die Ceph., p. 87, pl. 4, fig. 10. This has a keel and must be of a different genus from the specimens here described, which appear to be identical with the figure in "Der Jura," as quoted above.

DEROCERATIDÆ.*

Deroceras† Hyatt.

Whorl circular; pilæ depressed; linear between and bifurcated on the tubercles. Tubercles large, prominent, pointed, and in a single row. Septal lobes with numerous pointed, deeply cut, irregularly shaped minor lobes. Abdominal lobe very deep, and level with superior lateral lobe. Siphonal cell long and narrow.

Deroceras ziphius Hyatt.

Amm. ziphius Ziet., Verst. Würt., p. 6, pl. 5, fig. 2.

Amm. arnatus sparsinodus Quens'dt, Die Ceph., p. 82, pl. 4, fig. 5.

Amm. ziphius Quens'dt, Der Jura, p. 97, pl. 12, fig. 2.

Loc. Löppingen; Coll. Mus. of Stuttgart.

Note. The foregoing descriptions of the Discoceratidæ, Liparoceratidæ, and Deroceratidæ comprehend all the species in the Museum collections from the Lower Lias, except *Amm. Birchii* Sow., which I was unable to assign to its proper place.

Middle Lias.

LIPAROCERATIDÆ.

There is throughout the three genera of this family a positive agreement in the septa and the mode of development.

The young of *Liparoceras indecisus* resemble the adult of *Androgynoceras*, and the young of *Androgynoceras* in turn closely resemble the adults of *Microceras*.

Abdominal lobe is large and not generally so deep, but of less width than the superior lateral. Inferior lateral lobe very narrow, and of insignificant size; one auxiliary lobe is usually visible on the side. The minor lobes are particularly sharp or pointed; penetrate deeply into the cells. Both cells and lobes unequally divided by three minor lobes.

Microceras.

Microceras planicosta Hyatt.

Amm. planicosta Sow., Min. Conch., v. 1, p. 167, pl. 73.

* Includes the Dorsati.

† Δέρας, skin.

Amm. planicosta D'Orb., Terr. Jurass., Ceph., p. 242, pl. 65.

Loc. Whitby, Yeovil, Semur, Besançon, Gundershofen; Coll. Sir C. Lyell, L. de Koninck, Prof. Bronn, and M. Boucault.

Microceras crescens Hyatt.

Loc. Whitby and Rautenberg bei Schöppenstadt; Coll. L. de Koninck, Dr. Krantz, and Prof. Bronn.

This species is closely allied to *Microceras arcigerens*; it differs, however, in being more robust, the young are larger, the radii of the spiral increase faster, and the septa differ in having a very deep ventral, and very shallow, superior lateral and inferior lateral lobes. The minor lateral lobes are also of the simplest kind, the superior and inferior lateral cells being but slightly indented by them.

Microceras arcigerens Hyatt.

Amm. arcigerens Phil. Geol. York, p. 163, pl. 13, fig. 9.

Loc. Whitby, Semur, St. Cyr bei Lyon and Aargau; Coll. L. de Koninck, Prof. Bronn, and M. Boucault.

Microceras maculatum Hyatt.

Amm. capricornus nudus Schlot. Petrefactenkunde.

Amm. maculatus Young and Bird, Geol. York, pl. 14, fig. 12.

Amm. maculatus Phil. Geol. York, p. 135, pl. 13, fig. 11.

Amm. capricornus nudus Ziet., Verst. Würt., p. 6, pl. 4, fig. 8.

Amm. capricornus nudus Bronn, Leth, Geog., Sh. 4, p. 340, pl. 22, fig. 1.

Amm. capricornus nudus Quens'dt, Der Jura, p. 96, pl. 12, fig. 3.

Loc. Lyme Regis, Whitby, Semur, Pouilly, Besançon, Milhaud Dep. L'Aveyron, Gundershofen, Rautenberg bei Schöppenstadt, and Gegenberg; Coll. Sir C. Lyell, Damon, L. Agassiz, Dr. Krantz, and M. Boucault.

Microceras sinuosum Hyatt.

Loc. Pouilly en Auxois, Venarey près Semur, Gundershofen, Reutlingen, and Brunswick; Coll. M. Boucault, Dr. Krantz, and L. de Koninck.

This species differs from *Planicosta* in its development, acquiring the pilæ at an earlier age of growth, and from *M. arcigerens* and *M. maculatus* in the forward bend of the abdominal pilæ, the double row of tubercles ornamenting the lateral pilæ of the adult, and the more complicated character of the septa.

Abdominal lobe with abrupt sides. Minor lobes long and narrow. Superior lateral lobe broad and shallow; inferior lateral, proportionately very narrow. Superior lateral cell very broad; inferior lateral, much longer and narrower, and very irregularly and deeply cut by minor lobes, resembling in this respect the upper portion of the superior lateral cell.

Androgynoceras* Hyatt.

The sides of the adult whorl slope outward and are ornamented with pilæ, usually single and set with two rows of tubercles. Abdomen narrow. The large pilæ of the young are split into smaller pilæ on the abdomen of the adult, but usually retain the characteristics of *Microceras* until a late period of growth. The septa are more complicated than in *Microceras*, and the increase by growth in the radii of the spiral is much greater, the species consequently have fewer whorls and are of larger size. The envelopment may cover up only the abdomen of each internal whorl, or extend over the whole side to the internal line of tubercles.

Androgynoceras hybridum Hyatt.

Amm. androgynoceras D'Orb., Terr. Jurass., Ceph., p. 285, pl. 85.
Loc. Semur; Coll. M. Boucault.

Androgynoceras appressum Hyatt.

Loc. Rautenberg; Coll. Dr. Krantz.

This species is very much flatter than *Liparoceras Bechei*, and differs also in the development of the shell. The pilæ for a long time resemble those of *Microceras*, the peculiar pilæ of this genus are not brought out distinctly until the fifth whorl is attained.

Envelopment extends laterally to the internal line of tubercles. The external tubercles are larger and more prominent than the internal row. Abdominal lobe is deeper than the superior lateral, which last is deeper but hardly broader than the inferior lateral. Lateral lobes and lateral cells unequally divided.

Liparoceras† Hyatt.

This genus differs from both of those previously described in the greater breadth of the abdomen, the greater increase of the radii of the spiral, the consequently smaller number of whorls, and the larger size of the species.

The envelopment may cover only the abdomen of each internal whorl, or extend to the inner row of tubercles.

The pilæ of the adult are split into numerous smaller pilæ, and are ornamented on the sides with two rows of tubercles. The young are smooth on the first two or three whorls, the pilæ never appear to assume, except to a very slight degree, the characteristics of *Microceras*, but at once take on the less prominent and diffuse character of *L. Bechei*.

The septa also at an early period are more complicated than those of the adult *Microceras*. The superior lateral cell is narrower proportionately to the inferior lateral, than in the preceding genera.

* **Ανδρόγυνος**, hermaphrodite. † **Λιπαρός**, shining.

Liparoceras indecisum Hyatt.

Loc. Lyme Regis, Balingen, and Rautenberg bei Schöppenstadt; Coll. B. M. Wright, L. de Koninck, and Dr. Krantz.

This species is closely allied to *Liparoceras Henleyi*, but differs in the form of the whorls which are much flatter on the sides, do not spread laterally so rapidly, and are more numerous.

The tubercles and lateral pilæ are hardly so prominent, but more numerous than in *Henleyi*. The specimen from Rautenberg, which apparently belongs to this species, has the tubercles and displays the characteristics of *Microceras* in the abdominal pilæ on the fourth whorl. The envelopment barely covers the external line of tubercles, which are larger and more prominent than the internal line of tubercles. Septa were not observed.

Liparoceras Henleyi Hyatt.

Amm. Henleyi Sow., Min. Conch., v. 2, p. 161, pl. 172.

Naut. striatus Rein, Naut. et Argo, p. 85, pl. 8, figs. 65, 66.

Amm. striatus Ziet., Verst. Würt., pl. 5, fig. 6.

Amm. Henleyi Bronn, Leth. Geog., p. 449, pl. 23, fig. 7.

Loc. Hewlitt's Hill, Stonehouse, Lyme Regis, Bourgogne, Milhaud, St. Thibault, Venarey, Evrecy in Normandy, and Reschnau in Lippe; Coll. L. de Koninck, B. M. Wright, M. Boucault, Dr. Krantz, and Prof. Bronn.

Liparoceras Bechei Hyatt.

Amm. Bechei Sow., Min. Conch., v. 3, p. 143, pl. 280.

Amm. Bechei Ziet., Verst. Würt., p. 37, pl. 28, fig. 4.

Loc. Lyme Regis, Semur, Milhaud, St. Amand, Balingen, and Rautenberg; Coll. B. M. Wright, M. Boucault, L. de Koninck, and Dr. Krantz.

DEROCERATIDÆ.

Deroceras Hyatt.

Deroceras Davōei Hyatt.

Amm. Davōei Sow., Min. Conch., v. 4, p. 71, pl. 350.

Amm. Davōei Ziet., Verst. Würt., p. 19, pl. 14, fig. 2.

Amm. Davōei D'Orb., Terr. Jurass., 1, p. 276, pl. 81.

Amm. Davōei Quens'dt, Die Ceph., p. 91, pl. 5, fig. 6.

Loc. Semur, Ardèche, Vassy, Gmund, Elsass, and Durrenberg; Coll. M. Boucault, Dr. Krantz, Prof. Bronn, and Mus. of Stuttgart.

Deroceras densinodum Hyatt.

Amm. armatus densinodus Quens'dt, Der Jura, p. 105, pl. 13, figs. 9, 10.

Loc. Zurmiethen bei Holtzmünden; Coll. Mus. of Stuttgart.

Deroceras armatum Hyatt.

Amm. armatus Sow., Min. Conch., v. 1, p. 215, pl. 95.

Loc. Lyme Regis, Dorsetshire; Coll. Damon.

Peronoceras * Hyatt.

Abdomen depressed; pilæ depressed; linear between the tubercles; usually, but not invariably, bifurcated by the tubercles on the sides, though invariably bifurcated on the abdomen. Tubercles depressed, often obtuse upon the casts, but pointed and prominent upon the shell. Septa not closely crowded as in *Deroceras*, or so profusely branching.

Peronoceras fibulatum Hyatt.

Amm. fibulatus Sow., Min. Conch., v. 4, p. 147, pl. 407, figs. 3, 4.

Loc. Whitby, Boll, Plateau de Larzac, Robin Hood's Bay, St. Quentin près de la Verpillier; Coll. Dr. Krantz, L. Agassiz, Prof. Bronn, and L. de Koninck.

Peronoceras subarmatum Hyatt.

Amm. subarmatus Sow., Min. Conch., v. 4, p. 146, pl. 407.

Amm. subarmatus Young and Bird, Geol. York., p. 250, pl. 13, fig. 3.

Loc. Whitby; Coll. Dr. Krantz.

Peronoceras muticum Hyatt.

Amm. muticus D'Orb., Terr. Jurass., 1, p. 274, pl. 80.

Loc. Semur and St. Amand; Coll. Boucault and L. de Koninck.

Peronoceras nodogigas Hyatt.

Amm. nodogigas Quens'dt, Der Jura, p. 125, pl. 15, fig. 8.

Loc. Göppingen; Coll. Mus. of Stuttgart.

Peronoceras fraudulentum Hyatt.

Loc. Lyme Regis; Coll. Damon.

Abdomen rounded, and much broader than the back; tubercles prominent, salient; pilæ single, thick, depressed. Young resemble *Planicosta*, having the flattened abdomen and pilæ of the latter until a late period. Abdominal lobe narrow and deep. Superior lateral cell narrow and deeply cut by pointed minor lobes. Siphonal cell long, narrow, serrated.

Peronoceras alternum Hyatt.

Loc. Milhaud, Dép. de l'Aveyron; Coll. L. de Koninck.

Whorls much flattened; sides gibbous; tubercles depressed, widely separated by numerous intervening smooth pilæ. Tuberculated pilæ, large

* Περόνη, a clasp.

and most prominent, divided on the abdomen. The young are smooth for the first two or three whorls; tubercles occupy the whole next whorl, extending gradually into tuberculated pilæ between which the smooth pilæ finally appear. Abdominal lobe larger and deeper than superior lateral lobe. Inferior lateral lobe small, shallow; both unequally divided. Superior lateral cell entirely on the abdomen. Inferior lateral cell on the side.

THYSANOIDÆ.

This family includes the Fimbriati, Ligati, and Heterophylli, which agree in the foliaceous character of the septa.

Thysanoceras.*

Abdomen rounded; whorls exposed; the envelopment does not extend laterally over more than one third of each interior whorl.

Abdominal lobe about the same depth, but narrower than the superior lateral lobe; the latter is equally divided by a peculiar minor cell of a lobiform aspect. The siphonal cell is cuneiform, and the superior and inferior lateral cells equally divided.

Thysanoceras fimbriatum Hyatt.

Amm. fimbriatus Sow., Min. Conch., v. 1, p. 145, pl. 164.

Amm. fimbriatus D'Orb., Terr. Jurass., Ceph., p. 313, pl. 98.

Amm. fimbriatus Bronn, Leth. Geog., p. 441, pl. 23, fig. 2.

Loc. Lyme Regis, Semur, Plateau de Larzac, Milhaud, Dép. de l'Aveyron, Balingen, Gundershofen, Schomberg, Falkenhagen, Lippe, and Sondelfingen; Coll. Mus. of Stuttgart, B. M. Wright, M. Boucault, Dr. Krantz, L. de Koninck, and Prof. Bronn.

Rhacoceras† Agassiz.

Abdomen rounded; sides of the whorls flattened; envelopment extends about two thirds over each of the interior whorls, or entirely encloses them, covering up the umbilicus.

The lobes and cells gradually decrease in size inwardly, and are remarkable for the profusion and peculiar foliaceous aspect of the minor cells.

Rhacoceras Loscombi Hyatt.

Amm. Loscombi Sow., Min. Conch., v. 1, p. 183, pl. 183.

Amm. heterophyllus numismalis Quens'dt, Die Ceph., p. 100, pl. 6, fig. 5.

Amm. Loscombi D'Orb., Terr. Jurass., Ceph., p. 262, pl. 75.

Loc. Lyme Regis and Semur; Coll. Damon, Wright, Boucault, and L de Koninck.

* Θύσανος, fringe. † Ῥάκος, ragged.

In some individuals the abdomen is crenulated, resembling in this respect *R. Boblayei.*

Rhacoceras Boblayei Hyatt.

Amm. Boblayei D'Orb., Terr. Jurass., Ceph., p. 25, pl. 69.

Loc. St. Thibault près de Semur; Coll. Boucault.

The character of the septa allies this species closely with *Loscombi*, and the abdominal crenulations are of the same character as those of some individuals in that species.

DACTYLOIDÆ.

This family includes the Planulati and part of the Macrocephali.

Cœloceras* Hyatt.

Pilæ on the abdomen bifurcated; lateral pilæ single or bifurcated with one external row of tubercles, occurring regularly on each pilæ, or at intervals on widely separated pilæ. The young are very much flatter than the adult, and the sides consequently very narrow. They are smooth for the first one or two whorls, subsequently becoming tuberculated.

The tubercles almost immediately spread, forming the pilæ; they may enlarge and remain distinct, or become absorbed and disappear upon alternate pilæ. The abdomen remains perfectly smooth for some time after the lateral pilæ are developed, not acquiring the abdominal pilæ until the third whorl is reached. Septa close together and very intricate in the adult. Abdominal lobe broader and deeper than the superior lateral. The inferior lateral is nearly the same in size, and both are unequally divided into three shallow, minor lobes. Superior lateral cell lobiform and together with the inferior lateral, unequally divided by two minor lobes.

Cœloceras centaurus Hyatt.

Amm. centaurus D'Orb., Terr. Jurass., Ceph., p. 266, pl. 76, fig. 3 – 6.

Loc. St. Amand, Semur, and Balingen; Coll. L. de Koninck and M. Boucault.

Cœloceras pettos Hyatt.

Amm. pettos Quens'dt, Flotzge., p. 178.

Amm. pettos Quens'dt, Der Jura, p. 135, pl. 16, fig. 14.

Amm. crenatus Ziet., Verst. Würt., pl. 1, fig. 4.

Loc. Venarey, Milhaud, Balingen, Metzingen, Hinterweiler; Coll. Boucault, L. de Koninck, Prof. Bronn, and Dr. Krantz.

* Κοῖλος, hollow.

PHYMATOIDÆ.*

Phymatoceras Hyatt.†

Abdomen may be flattened or rounded, but never acute; has no channels in the adult. Envelopment covers the abdomen of each internal whorl. Radii of the spiral increase more slowly than in the succeeding genera. The young are smooth on the first or second whorl, the tubercles begin either on the second or third whorl, and, gradually dividing, spread themselves out upon the abdomen as bifurcated pilæ, which disappear on the borders of the channels. The keel makes its appearance at an early stage, probably on the second whorl, but the channels are not visible until a much later period, and disappear in the adult.

Abdominal lobe broad and deep. Superior lateral broader, but of about the same depth; inferior lateral, very shallow. Superior and inferior lateral cells equally divided; both are short, broad, and but slightly indented by the minor lobes.

Phymatoceras robustum Hyatt.

Loc. Plateau de Larzac; Coll. Dr. Krantz.

The abdomen of this species is flattened, the sides of the whorls gibbous and narrow, and the keel very prominent. The channels in the young are shallow, and the whorls unusually broad. Superior lateral cell is deeper than the inferior lateral, and the latter is straight; the auxiliary cell is divided by one small auxiliary lobe.

Hammatoceras‡ Hyatt.

Abdomen may be either rounded or acute, always keeled, but never sulcated. Pilæ are prominent and straight. Envelopment may extend over one half the sides, or only cover the abdomen of each internal whorl. The young develop as in *Phymatoceras*, but are generally much broader; the pilæ, also, do not become prominent so soon. Nor do they invariably begin by the development of tubercles on the sides, but may make their appearance as fine, raised lines, and afterwards become tuberculated.

During the earlier stage of growth the different species have a very close resemblance to the adult *Macrocephali*. The lobes are more complicated than in *Phymatoceras*. Abdominal lobe broad and deep, and continued into two long, narrow, minor lobes. Superior lateral narrower than the abdominal. Inferior lateral hardly wider than the minor lobes of the superior lateral, and of about the same depth. Abdominal cell blunt. Superior lateral and inferior lateral very narrow and deeply indented by the minor lobes.

* Includes part of the Falciferi. † Φῦμα, a swelling. ‡ Ἅμμα, a knot.

Hammatoceras insigne Hyatt.

Amm. insignis Schlot. Ziet., Verst. Würt., p. 20, pl. 15, fig. 2.
Amm. insignis D'Orb., Terr. Jurass., Ceph., p. 347, pl. 112.
Amm. insignis Quens'dt, Die Ceph., p. 280, pl. 40, figs. 4, 5.
Loc. Uhrweiler and Gundershofen; Coll. Dr. Krantz and L. de Koninck.

Hammatoceras variabile Hyatt.

Amm. variabilis D'Orb., Terr. Jurass., Ceph., p. 350, pl. 113.
Loc. Bantz; Coll. Dr. Krantz.

AMALTHEOIDÆ.

Pleuroceras * Hyatt.

Abdomen flat, with keel and channels well defined; keel crenulated; channels vary from obsolete to deep and well defined. Pilæ swelling below, tuberculated; genicular bend prominent. Tubercles lateral, arranged along the line of envelopment. Umbilicus open.

Ventral lobe narrow and but slightly deeper than lateral lobes; the latter unequally divided. Inferior lateral lobe small, shallow, equally divided. Superior lateral cell only partly exposed on the side, and together with the inferior lateral unequally divided.†

Sub-Genus No. 1.

Sides of whorls exposed.

Pleuroceras hawskerense Hyatt.

Amm. hawskerensis Y. and B., Phil. Geol. York., p. 164, pl. 13, fig. 8.
Loc. Yeovil; Coll. H. W. Marder.

Pleuroceras spinatum Hyatt.

Amm. spinatus Brug., Ency. Meth., t. 1, p. 40, pl. 14.
Amm. spinatus D'Orb., Terr. Jurass., I., p. 209, pl. 52.
Loc. Whitby, Yeovil, Avallon, Quedlinburg, Coburg, Franconia, Banz, Gundershofen, and Canal du Danube; Coll. Mus. of Stuttgart, Dr. Krantz, L. de Koninck, Bronn, Marder, and Boucault.

Pleuroceras costatum Hyatt.

Amm. costatus Schlot., Pet., p. 66, pl. 12.
Naut. costatus Rein., Naut. et Argo., p. 87, figs. 68, 69.
Amm. costatus Ziet., Verst. Würt., p. 5, pl. 4, fig. 7.
Amm. costatus Bronn, Leth. Geog., pl. 22, fig. 12.

* Πλευρόν, a rib.
† Septa are described from one species only, — *Pleuroceras spinatum.*

Loc. England, Tours, Weimar, Bantz, Uhrweiler, and Bas-Rhin; Coll. Sir C. Lyell, M. Boucault, Bronn, Dr. Krantz, and L. Agassiz.

SUB-GENUS No. 2.

Sides of whorls partially covered and flatter, especially in the young.

Pleuroceras pseudo-costatum HYATT.

Amm. costatus nudus Quens'dt, Die Ceph., p. 95.

Amm. costatus nudus Quens'dt, Der Jura, p. 171, pl. 21, fig. 3.

Loc. Yeovil, Dumbleton near Cheltenham, Rogueport, Canal du Danube, Plateau de Larzac, Goslar, Gundershofen, Baiern; Coll. Bronn, L. de Koninck, and Dr. Krantz.

Pleuroceras pseudo-spinatum HYATT.

Amm. costatus spinatus Quens'dt, Der Jura, p. 171, pl. 21, fig. 1 – 3.

Amm. costatus spinatus Quens'dt, Die Ceph., p. 95, pl. 5, fig. 10.

Loc. Vassy (Dép. Yonne), Milhaud (Dép. de l'Aveyron), and Courcy; Coll. Boucault and L. de Koninck.

Pleuroceras vittatum HYATT.

Amm. vittatus Phil. Geol. York., p. 164, pl. 13, fig. 1.

Loc. Whitby; Coll. Dr. Krantz.

Amaltheus DE MONTFORT.

Abdomen acute, keeled, and channelled; whorls compressed laterally. Keel crenulated, well defined. Tubercles, when present, are in a single row along the line of envelopment. Umbilicus open, with the sides of the whorls exposed or only partially covered.

Amaltheus gloriosus HYATT.

Amm. amaltheus coronatus Quens'dt, Der Jura, p. 169, pl. 20, figs. 9 – 12.

Loc. Milhaud, Balingen, Pliensbach, Boll, and Ofterdingen; Coll. L. de Koninck, Bronn, and Dr. Krantz.

Amaltheus salebrosus HYATT.

Amm. amaltheus spinosus Quens'dt, Die Ceph., p. 95, pl. 5, fig. 4.

Amm. amaltheus spinosus Quens'dt, Der Jura, p. 168, pl. 20, fig. 8.

Loc. Whitby, Semur, Strasburg, Mühlhausen (Bas-Rhin), Pliensbach, Boll, Geyslingen, Balingen, and Gundershofen; Coll. Dr. Krantz, Boucault, Bronn, L. Agassiz, and L. de Koninck.

Amaltheus turgidus HYATT.

Amm. Amaltheus gibbosus Schlot., Pet. p. 10.

Amm. Amaltheus gibbosus Ziet., Verst. Würt., p. 4, pl. 4, fig. 2.

Amm. paradoxus Stahl, Ziet., Verst. Würt., p. 15, pl. 11, fig. 6.

Loc. Plateau de Larzac, Heiningen, Boll, Lutzude bei Hanover, Semur, Göppingen, Ofterfeld bei Goslar, and Pliensbach; Coll. Mus. of Stuttgart, Dr. Krantz, L. de Koninck, Prof. Bronn, L. Agassiz, and Boucault.

Amaltheus margaritatus De Mont.

Amaltheus margaritatus De Montfort, Conch. Sys., p. 91.

Amm. acutus Sow., Min. Conch., v. 1, p. 51, pl. 17, fig. 1.

Naut. rotula Rein., Naut. et Argo., p. 59, pl. 1, fig. 5.

Amm. Stokesi Sow., Min. Conch., v. 2, p. 205, pl. 191, figs. 9, 10.

Amm. clevelandicus Phil. Geol. York., pl. 14, fig. 6.

Amm. amaltheus Ziet., Verst. Würt., p. 4, pl. 4, fig. 1.

Amm. margaritatus D'Orb., Terr. Jurass., I., p. 246, pl. 67.

Loc. Whitby, Avallon, Semur, Milhaud (Dép. de l'Aveyron), Bas-Rhin, Lutzude bei Hanover, Eislingen, Rezingen, Wasseralfingen, Gundershofen, Mühlhausen, Boll, Ubstadt bei Bruchsal, Falkenhagen in Lippe, Balingen, and Göppingen; Coll. Mus. of Stuttgart, L. de Koninck, Prof. Bronn, L. Agassiz, and Boucault.

Amaltheus præstabilis Hyatt.

Amm. amaltheus nudus Quens'dt, Der Jura, p. 167, pl. 20, fig. 4.

Amm. amaltheus nudus Quens'dt, Die Ceph., p. 94.

Loc. Robin Hood's Bay, Scarborough, Whitby, Mende in Lozère, Venarey près Semur, Milhaud, St. Cyr près de Lyon, Metzingen, Lutzude bei Hanover, Balingen, Geislingen, and Göppingen; Coll. Mus. of Stuttgart, Dr. Krantz, L. de Koninck, M. Boucault, Prof. Bronn, and L. Agassiz.

CYCLOCERATIDÆ.

This family is remarkable for containing species which on the one side ally it with the *Liparoceratidæ*, and on the other with the higher *Hildoceratidæ*. There is, however, a general agreement in the development and in the septal characteristics, which unite them in one family. The form is much more compressed laterally than in the *Liparoceratidæ* and the tuberculations of the pilæ separate them from the *Hildoceratidæ*. The young of *Tropidoceras Actæon* resemble the adults of *Cycloceras Valdani*, and the young of the last in their turn are like the adults of *Platypleuroceras latæcosta;* thus all three genera are closely connected by development. The abdominal lobe is of about the same depth as the superior lateral; the latter is unequally divided into three minor lobes of variable length, and there is only one auxiliary lobe exposed to view on the side. Superior lateral cell is generally equally divided, and of great breadth. Inferior lateral, narrower and more prominent.

Platypleuroceras* Hyatt.

Abdomen nearly as broad, or broader, than the dorsal side of the whorl. Pilæ single, tuberculated, and extending across the rounded abdomen, as in *Planiceras*. The septa are minutely divided by minor lobes, very closely set. The abdominal lobe is deep; sides abrupt. Superior lateral very narrow, deeper than the abdominal, and profusely branching. Inferior lateral not as deep as superior lateral, and of about the same breadth and general aspect. Abdominal cell large and serrated. Superior lateral very broad, about the same height as the inferior lateral.

Platypleuroceras latæcosta Hyatt.

Amm. latœcosta Sow., Min. Conch., v. 6, p. 106, pl. 556.

Amm. latœcosta Ziet., Verst. Würt., p. 36, pl. 27, fig. 3.

Amm. natrix-rotundus Quens'dt, Die Ceph., p. 85, pl. 4, fig. 17.

Loc. Gegenberg, Hinterweiler, Welflingen, Rentlingen, and Balingen; Coll. Mus. of Stuttgart, L. Agassiz, Dr. Krantz, and L. de Koninck.

Cycloceras† Hyatt.

Abdomen rounded or keeled, not so broad as the dorsal side of the whorl. Pilæ single, tuberculated, and not extending across the abdomen in the keeled species. Young smooth for the first two or three whorls, then become ribbed. Keel appears at an earlier stage of growth than the pilæ. Septa not so minutely divided by minor lobes, and the large lobes less dendritic than in *Platypleuroceras*. The abdominal lobe of medium depth, and quite broad. Superior lateral of medium breadth and considerable depth. Inferior lateral about two thirds as broad and deep as superior lateral. One small auxiliary lobe exposed laterally. Superior lateral cell broad and depressed. Inferior lateral more prominent and narrower; small auxiliary cell exposed on the side.

Cycloceras molare Hyatt.

Amm. natrix oblongus Quens'dt, Die Ceph., p. 85, pl. 4, fig. 16.

Loc. Balingen; Coll. L. de Koninck.

Cycloceras natrix Hyatt.

Amm. natrix Schlot., Petrefaktenkunde.

Amm. natrix Ziet., Verst. Würt., p. 5, pl. 4, fig. 5.

Loc. Balingen and Rentlingen; Coll. L. de Koninck and Dr. Krantz.

Cycloceras Valdani Hyatt.

Amm. Valdani D'Orb., Terr. Jurass., Ceph., p. 255, pl. 71.

Amm. compressus Quens'dt, Die Ceph., p. 90, pl. 5. fig. 3.

* Πλατύς, flat, and Πλευρόν, rib. † Κύκλος, circle.

Amm. Valdani Quens'dt, Der Jura, p. 131, pl. 16, fig. 2 – 3.

Loc. St. Amand, Semur, Balingen, Rentlingen, and Gagenberg; Coll. Mus. of Stuttgart, L. de Koninck, M. Boucault, and L. Agassiz.

Tropidoceras* Hyatt.

Abdomen invariably keeled, much narrower than the dorsal side of the whorl. Pilæ single, smooth or tuberculated in the same species, do not extend across the abdomen in any species.

Young are smooth for one or two whorls. Keel and pilæ appear simultaneously. Septa have a more complicated aspect than in the preceding genus, the minor lobes being deeper and more numerous. The abdominal very broad at the bottom, narrower above. Superior lateral lobe narrow, and about the same depth as the abdominal. Inferior nearly the same, but less branching than the superior lateral. One auxiliary lobe exposed on the side. Abdominal cell very broad. Superior lateral and inferior lateral cells very irregularly divided by minor lobes. One small auxiliary lobe exposed on the side.

Tropidoceras Actæon Hyatt.

Amm. Actæon D'Orb., Terr. Jurass., Ceph., p. 232, pl. 61, fig. 1 – 3.

Loc. Semur and Schöppenstadt; Coll. Dr. Krantz and L. de Koninck.

Tropidoceras Ægæon Hyatt.

Amm. Ægæon D'Orb., Terr. Jurass., Ceph., p. 234, pl. 61, fig. 4 – 6.

Loc. Près de Semur; Coll. M. Boucault.

Tropidoceras Masseanum Hyatt.

Amm. Masseanus D'Orb., Terr. Jurass., Ceph., p. 225, pl. 58.

Amm. Masseanus Quens'dt, Die Ceph., p. 90, pl. 5, fig. 2.

Loc. Scarborough in Yorkshire, Près de Semur, and Balingen; Coll. Dr. Krantz, L. de Koninck, and M. Boucault.

Upper Lias.

DISCOCERATIDÆ.

Ophioceras.

Ophioceras Levesquei Hyatt.

Amm. Levesquei D'Orb., Terr. Jurass., Ceph., I., p. 230, pl. 60.

Amm. solaris Ziet., Verst. Würt., p. 19, pl. 14, fig. 7.

Amm. radians quadratus Quens'dt, Die Ceph., p. 113.

Loc. Niort, Salins, Heiningen, and Metzingen; Coll. Mus. of Stuttgart, Dr. Krantz, and L. de Koninck.

* Τροπίς, a keel.

DEROCERATIDÆ.

Deroceras.

Deroceras minatum Hyatt.

Loc. Plateau de Larzac; Coll. Dr. Krantz.

Abdomen depressed. Sides flattened or inclining toward umbilicus. Septal lobes and cells very simple, with but few minor lobes. Abdominal lobe broad and shallow. Superior lateral the same, and of nearly the same size. Inferior lateral pointed and very small. Superior lateral and inferior lateral cells equally divided by minor lobes. Young are smooth for the first two or three whorls. Tubercles usually make their appearance on the third whorl and on the fourth; these spread out into pilæ, and other untuberculated pilæ arise between them. The pilæ are often slightly depressed or concave along the siphonal line.

Deroceras subarmatum Hyatt.

Amm. subarmatus Sow., Min. Conch., v. 4, p. 146, pl. 407.

Amm. subarmatus Young and Bird, Geol. York., p. 250, pl. 13, fig. 3.

Loc. Milhaud (Dép. de l'Aveyron); Coll. M. Boucault.

Deroceras acanthopsis Hyatt.

Amm. acanthopsis D'Orb., Prod. Pal. Stratigraph., p. 247.

Loc. Villebois (Dép. Ain); Coll. Prof. Bronn.

DACTYLOIDÆ.

Cœloceras.

Cœloceras Grenouillouxii Hyatt.

Amm. Grenouillouxii D'Orb., Terr. Jurass., Ceph., pl. 96.

Loc. Fontaine Étoupe and Fours in Calvados, Plateau de Larzac, Cheville in Sarthe, and Semur; Coll. Dr. Krantz, L. de Koninck, and M. Boucault.

Cœloceras Desplacei Hyatt.

Amm. Desplacei D'Orb., Terr. Jurass., Ceph., p. 334, pl. 107.

Loc. Avallon (Dép. Yonne); Coll. M. Boucault.

Cœloceras crassum Hyatt.

Amm. crassus Phil., Geol. York., p. 12, fig. 15.

Amm. crassus Quens'dt, Der Jura, p. 251, pl. 36, fig. 1.

Amm. raquinianus D'Orb., Terr. Jurass., p. 332, pl. 106.

Loc. Whitby, Milhaud, Laumière, Cheville in Sarthe, St. Cyr bei Lyon. Plateau de Larzac, Villebois (Dép. de l'Ain), Salins (Dép. Jura), Semur, Montpellier, St. Quentin, and Près de Verpillier; Coll. L. de Koninck, Dr. Krantz, L. Agassiz, Prof. Bronn, and M. Boucault.

Cœloceras mucronatum Hyatt.

Amm. mucronatus D'Orb., Terr. Jurass., Ceph., p. 328, pl. 104, fig. 4–8.

Loc. Whitby, Milhaud, Laumière, Mende in Lozère, Donau-Main Canal, Salins in Jura, Près d'Avallon, Montpellier; Coll. Dr. Krantz, L. de Koninck, Prof. Bronn, and M. Boucault.

Dactylioceras* Hyatt.

The abdomen is either equal in breadth, or less than the back, instead of being broader than, or equal in breadth to, the back, as in the preceding genera. The lateral pilæ in the adult are smooth and invariably single; the abdominal pilæ may be either bifurcated or single. The young have the same development as the young of *Cœloceras crassum*, but the tubercles are dispensed with before the adult state is attained. (The tubercles are hardly distinguishable in the young of some species, such as Holandrei and Braunianum, especially on the fossil casts, but are, nevertheless, present in all the shells.) Septa do not differ materially from those of the preceding genus, except perhaps in the greater simplicity of the lobes and cells, which are hardly so close together or so complicated.

Dactylioceras commune Hyatt.

Amm. communis Sow., Min. Conch., v. 2, p. 9, pl. 107, fig. 23.

Naut. annularis Rein., Naut. et Arg., p. 79, pl. 6, figs. 56, 57.

Amm. annularis Ziet., Verst. Würt., p. 14, pl. 10, fig. 10.

Loc. Whitby, Boll, Amberg, and Langenbrücken; Coll. Dr. Krantz, L. de Koninck, and Prof. Bronn.

Dactylioceras Holandrei Hyatt.

Amm. Holandrei D'Orb., Terr. Jurass., Ceph., p. 330, pl. 105.

Loc. Whitby, Cheville in Sarthe, Fontaine Étoupe Fours in Calvados; Coll. L. de Koninck and M. Boucault.

Dactylioceras annulatum Hyatt.

Amm. annulatus Sow., Min. Conch., v. 3, p. 41, pl. 222.

Amm. annulatus D'Orb., Terr. Jurass., Ceph., p. 265, pl. 76, figs. 1, 2.

Argo. anguinus Rein., Naut. et Arg., p. 89, No. 1, pl. 12, fig. 73.

Amm. æquistriatus Ziet., Verst. Würt., pl. 12, fig. 5.

Loc. Whitby, Illminster, St. Amand, Fontaine Étoupe Fours; Coll. L de Koninck and Dr. Krantz.

Dactylioceras Braunianum Hyatt.

Amm. Braunianus D'Orb., Terr. Jurass., Ceph., p. 327, pl. 104.

Loc. Milhaud and Plateau de Larzac; Coll. L. de Koninck and Dr. Krantz.

* Δακτυλίος, a ring.

THYSANOIDÆ.

Thysanoceras Hyatt.

Thysanoceras fimbriatum Hyatt.

Amm. fimbriatus Sow., Min. Conch., v. 2, p. 145, pl. 164.

Loc. Pouilly in Côte d'Or and Plateau de Larzac; Coll. L. de Koninck and Dr. Krantz.

Thysanoceras Germainii Hyatt.

Amm. Germainii D'Orb., Terr. Jurass., Ceph., p. 320, pl. 101.

Amm. interruptus Ziet., Verst. Würt., pl. 15, fig. 3.

Amm. oblique-costatus Ziet., Verst. Würt., pl. 15, fig. 4.

Loc. Milhaud (Dép. de l'Aveyron), Semur, Pouilly in Côte d'Or, and Gundershofen; Coll. Dr. Krantz, M. Boucault, and L. de Koninck.

Thysanoceras articulatum Hyatt.

Amm. articulatus Sow., De la Bèche, Geol. Manual, p. 276, fig. 63.

Loc. Spezzia; Coll. Prof. Bronn.

Thysanoceras Phillipsii Hyatt.

Amm. Phillipsii Sow., De la Bèche, Geol. Manual, p. 275, fig. 57.

Loc. Spezzia; Coll. Prof. Bronn.

Thysanoceras cornucopia Hyatt.

Amm. cornucopia Young and Bird, Geol. York., pl. 12, fig. 6.

Amm. cornucopia D'Orb., Terr. Jurass., Ceph., p. 316, pl. 99.

Loc. Semur, St. Quentin, près de Verpillier, Plateau de Larzac, and Milhaud (Dép. de l'Aveyron); Coll. L. Agassiz, M. Boucault, Dr. Krantz, and L. de Koninck.

Thysanoceras torulosum Hyatt.

Amm. torulosus Schub. Ziet., Verst. Würt., p. 19, pl. 14, fig. 1.

Amm. scutatus Von Buch, Pet. remarq., pl. 8, fig. 1.

Amm. torulosus D'Orb., Terr. Jurass., Ceph., p. 322, pl. 102.

Loc. Plateau de Larzac, Zillhausen, Metzingen, Schomberg, and Durwangen; Coll. Mus. of Stuttgart, Dr. Krantz, and L. de Koninck.

Thysanoceras jurense Hyatt.

Amm. jurensis Ziet., Verst. Würt., pl. 68, fig. 1.

Amm. jurensis D'Orb., Terr. Jurass., Ceph., p. 218, pl. 100.

Amm. phyllocinctus Quens'dt, Der Jura.

Loc. Semur, Plateau de Larzac, Milhaud (Dép. de l'Aveyron), Hechingen in Würtemberg, Uhrweiler in Elsass, Adnet bei Salzburg, Sondelfingen, Balingen, Reutlingen, Metzingen, and Gundershofen; Coll. Mus. of Stuttgart, M. Boucault, Dr. Krantz, Prof. Bronn, and L. de Koninck.

Thysanoceras hircinum Hyatt.

Amm. hircinus Schlot., Pet., p. 72.

Amm. hircinus Quens'dt, Der Jura, p. 280, pl. 40.

Loc. Semur, Donau-Main Canal, and Mistlegau bei Bayreuth; Coll. M. Boucault and Prof. Bronn.

Rhacoceras L. Agassiz.

Rhacoceras calypso Hyatt.

Amm. calypso D'Orb., Terr. Jurass., I., p. 167, pl. 52, figs. 7 – 9.

Loc. Plateau de Larzac, Monte de Aquasparta bei Cesi in Umbria, Milhaud, Laumière, Digue in Basses Alpes, and Erba bei Como; Coll. Dr. Krantz, L. de Koninck, and Prof. Bronn.

The abdomen is broader than in *R. heterophyllus*, and the septa different, but, nevertheless, the varieties of this species which are devoid of the annular depressions caused by the permanent mouths, are frequently identified with that species.

Rhacoceras heterophyllum L. Agassiz.

Amm. heterophyllus Sow., Min. Conch., v. 3, p. 119, pl. 266.

Amm. heteraphyllus D'Orb., Terr. Jurass., I., p. 339, pl. 109.

Loc. Whitby, Boll, Vassy près d'Avallon, Erzingen (Dép. du Doubs), Balingen and Bruchsal; Coll. Dr. Krantz, M. Boucault, and Prof. Bronn.

Rhacoceras cylindricum Hyatt.

Amm. cylindricus De la Bèche, Man. Geol., p. 275, fig. 55.

Loc. Schöppenstadt; Coll. Dr. Krantz.

Rhacoceras mimatense Hyatt.

Amm. mimatensis D'Orb., Terr. Jurass., p. 344, pl. 110, figs. 4 – 6.

Loc. Plateau de Larzac (Dép. de l'Aveyron) and Boll; Coll. L. de Koninck and Dr. Krantz.

PHYMATOIDÆ.

Phymatoceras Hyatt.

Phymatoceras enervatum Hyatt.

Loc. Plateau de Larzac and Villenotte près de Semur; Coll. Dr. Krantz and M. Boucault.

The abdomen is much flatter in this species than in the succeeding *P. robustum*, and in the young the channels are deeper and more distinct. The increase of the radii of the spiral is also less, and there are therefore a greater number of whorls in specimens of the same size. The sides of the whorls are also less gibbous than in *P. robustum*, and auxiliary cells differently formed, being comparatively but slightly indented by the minor lobes, and the inferior lateral cell inclined toward the umbilicus, instead of being straight.

Phymatoceras robustum Hyatt.

Loc. Plateau de Larzac, Milhaud, and Semur; Coll. Dr. Krantz, L. de Koninck, and M. Boucault.

Ammatoceras.

Ammatoceras insigne Hyatt.

Amm. insignis Schub., Ziet., Verst. Würt., p. 20, pl. 15, fig. 2.
Amm. insignis D'Orb., Terr. Jurass., Ceph., p. 347, pl. 112.
Amm. insignis Quens'dt, Die Ceph., p. 280, pl. 40, figs. 4, 5.
Loc. Gundershofen (Bas-Rhin); Coll. M. Boucault.

Ammatoceras variabile Hyatt.

Amm. variabilis D'Orb., Terr. Jurass., Ceph., p. 350, pl. 113.

Loc. Laumière, Salins, Plateau de Larzac, St. Julien de Croix in Saone et Loire, Besançon, Evrecy bei Caen, Boll, and Balingen; Coll. Mus. of Stuttgart, L. de Koninck, Dr. Krantz, and M. Boucault.

Pelecoceras * Hyatt.

Having but one species of this genus, it would be exceedingly hazardous to give the generic characters. They will, however, probably be found to be distinguished by the peculiarly pointed aspect, shallowness and breadth of the lobes and cells; the limits of the envelopment, which last is greater than in other genera of this family; the acute form of the back, and the breadth of the whorls.

Pelecoceras attenuatum Hyatt.

Loc. Plateau de Larzac, Milhaud, and Besançon; Coll. Dr. Krantz and L. de Koninck.

Abdomen acute. Sides very broad and flat. Envelopment covers over one half the side of each internal whorl. Pilæ are curved forward on the abdomen. The young have no channels, and the development does not differ from *Amm. variabilis* or *Amm. insignis*, except in the size of the young, the whorls of these not being proportionately so large or broad. All the lobes and cells are broad and shallow, especially the pointed abdominal and the serrated auxiliary cells.

* Πέλεκυς, an axe.

HILDOCERATIDÆ.*

Hildoceras† Hyatt.

Abdomen keeled and channelled. Ribs large and broad. The young continue smooth throughout first whorl. Ribs, keel, and channels appear on the second whorl. The ribs are not preceded by a line of tubercles, but begin as folds, bent much in the same way as in the adult, but with the abdominal bend inclined more toward the apex. The abdominal lobe is shallow and broad. Superior lateral much deeper than either the abdominal or inferior lateral lobes, the last named very narrow and shallow, minor lobes small and pointed.

Hildoceras bifrons Hyatt.

Amm. bifrons Brug., Ency. Meth., Amm. No. 15.

Amm. bifrons D'Orb., Terr. Jurass., Ceph., p. 219, pl. 56.

Loc. Whitby, Dumbleton, Dorsetshire, Fontaine Étoupe Fours, Poillé in Sarthe, Laumière, Mende in Lozère, Verpillier, Milhaud, Plateau de Larzac, Cesi in Umbria, Mussy près de Semur, Chary près de Privas, Amayer sur Orne, Boll, and Metzingen; Coll. L. de Koninck, Dr. Krantz, M. Boucault, and Prof. Bronn.

Hildoceras Walcotii Hyatt.

Amm. Walcotii Sow., Min. Conch., v. 2, p. 7, pl. 106.

Amm. Hildensis Young and Bird, Geol. York., pl. 12, fig. 1.

Loc. Illminster, Niort, Fontaine Étoupe Fours, Plateau de Larzac, Cesi in Umbria, Milhaud, Vieux Ponts, and Guadalaviar in Aragon; Coll. B. M. Wright, Dr. Krantz, and L. de Koninck.

Grammoceras‡ Hyatt.

Abdomen keeled, but not channelled. Whorls flattened, laterally giving a discoidal aspect to the shells. Ribs finer and less prominent than those of *Hildoceras*. The young also continue smooth much longer, and channels never appear; they take, however, the same rounded form of the whorl. Septa differ but slightly from *Hildoceras* in the higher species, such as *Grammoceras serpentinum;* and not all generically in the lower, such as *Grammoceras striatulum.*

Grammoceras striatulum Hyatt.

Amm. striatulus Sow., Min. Conch., v. 5, p. 23, pl. 421, fig. 1.

Amm. Thouarsensis D'Orb, Terr. Jurass., Ceph., p. 222, pl. 57.

Amm. radians depressus Quens'dt, Der Jura, p. 281, pl. 40.

* Includes all the Falciferi proper with smooth pilæ.

† After St. Hilda.

‡ Γραμμή, a line.

Loc. Whitby, Robin Hood's Bay, Milhaud, St. Julien du Cray in Saone et Loire, Niort, Plateau de Larzac, Près de Lyon, Boll, Keulwagen, Redangen, Heiningen, Aalen, Falkenhagen in Lippe, Metzingen, and Uhrweiler; Coll. Mus. of Stuttgart, L. de Koninck, Dr. Krantz, Prof. Bronn, and M. Boucault.

Grammoceras radians Hyatt.

Amm. radians Schlot., Pet. p. 78, No. 34.

Naut. radians Rein., Naut. et Arg., p. 71, No. 17, figs. 39, 40.

Amm. radians Ziet., Verst. Würt., p. 5, pl. 4, fig. 3.

Amm. lineatus Ziet., Verst. Würt., p. 12, pl. 9, fig. 7.

Amm. radians compressus Quens'dt, Die Ceph., p. 112, pl. 7, fig. 9.

Loc. Niort, Plateau de Larzac and Carnus in Cevenen, St. Cyr bei Lyon, Villebois in Ain, Salins in Jura, Milhaud, Mende, Besançon, Vaches Noires in Calvados, Uhrweiler, Falkenhagen, Boll; Coll. Dr. Krantz, Prof. Bronn, L. de Koninck, and M. Boucault.

Grammoceras aalense Hyatt.

Amm. aalensis Ziet., Verst. Würt., p. 37, pl. 28, fig. 3.

Amm. aalensis Quens'dt, Die Ceph., p. 114, pl. 7, fig. 7.

Amm. aalensis D'Orb, Terr. Jurass., Ceph., p. 238, pl. 63.

Loc. Trocester Hill, Milhaud, St. Vigor, St. Julien du Cray, La Verpillière in Ain, St. Quentin, Aalen, Heiningen, Neumarkt, Balingen, Mistlegau, Amberg, Wiesenthal, and Gundershofen; Coll. Mus. of Stuttgart, L. de Koninck, Sir C. Lyell, L. Agassiz, Prof. Bronn, M. Boucault, and Dr. Krantz.

Grammoceras costulatum Hyatt.

Amm. costulatus Schlot., Pet., p. 78, No. 33.

Amm. costula Krüg., Uhrwelt. Naturgesch., p. 27.

Naut. costula Rein, Naut. et Argo., p. 68, pl. 3, fig. 33.

Amm. radians costula Quens'dt, Die Ceph., p. 113, pl. 7, fig. 11.

Loc. Aalen, Amberg, and Metzingen; Coll. Mus. of Stuttgart, L. de Koninck and Prof. Bronn.

Grammoceras serpentinum Hyatt.

Amm. serpentinus Schlot., Pet., p. 64, No. 6.

Argo serpentinus Rein., Naut. et Argo., p. 89, pl. 13, fig. 74.

Amm. serpentinus Ziet., Verst. Würt., p. 16, pl. 12, fig. 4.

Amm. serpentinus D'Orb, Terr. Jurass., p. 215, pl. 55.

Amm. Strangewaysii Sow., Min. Conch., v. 3, p. 99, pl. 25, fig. 1–3.

Loc. Whitby, Somerset, Dorsetshire, Bannington, Milhaud, Fontaine

Étoupe Fours, Thouars, Près de Semur, Vassy in Yonne, Amayer sur Orne, Boll, and Metzingen; Coll. L. de Koninck, Dr. Krantz, M. Boucault, Prof. Bronn, Duval, and Damon.

Leioceras* Hyatt.

Abdomen keeled, acute. Sides of the whorls flattened. Envelopment uniformly greater than in *Grammoceras*. The young differ, however, in being much flatter at the corresponding periods of growth. The lobes and cells, also, are less obtuse, shallower, and much more numerous.

Leioceras lythense Hyatt.

Amm. lythensis Young and Bird, Phil. Geol. York., p. 164, pl. 13, fig. 6.
Loc. Whitby; Coll. Prof. Bronn.

Leioceras opalinum Hyatt.

Naut. opalinus Rein., Naut. et Argo., p. 55, pl. 1, fig. 1.
Naut. comptus Rein., Naut. et Argo., p. 57, pl. 1, figs. 5, 6.
Amm. primordialis Schlot., Pet., No. 7, p. 67.
Amm. erratus Young and Bird, Phil. Geol. York., pl. 13, fig. 7.
Amm. primordialis Ziet., Verst. Würt., p. 5, pl. 4, fig. 4.
Amm. primordialis D'Orb., Terr. Jurass., Ceph., p. 235, pl. 62.
Amm. opalinus Quens'dt, Die Ceph., p. 115, pl. 7, fig. 10.
Loc. Robin Hood's Bay, Whitby, Trocester Hill, La Verpillière in Ain, St. Quentin près Verpillièr, Szaflary, Amberg près de Goslar, Neuffen, Quedlinburg, Teufelsloch, Gundershofen, and Metzingen; Coll. Mus. of Stuttgart, Dr. Krantz, Prof. Bronn, L. Agassiz, and M. Boucault.

Leioceras elegans Hyatt.

Amm. elegans Sow., Min. Conch., v. 1, p. 213, pl. 94, fig. 1.
Loc. Whitby; Coll. Dr. Krantz.

Leioceras complanatum Hyatt.

Amm. complanatus Brug., Encycl., p. 38, No. 11.
Amm. mulgravius Young and Bird, Phil. Geol. York., p. 251, pl. 13, fig. 8.
Amm. elegans Phil. Geol. York., pl. 13, fig. 2.
Amm. elegans Ziet., Verst. Würt., p. 22, pl. 16, fig. 5.
Amm. complanatus D'Orb, Terr. Jurass., p. 353, pl. 114.
Loc. Whitby, Lyme Regis, Villebois in Ain, Mussy près de Semur, Avallon, Privas, Boll, and Ubstadt bei Bruchsal; Coll. Prof. Bronn, Dr. Krantz, M. Boucault, and Damon.

* Λεῖος, smooth.

Leioceras discoides Hyatt.

Amm. depressus Schlot., Pet., p. 80, No. 80.

Amm. discoides Ziet., Verst. Würt., p. 21, pl. 16, fig. 6.

Amm. depressus Ziet., Verst. Würt., p. 7, pl. 5, fig. 15.

Loc. Milhaud, Mende, Plateau de Larzac, and Balingen; Coll. L. de Koninck and Dr. Krantz.

Bruguière (Encyclop., 1789), having described a different species by the name "depressus," Zieten's name "discoides" is necessarily the correct name of this species.

Leioceras cumulatum Hyatt.

Amm. bicarinatus Ziet., Verst. Würt., p. 21, pl. 15, fig. 9.

Loc. Milhaud, Laumière, Mende, Plateau de Larzac (Dép. de l'Aveyron), Montpellier, and Zillhausen; Coll. L. Agassiz, L. de Koninck, Dr. Krantz, and M. Boucault.

Zieten's "bicarinatus" differs specifically from Münster's figure, Beit. zur Pet., v. 4, p. 138, pl. 15, fig. 30, and therefore it becomes necessary to adopt a new name for this species.

Leioceras concavum Hyatt.

Amm. concavus Sow., Min. Conch., v. 1, p. 215, pl. 94, fig. 2.

Loc. Semur, Salins, and Heiningen; Coll. Dr. Krantz and M. Boucault.

Leioceras capellinum Hyatt.

Amm. capellinus Schlot., Pet., p. 65.

Amm. capellinus Quens'dt, Die Ceph., p. 206, pl. 7, fig. 2.

Amm. lythensis lineatus Quens'dt, Die Ceph., p. 107, pl. 7, fig. 1.

Loc. Metzingen and Holzmünden; Coll. Dr. Krantz.

No. 6. — *Contributions to the Fauna of the Gulf Stream at great depths.* By L. F. de Pourtales, Assist. U. S. Coast Survey.

(Communicated by the Superintendent of the U. S. Coast Survey.)

The study of the constitution and of the inhabitants of the bottom of the sea is a field of research which has attracted the attention of naturalists in comparatively recent times. What Humboldt did with regard to the distribution of life at different heights in the atmosphere, was done by Edward Forbes for the different depths of the ocean. The former's diagrams of the zones of vegetation on the slopes of the Andes are considered indispensable in every atlas of physical geography. But what one man could do where his glance embraced miles of country in height and breadth and where the types of vegetation could frequently be recognized as far as the eye could reach, an investigator even as zealous as Forbes could but sketch in broad though happily drawn lines for the marine animals.

Much has been done in this direction since Forbes's death, particularly in England, where dredging has become a favorite occupation of many naturalists; the Scandinavian seas have also been explored with much success, chiefly by the Norwegian naturalists; but much more remains to be done in a field in which the areas to be explored can, as Jeffreys remarks, be reckoned in square degrees, whilst the research extends only over square yards.

It is particularly in the greater depths, in the so-called abyssal region, that our knowledge is deficient. This is easily understood, since on many coasts the sea is comparatively shoal for a considerable distance from land, and the outfit for deep-sea dredging is beyond the means of but few private individuals. Government expeditions are generally fitted out for other duties, and can rarely devote their time to operations occasioning a delay of many hours. Furthermore, owing to the scantiness of the material, the impression generally prevailed, until recently, that animal life was soon reduced to a minimum with an increase of depth, or at least reduced to the lowest forms, so that the incentive of a rich harvest seemed denied to those who would have undertaken such researches.

Excepting the investigations of Dr. Stimpson on the coast of New England, the dredge has been as yet very little used along our shores. The character and constituents of the bottom are however pretty well known, thanks to the care of the late Superintendent of the Coast Survey, Professor A. D. Bache, who, during his whole administration of that work, required the hydrographical parties to preserve the specimens brought up by the lead. From eight to nine thousand specimens have thus been accumulated at the Coast Survey Office, from a region comprised between the shore and the outer edge of the Gulf Stream, and reaching nearly to 1500 fathoms. But, of course, aside from the Foraminifera and Diatomaceæ, for the study of which this material has proved of high interest, not much was contributed to our knowledge of the animals of the higher classes, the instrument used being only adapted to procure a small quantity of sand or mud.

The present Superintendent of the Coast Survey, Professor B. Peirce, has lately directed the resumption of the investigations of the Gulf Stream, so successfully inaugurated by his predecessor, but interrupted for several years by the war. Besides observations of the depth, velocity, and direction of that current, and the temperature and density of the water at different depths, the researches will be extended to the Fauna of the bottom, of the surface, and of the intervening depths. Not only will an insight be thus obtained into a world scarcely known heretofore, but that knowledge will have a direct bearing on many of the phenomena of that great current. Thus a new light may be thrown on its powers of transportation from shallow to deeper water, or along its bed, on its action in forming deposits in particular localities, or on its possible influence on the growth of coral reefs on its shores.

The first campaign on this plan was organized in 1867, the field of research being in a section between Key West and Havana, incidentally with the purpose of sounding out the line for the telegraph cable, shortly afterwards laid between these two points. The Coast Survey Steamer Corwin was assigned to the work; and here I wish to express my thanks to my colleague, Assistant H. Mitchell, charged with the physical part of the campaign, and to Captain Platt and his officers for the interest they showed to my work, and for their valuable practical aid.

The expedition was unfortunately interrupted by the breaking out of yellow fever on board, so that the dredgings were few in number.

However, short as the season's work was, and few as were the casts of the dredge, the highly interesting fact was disclosed, that *animal life exists at great depths, in as great a diversity and as great an abundance as in shallow water.*

The identifications of the species have been made by me at the Museum of Comparative Zoölogy at Cambridge, in the rich collections of which I have found abundant material for comparison ; facilities of every sort were afforded me by Professor Agassiz, for which I wish to express my heartfelt thanks, as also for this opportunity of prompt publication.

The first dredgings were made on May 17th, on the Florida side of the Gulf Stream, about 5 miles S.S.W. of Sand Key, in depths varying from 90 to 100 fathoms, on a bottom of calcareous mud. The following list comprises the animals obtained : —

ARTICULATES. A number of small Crustacea were brought up, which have not yet been determined. They belong to the following or allied genera: *Dromia*, *Ilia*, *Mithrax?* (a mutilated specimen), *Pagurus*, *Euphausia*, and *Orchestia*.

The tubes of several species of Annelids were obtained, but the animals were in most cases too defective for identification. The largest and best preserved is *Marphysa floridana*, nov. sp. (see description). There are also tubes of one or more species of *Serpula*.

The Gephyreans are represented by *Sipunculus corallicola*, Pourt. (Proc. Am. Assoc., 1851).

MOLLUSCS not determined specifically. They are mostly immature specimens or fragments of dead shells, and belong to the following genera : *Murex* (dead), *Turbo?* (operculum), *Leda* (living), *Astarte* (living), *Tellina* (dead). Of Pteropods dead shells of the following species : *Hyalea tridentata*, *Hyalea trispinosa*, *Cuvieria columella*, *Cleodora lanceolata*. The shells of this order are very common in deep-sea soundings. The Bryozoa are represented by *Vincularia margaritacea*, nov. sp. (see description).

RADIATA. Of Echinoderms were obtained an *Ophiurian* (an arm, undetermined) and a number of specimens of *Comatula Hagenii*, nov. sp. (see description).

A *Zoanthus*, rather small, was obtained also, but not having been noticed when alive, it would be somewhat uncertain to determine.

Hydroids : *Antennularia triseriata*, nov. sp. ; *Thoa pulchella*, nov. sp. ; *Th. capillaris*, nov. sp. (see descriptions).

The Foraminifera had nearly all been washed out of the dredge ; only the following were noticed : *Textilaria conica* D'O. (very large) ; *Operculina*

(*Spirillina*) *incerta* D'O.; *Rotalina cultrata* D'O.; and *Globigerina rubra* D'O.

The total for this locality is therefore twenty-nine species, to which a few ought to be added for the undetermined fragments of Annelids.

No dredgings were had in mid-channel; this part had been reserved for the return trip, but the unfortunate interruption of the cruise prevented the execution of the project, at least for this season.

The next casts were obtained off Havana in 270 fathoms on May 24th and 29th, on both days as nearly as possible on the same spot, as the little that was obtained at the first date had given much promise.

The results of the two casts are combined below: —

ARTICULATES. The Crustacea are not determined, but of or near the following genera: *Stenopus*, *Axia*, *Callianassa*, *Orchestia*, and *Idotea*, all living. Annelids: *Marphysa tibiana*, n. sp., and *M. antipathum*, n. sp. (see description). Tubes and fragments of four or five other species.

Of the *Molluscs* the Gasteropods and Acephala have not yet been determined, with one exception.

The following genera are represented: *Mitra ?*, *Fusus*, *Turbo*, *Emarginulina*, *Dentalium*, *Nucula*, and *Spondylus*, all dead; *Pedicularia decussata*, Gould (see remarks), and a very small *Anomia*, both living. The Pteropods and Heteropods were all dead; they are: *Hyalea trispinosa*, *affinis* D'Orb., *gibbosa* Rang, and *uncinata* Rang; *Creseis spinifera* Rang; *Cleodora pyramidata* Pér. and Les.; *Spirialis rostrata* Eyd. and Soul.; and *Atlanta Peronii* Les. Of Brachiopods we obtained *Terebratula cubensis*, n. sp., and *Terebratulina Cailleti* Crosse; both living and apparently abundant. The Bryozoa are: *Farcimia cereus*, n. sp.; *Vincularia margaritacea*, n. sp.; *Cellepora reticulata*, n. sp.; *C. sigillata*, n. sp.; *Canda retiformis*, n. sp.; *Canda cornigera*, n. sp., *Idmonea flexuosa*, n. sp. (see descriptions).

RADIATA. Echinoderms are represented by the following species: *Spatangus* (dead, fragments); *Fibularia* (dead); *Cidaris annulosa* Gray (probably, young, living); *Tripneustes ventricosus* (living, very young); *Asterias*, sp. (very young, living); *Ophiurians*, at least three species, immature and difficult to determine; *Comatula brevipinna*, n. sp., living; *Pentacrinus*, sp. (fragments of stem, among which some appear quite fresh).

Of Zoantharia the following were brought up: *Antipathes humilis*, n. sp.; *Antipathes filix*, n. sp.; *Acanthogorgia aspera*, n. sp.; *Gorgonia exserta* Ellis; *Swiftia exserta* Duch. and Mich.; *Hyalonema* (spicules); *Caryophyllia formosa*, n. sp.; *Deltocyathus Agassizii*, n. sp.; *Stylaster complanatus*, n. sp.; *Errina glabra*, n. sp.; *Errina cochleata*, n. sp.; *Crypthelia Peircei*, n. sp.;

Distichopora sulcata, n. sp.; *Heliopora? tubulata*, n. sp.; *Heliopora? carinata*. n. sp.; *Isis?* (base of stem); *Sarcodyction rugosum*, n. sp.

Hydroids: *Thoa pulchella*, n. sp.; *Tubularia crinis*, n. sp. Foraminifera: *Lagena striata* Mont., rare; *Nodosaria pyrula* D'O., rare; *Dentalina communis* D'O., rare; *D.* (*agglutinans?*); *Lingulina carinata* D'O.; *Textularia trochus* D'O., common, very large, also abundant in shoaler water; *T. agglutinans* D'O., rare; *Nonionina scapha*, rare; *Nonionina umbilicatula* Montg., rare; *Cristellaria crepidula* F. and M., rather common; *Orbiculina adunca* D'O., rare and only in a worn state, its proper habitat is in the littoral zone; *Amphistegina gibbosa* D'O., rare and only young specimens; it is very common throughout the Gulf of Mexico in deep water; *Globigerina rubra* D'O., very abundant, also in the Orbulina form; *Gl. Dutertrei* D'O., common; *Pullenia obliquiloculata* P. and J., rather common; *Pullenia coarctata*, n. sp., rather common; *Sphæroidina dehiscens* P. and J., not common; *Rotalina cultrata* D'O., very common; *Rot. truncatulinoides* D'O., common; *Rot. Poeyi* D'O., rather common; *Rotalina*, 2 other species in single and imperfect specimens; *Biloculina*, sp.; *Triloculina Brongniartiana* D'O., rare; *Quinqueloculina bicostata* D'O., rare.

Many of the specimens of Foraminifera are filled with a yellow mass, like the first stage of transformation into greensand, but the process seems to stop here.

Of Sponges quite a number were obtained, at least a dozen species, which have not yet been determined. Some of the detached spicules are remarkable for their size; one, for instance, of the slender rectangulated sexradiate type of Bowerbank measuring more than half an inch.

The vegetable kingdom was represented in this dredging by a single specimen of a minute alga, *Centroceras clavulatum* Agardh., which Harvey says is found abundantly at low water mark at Key West. In its branchlets was entangled a chain of a species of *Biddulphia*. Other Diatomes are rather scarce and have not yet been determined. We therefore find here also a confirmation of the remark made in European seas, that vegetable life does not extend to depths as great as are reached by animals, and that therefore the greater number of deep-sea animals must be carnivorous.

The dredge contained also a number of nodules of a very porous limestone, similar in color and texture to the limestone forming the range of low hills along the shore of Cuba, but composed apparently of the remains of the same animals which were found living. Thus our Deltocyathus, Caryophyllia, the various Pteropods were recognized in the stone, and found also in various stages of fossilization. The interstices between the larger forms are generally filled up with Foraminifera.

On May 25th the dredge was sent down in 350 fathoms, outside of the locality occupied on the 24th and 29th. It brought up only a few dead corals: *Caryophyllia formosa, Deltocyathus Agassizii, Diplohelia profunda*, the latter in numerous specimens (see description). Also a fragment of the siliceous skeleton of a sponge, forming a regular network somewhat like that of Euplectella as figured by Bowerbank, but lacking the spines.

The soundings made during this cruise seem to indicate a kind of submarine terrace, on which the dredgings of the 24th and 29th were made. The cast of the 25th was probably made on the edge of it, and the dredge no doubt touched bottom only for a short time, after which the ship drifted off into water too deep for the line attached.

Remarks and Descriptions of New Species.

Marphysa floridana Pourt.

Head small, with 5 antennæ; no tentacles on the buccal ring. Branchiæ pectinated, with 5 to 7 lobes, small, beginning about the 7th or 9th ring. The composite bristles with a small lancet-shaped appendage. Two eyes, rather large. Superior cirrhi longest, inferior short and conical. Teeth of the labrum large, broad, enamelled, white. Caudal cirrhi two, short. The first ring of the body has only the two superior cirrhi, which are nearly dorsal.

Body rings about 115. Color reddish, iridescent. Length 3 or 4 inches (contracted). Inhabits large deformed paper-like tubes, with lateral openings irregularly placed, though in general alternate, bordered by laciniate and fimbriate flaps.

Off Sand Key in 100 fathoms.

Marphysa tibiana Pourt.

All the characters as in the preceding, but the whole animal is more slender, and in some parts of the body the rings are considerably elongated, which may possibly be due to its position in the tube at the time of death The branchiæ are almost rudimentary, in the shape of small club-like appendages to the upper cirrhi. It differs particularly from the former by its tubes, which are horny, dark brown, regularly serpentine; at every bend there is a tubulated aperture directed backwards, with an expanded fimbriated border. Similar tubes have been figured by Ellis, and on them Lamarck founded the genus Tibiana, which he placed among the polyps. (See figure in Ellis, also copied by De Blainville.) In this species the tubes are free and appear to have been buried in the mud by their smaller end. Abundant in 270 fathoms off Havana.

Marphysa antipathum. POURT.

Animal not observed; tubes differing from those of the preceding species in being attached by their whole length to the stems of a small species of Antipathes. They are also somewhat smaller, and the tubular apertures are entire, without fimbriæ, and only slightly widened.

Found, with the preceding, off Havana in 270 fathoms.

Tubes of various forms were also found, but not containing the animal, or only insufficient fragments of it, so that they cannot be determined. One tube deserves mention; it is white, parchment-like, straight and flattened; it is armed densely with spicules of sponges placed transversely, and stiffened by the long threads of a Hyalonema attached longitudinally; it contained only a very small fragment of the inhabitant. Obtained in 270 fathoms off Havana.

Pedicularia decussata GOULD. (Proc. Bost. Soc. Nat. Hist., Vol. V. p. 127.)

As I have not Dr. Gould's specimens at hand for comparison, I refer with some hesitation to this species, a small living shell dredged on May 29th. As it is immature it is difficult to determine by the description alone.

Terebratula cubensis POURT.

Shell globose, thin, light horn-colored, translucent, obscurely pentagonal, smooth, or showing faintly the lines of growth; the inferior margin of the transverse portion of the loop with three indentations, differing in this respect from *T. vitrea*, in which this part is entire; otherwise these two species resemble each other very closely. The largest specimen is $1\frac{1}{10}$ inch long, $\frac{9}{10}$ of an inch broad, and $\frac{7}{10}$ high.

It may prove to be identical with an undescribed *Terebratula*, from a recent formation of Guadaloupe, mentioned in Bull. Soc. Geol. de France, Tom. xx. 1863.

Several specimens, mostly large, were obtained off Havana in 270 fathoms.

Terebratulina Cailleti CROSSE.

A number of specimens of this species, of all ages, were obtained with the former. They are all smaller than the Guadaloupe specimen, figured by Crosse, and perhaps on that account show the depression in the middle of the dorsal valve less distinctly than the figure.

Vincularia margaritacea Pourt.

Irregularly branching, generally at a large angle. White, pearly. Cells set round the axis in six rows alternating by threes, oval, smooth. Aperture rounded, with a small notch on inferior border for the attachment of the horny operculum, which is thin and round. Some of the cells have an accessory upper chamber (*ovarian vesicle*) inflated and cribriform. About 1 inch high; rather abundant off Sand Key in 100 fathoms, and off Havana in 270.

Farcimia cereus Pourt.

Frustules long, cylindrical, branching laterally from the middle of the older ones. Cells in six rows, alternating three and three, concave, oval. Aperture small, horseshoe-shaped, with a pore on each side. In old and worn specimens the operculum giving the shape to the aperture is lost and the latter becomes oval. The space between the cells is then also deprived of a kind of epidermis, and shows rows of pores forming lozenges around the cells. Articulating peduncles horny; sometimes strengthened by radicles. Rather abundant in 270 fathoms off Havana.

Cellepora reticulata Pourt.

Flabellate, much anastomosing, pearly; apertures alternate, directed obliquely upward, all on the same side of flabellum, rounded, with small knob on lower part, on which is a small pit for the articulation of the operculum. (The latter all lost from specimen on hand.) About three quarters of an inch high. Off Havana in 270 fathoms.

Cellepora sigillata Pourt.

Flabellate, anastomosing, all the cells opening on the same side of the flabellum. Aperture oval, somewhat truncated towards the top, above which rise four short bristles. Cells irregularly alternate, crowded, concave. Operculum large, pearly, convex with a somewhat turned-up lip.

Only a small fragment was obtained off Havana in 270 fathoms.

Canda* retiformis Pourt.

Flabellate, irregularly dichotomous. Membranous tubular radicles connecting the branches with each other at about every fourth cell, giving the whole the appearance of network. Cells elongated, thin, half-membranous, alternate, opening on the same side of flabellum, punctated, two short blunt spines at the top. Aperture large, occupying about two thirds of the cell, protected by a broad T-shaped shield rising from the side of the aperture. About one inch high. Off Havana in 270 fathoms.

* Cellarina, Van Beneden.

Canda cornigera POURT.

Flabellate and resembling the former, but the branches are not so dense, and not connected by radicles, which are only numerous near the foot and attached to foreign bodies. Cells as in the other species, but the shield is ramified like a pair of elk horns. Off Havana in 270 fathoms.

Idmonea flexuosa POURT.

Branching irregularly, calcareous, white. Branches variously curved or flexuous. Cells long, cylindrical, striated; aperture rounded at the end of a curved tubular projection, almost opposite, with a slight tendency to become alternate. Resembles closely the fossil species *Idmonea coronopus.*

Off Havana in 270 fathoms.

Comatula (Alecto) Hagenii POURT.

Ten arms. Mouth central, with the five brachial grooves radiating from it. Centre of disc convex, surrounded by about 30 cirrhi, each of which is composed of 18 to 20 articulations, much longer than broad, smooth, of nearly equal size throughout the whole length of the cirrhus. Cirrhi in several circles. A small part of the second radial only visible, so that the axial radial appears almost sessile. The radials of two contiguous arms, and the first brachials of the same pair well separated down to the angle. Arms convex on dorsal side. Syzygia composed of three or seldom four articulations, with very oblique joints, and very finely denticulated edges, better recognized by the touch than by the eye. The first three or four pinnules of the arms long and nearly eqnal, the pinnules of the middle of the arm shorter than those of the base or extremity. Arms about three inches long. Color pale greenish, turning white in alcohol. All the specimens had the pinnules filled with eggs. Quite abundant in 100 fathoms off Sand Key.

Comatula brevipinna POURT.

Ten arms. Mouth and anus not seen in the only specimen obtained. About 15 cirrhi, with the same number of long articulations. Seven or eight articulations to every syzygium. The two radials are visible, and have, as well as the axial radials and the two first brachials, a smooth tubercle in the middle. The same pieces are denticulated on the sides, the denticulations meeting those of the collateral radials and brachials, so as to close up the angle between them. A row of very small tubercles on the proximal border of the radials and radial axials. The articulations of the arms somewhat imbricate. First pinnule longest, with about twelve joints. The other pinnules very short, having only five or six joints in the middle of the arm, but lengthening out again near the end of the arm, the last ones being tipped with a hook like the cirrhi.

In the only specimen obtained one of the arms is abortive and divided into three very short branches; to compensate, one of the arms of the next pair is divided into two from its origin.

In 270 fathoms off Havana.

Antipathes filix Pourt.

Main stem erect and straight, pinnate, the pinnules set off nearly at right angles, rather short, alternate, covered with spines or short stiff hairs, and showing a succession of slight swellings and contractions. Axis tough and corneous, nearly black, dark amber color by transmitted light. About 3 inches high. Soft parts not observed.

In 270 fathoms off Havana.

Every specimen obtained served as support to the tubes of an Annelid (*Marphysa antipathum*).

Antipathes humilis Pourt.

Differs from the former by its mode of branching, which is dense and irregularly subflabellate, like a spray of heather; more expanded laterally than in height, which is 3 or 4 inches, whilst the spread is 4 or 5. Every swelling corresponds to a polyp. Polyps all on the same side of the flabellum, six-armed, with very elongated calicle in the younger branches, so that the tentacles appear almost like two parallel rows of three tentacles each. It differs from *A. Boscii* in having rather thicker and more hispid branches, curved somewhat downwards, as the branches of an elm.

Abundant in 270 fathoms off Havana.

Gorgonia exserta Ellis.

Two specimens of this species, 3 or 4 inches high, were obtained off Havana in 270 fathoms. They agree very well with the figures in the different authors. One of them has all the polyps retracted and the calicles closed, the other has them all expanded as usually represented. The whole cortical substance is filled with spindle-shaped spicules, by which character it is distinguished from *Thesea guadalupensis* Duch. and Mich., in which the spicules are covered by a squamose layer.

In 270 fathoms off Havana.

Swiftia exserta Duch. and Mich.

I refer to this species a few specimens of a very small Gorgonian, not more than one inch high, which at first sight does not appear different from the preceding species. Under the microscope the cortical substance appears studded with rough irregular calcareous pieces, without spindle-shaped spicules. The polyps are perhaps a little more verrucose than those of the Gorgonia exserta. Off Havana in 270 fathoms.

Acanthogorgia aspera Pourt. (The generic name given by Gray has priority over the name *Blepharogorgia* Duch. and Mich.)

Slender, flabelliform, few-branched, sparsely beset with short spines. Polyps rather scattered, long verruciform (length equal to four or five times the diameter), with eight rows of spines longest at the base and at the summit of the polyp. Tentacles black, the rest of the polyps translucent. Stem dark brown. The whole polypidom not more than two inches high. By its spiny stem, and spines at the base of the polyps, and by the greater length of the latter, it differs decidedly from *A. hirsuta* Gray, *A. Grayi* and *atlantica* Johnson, and from *A.* (Blepharogorgia) *Schrammi* Duch. and Mich.

In 270 fathoms, off Havana.

Sarcodyction rugosum Pourt.

Small polypidoms rising from creeping stolons, on pebbles. Like little knobs, fragile, rough, closed by the contraction of the polyp by means of about six irregular rough pieces meeting together. When opened, the cavity shows six or eight membranous septa, nearly meeting in the centre. Stolons covered with irregular calcareous pieces. Color dirty white. Diameter of polyps one tenth of an inch. In 270 fathoms off Havana.

Caryophyllia formosa Pourt.

More or less turbinate, on a rather thin curved, or straight stem. Costæ equal, distinct only near the calicle. Calicle circular or subovate, moderately deep. Columella formed of four to six very flexuous or twisted laminæ. Six complete systems of septa. Four cycles. Septa thin, prominent, sharp and rounded on the edge; sparsely granulated. Those of the third order sometimes flexuous near the inner end in some specimens. Twelve pali, opposed to the third order, equal, large, flexuous, ornamented with tubercles disposed in horizontal lines on the convexity of the flexures. The young are rather variable, sometimes long and cylindrical, with the septa little developed and showing neither pali nor columella, and sometimes very small and cup-shaped and showing pali and columella.

The largest are $1\frac{1}{4}$ inches high; calicle $\frac{1}{2}$ inch in diameter.

Abundant in 270 fathoms, off Havana. Specimens mostly alive and growing singly or attached to each other.

It differs from *C. Berteriana* which has the costæ more prominent and a different number of septa. I have not seen specimens or figures of *C. Guadulpensis*, which is fossil in volcanic formations of Guadaloupe, and may not be extinct.

Deltocyathus Agassizii Pourt.

Corallum discoidal, free at all ages. Wall nearly horizontal, sometimes with a nipple-shaped projection in the centre. Costæ well marked, covered with spiny or smooth granules; the six primary costæ in one specimen much broader than the others and forming a star. Septa in six complete systems, with four cycles; covered with small spinous tubercles. Pali of the first, second, and third cycles projecting generally higher than the septa, to which they are soldered at the base. The pali of the first cycle short, those of the third joined to those of the second, as in the fossil species, but the point of junction not being exsert the V or delta is not as apparent. Columella papillose and small, rising from the primary and secondary pali which meet in the centre.

Dredged from 270 fathoms off Havana, in numerous specimens of all ages, but none apparently alive.

Platytrochus coronatus Pourt.

This species, not belonging properly to the region under discussion, is based on a specimen brought up by the sounding lead from a depth of 460 fathoms in lat. 30° 41′ N., and long. 77° 3′ W., by one of the hydrographical parties of the Coast Survey. It is in a bad state of preservation, the outer wall and base being so corroded as to make the characters drawn from the epitheca and costæ very doubtful; the septa and columella are also rather imperfect.

Corallum free, base horizontal, with a tubercle in the centre. The costæ of the primary and secondary order alone distinct, forming a crown of twelve large tubercles around the base, but vanishing towards the edge of the calicle. Wall vertical, almost at a right angle with the base and the circular calicle. Six complete systems of septa, in four cycles. Septa meeting in the centre. Those of the tertiary cycle frequently but not regularly coalescing with the primary or secondary ones. Columella probably papillose (nearly destroyed). Diameter $\frac{6}{10}$ of an inch, height (without the central tubercle) $\frac{4}{10}$ of an inch.

Diplohelia profunda Pourt.

Corallum branching, cylindrical, finely granulated or striated, particularly on younger branches and around the calicles, which are projecting, very deep and pocket-shaped. Septa 24, nearly equal, not exsert, finely serrated and tuberculated, nearly meeting at the bottom of the fossa. Columella formed of six or seven club-shaped styles, not very distinct from the septa. The specimens obtained were all in fragments 2 or 3 inches long. Diameter $\frac{2}{10}$ inch.

This species resembles the fossil *Dipl. raristella*, but has deeper calicles and somewhat rougher surface.

Dredged from 350 fathoms off Havana; all the specimens dead; also brought up by the lead in same condition in 1050 fathoms, lat. 28° 24′ N., long. 79° 13′ W.

Crypthelia Peircei Pourt.

Corallum arborescent and subflabellate, irregularly dichotomous, slender, finely striated. Calicles subpedicellate, always of a larger diameter than the stem, facing to one side only of the corallum. Septa 12 to 16, thick, not extending far into the calicle. Columella not seen. The lower border of the calicle prolonged into a rounded lip folded over so as to hide the fossa. Some of the calicles are inflated and globular, perhaps from the presence of parasites. Size: $\frac{1}{2}$ an inch long (broken), diameter of stem from $\frac{1}{20}$ to $\frac{1}{30}$ of an inch, of the calicles $\frac{1}{30}$ to $\frac{1}{40}$.

This very pretty coral was dredged off Havana in 270 fathoms, but appears to be rather rare, only a few small fragments being obtained. It differs from the species described by Milne-Edwards in having a smaller lip, hiding only the fossa of the calicle, whilst in the species from the Pacific the lip is as large as the whole calicle. I have also found worn fragments in a specimen of bottom from 600 fathoms in lat. 31° 32′ N., and long. 78° 20′ W.

Stylaster complanatus Pourt.

Corallum branching, flabellate, not coalescing, slender. Calicles terminal, pedicellate; gemmating from the edge of the preceding calicle, generally on alternate sides, so as to give a zigzag form to the branch, but sometimes two or even three new corallites rise from the border of one. They are directed slightly more towards one side of the plane of the corallum than the other. Calicles compressed in the same plane, moderately deep, the styliform columella appearing at the bottom rising out of a small round fossa, and surrounded by rudimentary pali. Septa 12, appearing like folds of the wall, not extending far into the calicle, and punctured with small pores on the edge. When the branch rising out of a calicle increases in size, the calicle becomes hidden by the plicated lip raised against the stem, and at length becomes obsolete. Spiny ampullæ scattered along the stems, more abundantly on the rear side. It is white, about $1\frac{1}{2}$ inches high; the diameter of the calicles about $\frac{1}{30}$ of an inch.

Obtained in 270 fathoms off Havana.

It approaches nearly to *Stylaster elegans* Duch. and Mich., which has however nearly circular calicles with shorter pedicles and thicker branches. (The name *St. elegans* has been anticipated by Verrill for a species from the Kingsmill Islands, in Bull. Mus. Comp. Zoöl., Cambridge, 1864; I would propose therefore the name of *St. Duchassaingii* for the species from Guadaloupe.) From *Allopora maderensis* Johnson, to which it is very closely allied, it differs also by the compressed form of the calicles.

By its scale-like lip hiding the fossa in the older calicles, and by its transversely elongated terminal calicles, this species forms a passage to the genus Errina as defined below. It is here retained among the Stylasters on account of its distinct septa and the absence of tubular pores having a longitudinal fissure below. On the other hand the passage through *St. flabelliformis* to the Stylasters with round scattered calicles appears natural. When I have had more opportunity of examining the allied forms, it may be necessary to separate *S. complanatus* generically from the true Stylasters. The whole group of corals comprising the genera Stylaster, Errina, Allopora, and Distichopora, all closely allied, requires careful revision.

Genus Errina.

A comparison of specimens of *Errina aspera* Gray, in the Museum of Comparative Zoölogy in Cambridge, with the two species described below, showed very plainly that Gray has overlooked the true calicles and mistaken for them the tubular pores scattered over the younger branches. In his species these pores are very large and numerous, and the calicles small and concealed; in the new species, here described under the name of *St. cochleatus*, the reverse is the case. The structure of the latter species being once well understood, it is very easy to recognize the same parts in the other; of both I have furthermore made careful sections for the microscope. Whilst retaining the name adopted by Gray, I propose the following generical definition.

Corallum branching, subflabellate, finely granulated or obscurely striated, the younger branchlets more or less studded with tubular pores, split downwards into a furrow. Calicles at first terminal, in shape of a transverse slit, of which one lip continues to grow in a conical shape to repeat the process, whilst the other expands in the shape of a bract or spoon, hiding the calicle after it has become lateral. Fossa circular and very deep; septa obscure or none; pali rudimentary in the shape of small beads; columella pistilliform. Ampullæ as in Stylaster.

Errina cochleata Pourt.

Corallum branching, very slender, subflabellate, finely granulated and striated, studded with echinulated ampullæ. Branchlets almost filiform; the pores on them are sometimes tubular with a longitudinal fissure below. Fossa round and deep, the spoon-shaped lip hiding it entirely. Columella pistilliform and somewhat hirsute, very deep seated. Septa few and indistinct, formed by folds of the wall.

Compared with *Errina aspera* from Fayal, it is found to differ from it in having slenderer branches, with fewer and smaller furrowed tubercles and fewer echinulated ampullæ, whilst the calicles are larger and more conspicuous. The whole corallum is about one inch high. Found in 270 fathoms off Havana.

Fragments of an Errina, closely resembling *E. aspera*, have been also found by me in a specimen of bottom from 600 fathoms, in lat. 31° 32′ N. and long. 78° 20′ W.

Errina glabra Pourt.

Corallum flabellate, not coalescing, with the older parts of the stem massive, faintly granulated and striated ; a row of very small perforated tubercles on each side of the branches. Calicles very small, terminal on branchlets, obsolete on larger branches, and their place indicated by a small scale. Septa indistinct. Columella styliform in a deep fossa. Ampullæ scarce and small, smooth. Color white. Two or three inches high.

It differs from *Errina cochleata* in having much thicker branches, even when young, forming smaller angles with the stems. The ampullæ are not spinous. The tuberculated pores are confined to the sides of the branches and have seldom a distinct furrow. From *Errina aspera*, although resembling it in general habitus, it differs in having slenderer branches, less numerous ampullæ, and lacking the large furrowed pores on the younger branches.

Distichopora sulcata Pourt.

Corallum dendroid, much compressed, somewhat rugose. The calicles on the edge, mostly confluent; fossa a deep round hole. Septa about 12, very rudimentary ; the border of the calicle pierced by about eight or ten pores which form lateral rows when the calicles are joined. Columella deep seated, seldom visible, styliform, hirsute, similar to the columella of the Stylasters. The interior of the calicle is studded with bead-like tubercles.

This species differs from other known species of the genus in being more compressed, having the pores larger, more distant, and when confluent forming a much deeper furrow. When the calicles are isolated, they present all the characters of Allopora, as shown in *A. oculina*, Ehr.

Found in 270 fathoms off Havana ; rather scarce. Also in the shape of worn fragments in a specimen brought up by the lead from 600 fathoms in lat. 31° 32′ N. and long. 78° 20′ W., which is near the outer edge of the Gulf Stream off the coast of Georgia.

Of the close relationship of Distichopora with the Stylasters, and still more with the Alloporas, I entertain no doubt, after a careful examination. Indeed, I can see no reason for separating generically Allopora and Distichopora, which appears to differ only by the confluence or non-confluence of the calicles, both of which characters are found in the same individual in the species described above.

Heliopora tubulata Pourt.

I refer with great doubt to that genus, a form of small corals of which I have obtained but a few fragments, representing two species. Corallum small, branching, cylindrical, with pores of three kinds: small microscopical, somewhat larger and tubulated, and large round holes. The latter are rather distant, in irregular longitudinal rows. No trace of septa or columella. The internal structure shows a net-work of round canals communicating with the pores and with each other. The larger holes communicate with a cavity in the centre, not communicating with the next except through the small canals; the walls of these cavities are closely perforated. No floors or tabulæ were to be seen in the only section I was able to make. The largest specimen is one inch high.

Off Havana in 270 fathoms.

Heliopora carinata Pourt.

This species differs from the preceding by its much slenderer branches, on which every tubulated pore is at the extremity of a keel or ridge. The larger round pores are proportionally scarcer and smaller.

Off Havana in 270 fathoms.

Antennularia triseriata Pourt.

Tubular stems rising from a clustered root, straight, erect, not branching, corneous, translucent. Hair-like branchlets in three rows. Polyp cells very small, scattered sparsely on the stem, more plentiful but not dense on the branchlets, campanulate, very short on a longer, conical caliciform stem. Aperture entire. Ovarian cells in the axillæ of the branchlets, compressed, semi-lunar or long kidney-shaped, with the aperture on the inside of the upper horn, looking towards the peduncle.

Eight inches high, dark amber color. Off Sand Key in 100 fathoms.

Thoa pulchella Pourt.

Erect, rooted; stem composed of irregularly twisted tubes, regularly pinnate; branchlets alternate. Cells regularly alternate on the stem and branches, moderately distant, more or less corrugated, slightly contracted towards the four-sided aperture, the four angles of which form obtuse teeth. Ovarian cells long campanulate, regularly scolloped on the border with square teeth. Peduncles as long as the cells.

Off Sand Key in 100 fathoms and off Havana in 270.

Thoa capillaris Pourt.

Erect, irregularly branching. Branches almost capillary. Cells alternate, distant, small, tubular, bi- or tri-articulate; aperture terminal and entire. Ovarian cells large, elongated campanulate, denticulate margin, teeth rounded; peduncles as long or longer than the cell, connected with the latter by a small knob-like joint. One inch high. Off Sand Key in 100 fathoms.

Thoa siphonata Pourt.

Stem composed of irregularly twisted tubes; branches irregularly pinnate. Polyp-cells very small and scarce, tubular, at the base of the peduncle of the very long, tubular ovarian cells. The latter are bent at right angle near the top and terminate in a round aperture. Half an inch high, on Terebratulæ.

Off Havana in 270 fathoms.

Tubularia crinis Pourt.

Irregularly branching; branches rather smaller than horsehair, of dark horn-color, wrinkled at intervals; polyps terminal, large, not retractile. About two inches high, attached to tubes of Annelids. Off Sand Key in 100 fathoms.

In determining the Hydroid polyps, I have made use of the older generic names. The newer subdivision of these genera being based chiefly on characters derived from the softer parts, it is almost impossible to assign a polyp to its proper place in them, unless observed alive.

It would be premature to compare this deep-sea Fauna with the animals inhabiting the regions of lesser depth on the coast of Cuba or Florida. In the first place, many of the smaller forms of animals, such for instance as the Bryozoa or the Hydroid polyps of those shores, are not yet sufficiently known to enable us to say if any of the species dredged exist in any other than the abyssal region. Then, a very different value must be assigned to the different classes of animals under examination. Thus, the dead shells must be left out of the question, at least the smaller ones, for they may have been dropped with the excrements of fishes, or, in the case of Pteropods, have sunk from the surface after the death of the animal. The Crustacea and Annelids being abundant and generally sedentary will, when better known, afford good characteristics of the regions of inequal depth. The same remark applies to the Sponges and the Foraminifera; the great abundance of the latter and the ease with which they may be procured with the sounding-lead renders them particularly useful.

The Echinoderms appear to have a wide range in depth; at least we have two species (*Cidaris annulosa* and *Tripneustes ventricosus*) which are common to the shore and to the depth of 270 fathoms. The upper and lower limits of Pentacrinus are not yet known.

Of the corals, none of the species found in our dredgings are known to exist in lesser depths ; nor have any of the common species of the reefs been brought up from a considerable depth. The Gorgonians however are represented in 270 fathoms by at least two species known to belong to the West Indian Fauna in moderate depths.

Farther researches in all the zones of depth are much needed ; and we hope to have an early opportunity of continuing our researches in the Gulf of Florida, so as to throw more light upon this interesting subject.

CAMBRIDGE, December 26, 1867.

No. 7. — *Contributions to the Fauna of the Gulf Stream at great depths (2d series).* By L. F. de Pourtales, Assist. U. S. Coast Survey.

(Communicated by the Superintendent of the U. S. Coast Survey.)

The researches of which an account was given in the preceding number of the Bulletin were continued in the spring of the present year (1868) in connection with the regular explorations of the Gulf Stream by the Coast Survey. The few dredgings obtained in 1867 had given results of so rich and promising a character, that Professor Peirce, the Superintendent of the U. S. Coast Survey, directed me to accompany the party again, and to dredge on all the lines of deep-sea soundings off the Florida reef.

The U. S. Steamer Bibb, Acting Master R. Platt, U. S. N., was assigned to the work. The means of working were much more complete, a small engine having been set up on deck, by which not only a great economy of time and labor was obtained in hauling up the lead or dredge, but it was found perfectly practicable to work both at the same time ; so that our estimate of time, based on the plan of sounding out a line one day and dredging over the same ground the next, was reduced one half, — an advantage which will be understood by those who know the value of a calm day for such work. For the perfection of the mechanical arrangements, and the difficult task of keeping the reckoning in the current with very scanty landmarks, I am again deeply indebted to Captain Platt and his officers.

The region to be explored this season comprised a section of the Gulf Stream from Sombrero, or Dry Rocks Light-house, on the Florida reef, to Elbow Light-house on the Double-headed Shot Keys ; a section of the St. Nicholas Channel from Salt Key to the opposite coast of Cuba ; a section of Santaren Channel from Anguilla Keys to the edge of the Great Bahama Bank ; and a more detailed examination of the slope extending from the Florida reef to the trough of the channel from Sand Key to Sombrero Light. The sections across St.

Nicholas and Santaren channels were quite successful, as far as the soundings and current observations were concerned; but the few dredgings with which we had to be contented, for want of time and good weather, did not produce much of interest. We were more successful on the slope or so-called *apron* of the reef. Here the great advantage of having a safe anchorage every night inside the reef, and within half a mile of the field of work, allowed the soundings and dredgings to be carried on with great rapidity and success.

The six lines run (as far as possible normally to the reef) were the following: Off Coffin's Patches with only two dredgings; off Sombrero Light with seven dredgings, between 111 and 517 fathoms; off Bahia Honda thirteen dredgings, from 19 to 418 fathoms; off the American Shoal fourteen dredgings, from 16 to 266 fathoms; off the Samboes nineteen dredgings, from 13 to 298 fathoms; and off Sand Key twenty dredgings, from 23 to 306 fathoms. Besides these, numerous casts were made in 100 and 120 fathoms off Sand Key, whilst current observations were in progress.

The figures and the character of the bottom developed by the different lines were found quite concordant. At an average the slope, after leaving the reef, is uniform for four or five miles, and the bottom is composed of more or less comminuted shells and corals, with a rather scanty living Fauna. This we may call the first region. The next extends in the form of a band parallel to the reef, ten to twenty miles broad, beginning at a depth of about 90 fathoms, and extending to about 300; the slope being much less inclined than in the first region, and in fact deserving in a great part of its extent the name of a submarine plateau. The bottom is rocky, rather rough, and consists of a recent limestone, continually though slowly increasing from the accumulation of the calcareous *débris* of the numerous small Corals, Echinoderms, and Mollusks living on its surface. These *débris* are consolidated by the tubes of Serpulæ, the interstices filled up by Foraminifera, and further smoothed over by Nullipores. It is not unreasonable to suppose that we have here the foundation of a future reef, which, when in the course of ages it shall have approached the surface, will be covered with a growth of Madrepores and Astreans, such as we find on the present barrier reef, and as have lived on the former reefs constituting the chain of the Florida Keys, the border of the main-land of the peninsula, and probably some older as yet unexplored ones in the Everglades.

This region ceases at a depth varying from 250 to 350 fathoms; the third region begins with a more rapid slope, and extends over the whole trough of the channel, the depth of which in this part does not much exceed 500 fathoms. This is the great bed of Foraminifera, and more specially of Globigerinæ, which covers so great an extent of the bottom of the ocean, and which, as we shall see, is not destitute of living representatives of the higher branches of the animal kingdom.

The Fauna of the three regions is very distinctly marked. The first region is singularly barren, and shows that the rich Fauna of the Florida reef extends but very little to seaward or into depth. The greater number of the shells brought up are dead and broken, and can scarcely be regarded as characteristic, as large numbers of them have evidently served as food for turtles and fishes, and may have been thus transported some distance. Crustaceans and Annelids are more common. The Echinoderms are represented by a few Ophiurians, and the Corals chiefly by *Balanophyllia floridana*, nov. sp., very abundant in some places, particularly near Sand Key.

The second region, on the contrary, is remarkably rich in animal forms, which may be in part attributed to the hard and rough bottom offering points of attachment and shelter. If this formation were emerged, the geologist would find it to consist of beds of limestone full of fossils, of which we shall point out the most characteristic ones; remarking, however that though the great majority of the animals furnishing those remains now live on the bottom, a few contribute by sinking after death from the higher regions of the superincumbent water (teeth of fishes and shells of Pteropods), and others are brought by currents from littoral regions (bones of Manatee, fragments of littoral plants).

The *Vertebrates* are represented by the bones of the Manatee, chiefly fragments of the ribs. These are quite abundant, no less than ten or twelve casts of the dredge having brought them up, generally several pieces at a cast. Until we are better acquainted with the set of the currents on the west coast of Florida and the coast of Cuba, the former *habitat* of these animals cannot be guessed at with much certainty, as their carcasses, either floated out of the estuaries of those coasts, or when very numerous, as they evidently were, the animals may have been in the habit of migrating across the straits, and may have been frequently destroyed by sharks on the passage. As no fresh addition of these bones is now made to the bottom, nor has been since these coasts have been settled upon by white men, we have a proof that the deposit due to other causes is very slow, since the dredge finds the bones still lying loose on the bottom.

The other vertebrate remains are teeth of sharks and eggshells of skates. Living fishes were obtained in only two instances at about 100 fathoms: one was a Phycis; another, a small fish of the Lophioid family, not yet determined.

The *Crustacea* are rather abundant, but, the specimens not having been fully examined, we can only give now an imperfect list of the genera represented: *Stenorhynchus*, *Inachus*, *Amathia*, *Pisa*, *Mithrax*, *Lupa*, *Ethusa*, *Pilumnus*, *Dromidia*, *Eupagurus*, *Paguristes*, *Galathea*, *Thysanopoda*, *Alima*, *Caridine*, &c.

Of the *Mollusks*, the most abundant in individuals are the Brachiopods, particularly *Terebratula cubensis*, Pourt. (Bulletin Mus. Comp. Zoöl. No. 6), of which over 1,200 specimens were collected, and *Waldheimia floridana*, nov. sp., a little less common. The *Terebratulina Cailleti*, common on the coast of Cuba, was found very rarely on the coast of Florida, and always dead. The Gasteropods are more numerous than the Acephala, but, as well as the latter, are represented by small species. The largest ones are the *Voluta junonia*, and a *Trochus* of about the same size. As the Mollusks of the collection have not yet been determined, a list of the genera must suffice for the present: *Murex* (2 species), *Fusus*, *Nassa*, *Pedicularia*, *Cassis*, *Dolium*, *Pleurotoma*, *Voluta*, *Marginella*, *Natica*, *Vermetus*, *Trochus*, *Monodonta*, *Delphinula*, *Scissurella*, *Fissurella*, *Rimula*, *Emarginulina*, *Pileopsis*, *Dentalium*, *Chiton*, *Marsenia*, *Eolis*; — *Cucullea*, *Pectunculus*, *Nucula*, *Leda*, *Lucina*, *Mactra*, *Neæra*.

The only ones among these abundant in individuals are a Pleurotoma, a Marginella, a Vermetus, a Monodonta, and a Cucullea.

Bryozoa are also frequent in individuals; but there are less species apparently than on the coast of Cuba in similar depths.

The *Radiates* form perhaps the most interesting part of the collection, being represented in many cases by new or little known genera. The Echinoderms have not yet been determined, with the exception of the Holothurians, of which only three species are found; one of them, *Cuvieria operculata*, nov. sp., is tolerably common; the others are a *Thyonidium*, and another which the imperfection of the specimen has not allowed us to recognize with confidence. Of *Echinida* there are five or six species, of which a *Cidaris* is very abundant, and an *Echinus* rather common. Both are new species, and the immature specimens found on the coast of Cuba, and referred to *Cidaris annulosa* and *Tripneustes ventricosus*, in the Bull. Mus. Comp. Zoöl. No. 6, belong in reality to them. The genera *Echinocyamus, Amphidetus*, and a new genus near *Parasalenia*, are also represented. The *Asteridæ* are also represented by several new forms of *Ophidiaster, Pteraster, Asterias*, and *Luidia*, and among the Ophiurians of genera near *Asteroschema, Asteroporpa*, and *Astrophyton*. The *Comatula Hagenii*, Pourt., is found in great abundance. The Gorgonians and Corals will be described at the end of this paper. They belong to the following genera: *Nephthya, Primnoa*, 2 sp.; *Gorgonia*, 2 sp.; *Acis, Antipathes*, 3 sp. *Cænocyathus, Paracyathus, Thecocyathus, Rhizotrochus, Lophohelia, Allopora, Distichopora, Errina, Thecopsammia*, n. gen. 2 sp.; *Diaseris, Haplophyllia*, n. g. *Pliobothrus*, n. g.

It will be remarked that among the Corals the families of Madreporidæ and Astræidæ are entirely unrepresented, whilst the greater number belong to the families of Caryophyllidæ and Oculinidæ, as defined by Milne-Edwards, or, as we believe, to a new family to be separated from the Oculinidæ, and called Stylasteridæ.

The Sponges are found in this region in numerous forms; they are in general very abundantly provided with siliceous spicula, so much so as to be unpleasant to handle.

The third and last region is characterized by the great Globigerina deposit. No trace of Vertebrates is found here, the accidental remains being probably soon buried in the soft bottom. But other branches of the animal kingdom are still represented as deep as 517 fathoms, beyond which limit we had no occasion to dredge. The Crustaceans are confined to a few small and peculiar forms of Pagurians inhabiting shells of Dentalium and Pteropods. Annelids appear to be comparatively abundant and varied. Of living Mollusks only three species were obtained, — a *Phorus*, a *Dentalium*, and a *Limopsis*, the two latter more numerously; and of dead shells, Pleurotoma, Rimula, and Neæra, besides several kinds of Pteropods, not inhabitants of the bottom. The Radiates comprise a few small *Ophiurians; Bourgueticrinus Hotessieri*, D'Orb. (which will be described further on); *Primnoa, Gorgonia, Chrysogorgia, Acanthogorgia, Isis, Mopsea, Caryophyllia, Stephano-*

phyllia, and dead fragments of some of the Corals of the preceding region. Sertularians and Sponges are also found sparingly.

A few general remarks on the deep-sea Fauna may not be inappropriate. First, with regard to dimensions: almost all the species are of small size, compared with the allied forms of the littoral and shoal-water regions in general; the Voluta junonia, the largest shell found, is small for that genus. The only exception is an Echinus, which is nearly of the average size, and an Actinia. The prevailing colors are white, pink, — sometimes playing into orange, — and a pale green. Blue was only seen in a small incrusting Sponge. What proportion of light reaches a certain depth we shall try to determine during our next exploration. It is certain, however, that the deep-sea animals have generally well-developed eyes, larger if anything than those of their congeners of shallow water.

It is rather a matter of surprise to find so great a difference between the Fauna of similar depths on the coasts of Cuba and of Florida, separated as they are by a strait of no great width, and bathed by the same current. The few dredgings obtained on the former coast do not allow us to draw conclusions from the absence of Florida species, but they give still more weight to the inverse. Thus, to restrict our remarks to the Corals, — more carefully studied than the other classes, — of ten species of true Corals from Cuba described in the preceding number of this Bulletin, only two have been found on the Florida coast, and they only in very rare fragments. Something may be due to the gregariousness of Corals in certain spots and their rarity in others. The dredge may come up full of a certain species at one time, and it may never be found again, even in close proximity. This happened to us with regard to Lophohelia affinis, n. sp. The botanist is familiar with such instances among land plants.

We hoped to give in this paper a full catalogue of the species collected; but as time is insufficient, it is thought best to publish the following descriptions as far as completed, and, as the dredgings are to be continued throughout the straits of Florida, the descriptions of the other species will be reserved for a more extended final work.

I take this opportunity again to acknowledge the help I have received from Professor Agassiz in the way of advice and of facilities afforded to me in the Museum of Comparative Zoölogy.

Description of Species.

Waldheimia floridana Pourt.

Shell ventricose, triangular, smooth, wider than long, the widest part being across the front; horn-color. Both valves very convex, the larger one with a shallow longitudinal sinus near the front. Lateral margin of larger valve convex, frontal margin angularly sinuous, and deeply indenting the smaller valve in the middle. Front straight and flattened. Beak prominent and compressed laterally, with a round and rather large foramen. Deltidium small, in two pieces. Loop very long, reaching nearly to the frontal margin of the shell, formed of very thin crura, and a very broad ribbon-shaped reflexed portion. Septum well developed. Lines of growth distinct. Length of shell $\frac{7}{8}$ of an inch, breadth 1 inch.

Very young specimens are flatter, rounder, and have a straight margin; they could scarcely be distinguished from the young of Terebratula cubensis, if it was not for the loop and septum seen by transparency. There is also some variety of form in the old; in some specimens the length is greater than the breadth, and there is considerable diversity in the sinuosity of the frontal margin.

This species is quite common off the Florida reef, between 110 and 200 fathoms, on rocky bottom; it is always associated with Terebratula cubensis, the latter being still more common (in the proportion of about three to one), and making its first appearance in 100 fathoms.

Cuvieria operculata Pourt.

Body oval, flattened, covered with finely and sparsely granulated scales, very compactly imbricated, but overlapping very little except near the mouth and anus. A double row of suckers surrounds the soft abdominal disc, those of the outer row perforating the marginal plates; sometimes two or three suckers indicate a tendency towards a median row near the anterior end. Ten tentacles, of which two are much smaller than the rest. Œsophagial ring of ten pieces shaped like the letter T. The aperture through which the head and tentacles are retracted is closed by five large triangular plates, alternating with and covering five narrow, tooth-shaped ones. In the young the five plates form a very regular pentagonal shield. In the old they close less accurately, and their outside edges are covered by some overlapping body plates. The anus is closed in the same way, but the plates are much less regular or constant.

Length $1\frac{1}{4}$ inches; breadth $\frac{3}{4}$ of an inch. Color light gray.

Not uncommon; in 120 to 150 fathoms off Sand Key.

Thyonidium conchilegum Pourt.

Body very flaccid. Eighteen to twenty tentacles of unequal size, very little ramified, short, with conical papillæ; they are quite difficult to count, as some of them are so small that they may be mistaken for lobes of the larger ones. Suckers in five double rows, with others scattered between. The outer layer of the very thin skin contains a large number of calcareous bodies of the usual type; the base being a square plate with more or less rounded corners, perforated by a round central hole surrounded by eight smaller ones, those at the corners being smaller than those corresponding to the sides of the square. From this plate rise four cylindrical processes, converging towards and supporting a small spiny plate, which projects on the surface of the skin like small warts. These bodies are also plentiful in the suckers up to the terminal disc. In the muscular subcutaneous layer there are patches of smaller bodies formed of agglomerations of round granules. Œsophagial ring provided with retractor muscles, and composed of ten pieces alternately in the shape of a broad letter X and a thin letter T loosely connected. Anus unarmed. Color white, hyaline. Length 2 or 3 inches.

This animal covers itself with shells of Pteropods, particularly those provided with points, one of which seems to be held by every sucker of the body.

It is probably closely allied to T. pellucidum of the northern seas. Not being able to compare specimens, I base this species chiefly on the difference of the number of perforations in the calcareous plates of the skin, the T. pellucidum having four large holes surrounded by twelve smaller ones.

Bourgueticrinus Hotessieri D'Orb.

Several specimens of a living Crinoid were obtained by dredging in 237, 248, and 306 fathoms off the Samboes and off Sand Key, in a bottom of Globigerinæ and other deep-sea Foraminifera. They undoubtedly belong to the genus Bourgueticrinus, as defined by D'Orbigny. I refer them provisorily to the species named above, founded on some small fragments of the stem discovered in the recent breccia of Guadaloupe, which contained the well-known human skeleton now in the British Museum. D'Orbigny gives it as his opinion that his species is probably still living in the West Indian seas; but his figures are insufficient either to prove or disprove the identity of our species with his. A comparison with his specimens even would leave the matter in doubt. It is to be hoped that further researches in the Guadaloupe formation will bring to light specimens perfect enough to settle the question.

The following description is not as full as could be wished, as the specimens are not numerous or perfect enough to warrant a complete dissection.

The *calicle* is in the shape of a regular elongated inverted cone. It is composed of a cycle of elongated basal (pelvic) pieces, followed by the much shorter first radials (costals) alternating with them. These pieces are all so intimately connected with each other that the sutures are seen with difficulty. The surface is perfectly smooth. The first brachials are flat and square, and connected laterally by a membrane. The arms generally break off between these and the second brachials, and the first might therefore be called second radials, as they in a measure contribute to the formation of the calicle; still, as they are movable on the first radials, and similar in shape to the next two joints, it is more natural to name them as we have done. The next two joints, or second and third brachials, are similar, and but little smaller than the first. The arms contract suddenly at the fourth brachial; they are five in number, simple, and composed of forty joints, every pair of which forms a syzygium. The pinnules arise from the side of the upper joint of each syzygium, alternately on one side and on the other. There are none, however, on the four or five first syzygia. The inner side of the arm is channelled, and the middle of the channel is protected by a row of very thin alternate scales.

The *pinnules* are composed of from ten to fourteen somewhat imbricated plates, of which the first two are narrower than the subsequent ones. The inner side is provided with a row of rounded alternate scales similar to those on the inside of the arms.

The *stem* is composed of a variable number of joints; our largest specimen having fifty-nine and the smallest but thirty. The generic character of having the joints flattened at their two ends in planes alternately at right angles to each other is well marked, particularly near the root; it is less apparent near the calicle, though this conformation may still be recognized to within half a dozen articulations of it; the last joints are sensibly round. The length of a joint is on the average about three times its diameter, except the four or five joints preceding the calicle, which are much shorter. The joints are connected by a ligament passing through the central canal, also by two strong ligaments lodged in parallel oval cavities in the articulating surfaces, and finally by a membrane along the edge. This threefold connection is so strong that by applying force it is more easy to break through the body of the joint than to disconnect the articulation.

The *root* is variable; sometimes all its ramifications start from a single joint, whilst in other specimens some five or six joints send out roots from their upper compressed edges. Each root promptly subdivides into a large number of rootlets; the whole is formed of articulated joints, which become much elongated as they become thinner.

The stem and the outside of the calicle are covered with a rough brown skin, which, under the microscope, presents the appearance of a rough, corrugated reticulation. It contains thin calcareous plates without definite shape, and is very liable to fall off. No muscular fibres could be detected under it. J. Müller denies the power of voluntary motion to the stem of Pentacrinus, on account of the total absence of muscles. In Bourgueticrinus the stem has indeed no great flexibility, but the complication of the ligaments of the articulations, and the hinge-like arrangement of the latter in two alternate directions would seem unnecessary if the motion is to consist merely in a passive swaying to and fro with the oscillations of the water.

Two specimens have, in place of a calicle, a small conical button, composed of two or three joints. I am not prepared to say whether this is an undeveloped form, or the result of an effort to reproduce a lost head.

The length of the largest stem obtained is $5\frac{1}{8}$ inches, exclusive of root and calicle. The smallest and most complete specimen has a stem measuring only $1\frac{1}{2}$ inches. This specimen has three small stylifers adhering to the outside of its calicle. Small round holes, bored probably by these parasitic mollusks, can be seen also on the calicles of some of the other specimens.

Nephthya nigra Pourt.

Corallum rising from a membraneous expansion, and forming several small tufts of elongated, costate cells, densely grouped. Every part filled with spicules; those of the polyp-cells being long, fusiform, and particularly numerous in the costæ of the cells. Every corallum bears from 150 to 200 polyps. Height 1 inch; color black. Rather common off Sand Key, Florida, from 120 to 152 fathoms.

Primnoa verticillaris Ehrbg.

I refer to this species several branches eight or ten inches long, obtained in 120 fathoms, off Sand Key, Florida. Compared with specimens from the Azores, in the Mus. Comp. Zoöl., some slight differences in the length of the calicles and size of the scales were noticed, but they are not deemed sufficient to warrant a specific separation.

Primnoa trilepis Pourt.

Branches irregularly and sparsely dichotomous, subflabellate. Branchlets very thin and flexible. Calicles in verticils of four, or more generally five, formed of three large cylindrical scales, joined angularly to each other, like the elbows of a stove-pipe. Aperture closed by eight triangular scales. The distance between the verticils is equal to or a little less than the length of the single polyps. The cœnenchyma is very thin, and covered with irregular imbricated scales. Axis hard and brittle, brown in the thicker branches and yellow in the younger. By its simplified scales, this species makes an approach to the genus *Calyptrophora*, Gray.

A few small branches, five or six inches long, were obtained in 324 fathoms off the Florida reef.

Gorgonia miniata Val.

A small dark crimson Gorgonian, obtained between 100 and 200 fathoms, may perhaps belong to this species. A comparison of the specimens could alone decide, as the description is rather scanty.

My specimens are 3 or 4 inches high, subflabellate; branchlets somewhat flattened at the end. Polyps in two rows, on moderately prominent verrucæ, more closely set than in *G. exserta*. Cœnenchyma rather thick, with fusiform spicules.

Gorgonia exserta Ellis and Solander.

The same Gorgonia which was obtained in the preceding year on the coast of Cuba, and referred to this species, was also brought up from 324 fathoms on the coast of Florida. Having no specimens for comparison, I do not feel quite sure of the determination.

Acanthogorgia hirta Pourt.

Corallum branching irregularly, subflabellate. Stem and branches of about equal thickness. Branchlets flattened and expanded at the end. Cœnenchyma covered with rough fusiform spicules, the upper end of which is free, and raised in the shape of small spires. Verrucæ rather distant on the stems, more numerous towards the ends of the branchlets, irregularly alternate, prominent, lobed, somewhat spinous. Polyps large, filled with long spicules, arranged in a regular pattern, being horizontal near the base, and at length in eight vertical rows, not as long as in most other species. Height about 4 inches; color gray. Dredged in 324 fathoms off the Florida reef.

This species differs from *A. aspera* Pourt. by its thicker stem and branches, less prominent, though thicker, verrucæ, and larger polyps with shorter spines.

Chrysogorgia Desbonni Duch. and Mich.

The specimens obtained by me in 324 fathoms appear to be more loosely branched, and to bear more numerous polyps, than the species to which I provisorily refer them. The figure given by the above authors is too deficient in details for a conclusive comparison.

The cœnenchyma is very delicate, filled with irregular scales, not imbricated. The sclerenchyma is rather brittle, smooth, yellow, of metallic appearance, resembling brass wire. The polyps are alternate, subpedunculate, numerous, though not contiguous, covered with scales like those of the stem, and closed by eight blunt lancet-shaped scales.

Acis solitaria Pourt.

Corallum never branching, five or six inches long. Cœnenchyma thick, covered with large, elongated, flat spicules, which become smaller and converging on the not very prominent verrucæ. Polyps in two rows, rather closely set; a few scattering ones out of line. No longitudinal furrow. Length 5 or 6 inches; color whitish.

In 200 fathoms.

Isis flexibilis Pourt.

Irregularly branching, subflabellate; branches very long and slender; calcareous joints cylindrical, nearly smooth, or with a few faint striæ, about four times as long as the corneous ones in the thicker branches, but proportionally much longer in the branchlets. Polyps rather thickly set, generally alternate, short, campanulate, armed with short spines. The thickest stems about $\frac{1}{16}$ of an inch in diameter, the branchlets not much thicker than horsehair; the main stems were not obtained. Color dark brown, from a thin cœnenchyma covering the younger branches.

In a few instances the branches appear to arise from the corneous joints.

In 324 fathoms off the Florida reef.

Mopsea eburnea Pourt.

Arborescent, slender, dichotomous. Calcareous joints long, cylindrical, faintly striated, seldom quite straight, not swollen at the ends. Corneous joints very short. (In one case a long straggling branch entirely corneous has grown from a calcareous joint, and bears four polyps.) Polyps scattered, bright orange, generally arising from the calcareous joints, but also, occasionally, from the corneous ones, surrounded by a spirally twisted bundle of strong spicules, of which eight longer ones project around the tentacles. The latter are pinnate, and strengthened in their whole length by a chain of blunt cylindrical spicules. The color of the whole corallum, with the exception of the corneous joints and the polyps, is pure white.

A fine specimen, 4 inches high, was obtained in 517 fathoms off Sombrero Light, Florida! — The diameter of the thickest part is $\frac{1}{16}$ of an inch; the root was not brought up.

Antipathes tetrasticha Pourt.

Corallum a simple stem, pinnate; the branchlets alternate and double, i. e. two branchlets starting from the same spot at an acute angle, thus forming four rows, two on each side of the main stem. Towards the base one of the branchlets of a pair is frequently abortive. Sclerenchyma black, nearly smooth, showing short spines only under the magnifier. No successive swellings on the branchlets as in *A. filix* Pourt. Polyps small. Height of the corallum 3 or 4 inches.

In 116 and 120 fathoms off Sand Key and the Samboes, Florida.

Antipathes sp.

Fragments of a very slender species were obtained off Sand Key in 26 fathoms, but not sufficient for identification. They are as thin as horsehair, and less, with short blunt spines, and small distant polyps.

Antipathes sp.

Irregularly branching, loosely subflabellate; sclepenchyma black, with very short and scarce spines. Polyps large, as in *A. arborea*, Dana.

Of this species, fragments were dredged up in 195 and 324 fathoms, presenting no very characteristic features in its mode of branching. I shall postpone its identification until an opportunity offers of comparing it with specimens of some of the other described species from the West Indies.

Caryophyllia cornuformis Pourt.

Corallum simple, conical, always regularly curved, distinctly but faintly costate. Calicle circular, rather shallow. Septa very little exsert, thin, and somewhat wavy; in six systems of four cycles. Pali opposite the secondary septa only, sometimes twisted. Columella of one or two twisted processes. Height $\frac{1}{4}$ of an inch; diameter of calicle $\frac{1}{8}$ of an inch. Dredged in 237 and 248 fathoms off Sand Key and the Samboes, Florida, on a bottom consisting of Foraminifera.

This species resembles a Ceratotrochus more than a Caryophyllia, but the single row of pali separates it from the latter genus.

All the specimens obtained have the base broken and apparently decayed, even when living, so that they are probably free when adult. One of them, still alive, was attached to the shell of a Xenophorus by the convex part of its wall.

Cœnocyathus vermiformis Pourt.

Corallum very elongated, cylindrical. Costæ indicated only by lines of very flat tubercles. Calicle circular, shallow. Septa rather thick, flexuose, not exsert in six systems of three cycles. Pali thick, flexuose, in front of the secondary septa. Frequently one of the systems remains incomplete, and there are then only five pali. Columella of a single twisted lamellar process. The older parts of the corallum are nearly filled up by the thickening of the septa, but the process is never carried out to a total obliteration of the chambers, which can be traced in the shape of slender canals to the very base. Height 1 to $1\frac{1}{2}$ inches; diameter $\frac{1}{16}$ to $\frac{1}{10}$ of an inch.

This small coral is easily mistaken for a tube of an annelid; it is placed in the genus Cœnocya thus, although I have no decided proof of its propagation by budding; in only one case have I found two corallites rising from a common base.

Dredged in 150 to 180 fathoms off Sombrero and Bahia Honda, Florida.

Paracyathus confertus Pourt.

Corallum turbinate, pedicellate. Costæ distinct to the base, not prominent, granulated. Calicle oblong, concave. Septa crowded, thin, entire, slightly exsert, in five cycles, but with considerable irregularity in some of the systems. Pali numerous, difficult to distinguish from the papillæ of the columella.

It resembles *P. De Filippii*, Duch. and Mich., but has a more contracted base and a more elongated calicle.

Rather rare in 50 to 100 fathoms off the Florida reef.

Thecocyathus cylindraceus Pourt.

Corallum attached by a broad base, short, cylindrical. Costæ generally visible through the epitheca which reaches to the border of the circular calicle. Fossa shallow. Septa entire, slightly sinuous, granulated, not exsert, forming six systems of four cycles; one of the systems often incomplete. Pali thick, with sinuous surfaces, fronting all the septa but those of the fourth and fifth order; those of the second order largest. Columella thick; formed of seven or eight papillose processes. Height $\frac{1}{2}$ to $\frac{3}{4}$ of an inch, diameter about $\frac{3}{8}$ of an inch.

Not rare between 100 and 200 fathoms off the Florida reef.

Rhizotrochus fragilis Pourt.

Corallum simple, pedicellate, straight or slightly curved, regularly conical. Calicle subelliptical, deep. Six complete systems of septa, four cycles. Septa very thin, not exsert, finely granulated; those of the first and second order meeting in the centre, and united for about half their height. Costæ not prominent. From the costæ of the second order rudimentary hollow roots arise in pairs at about one third or one half the height of the corallum, and descend along the pedicle to its foot; they are never detached. The wall and the septa are very thin and fragile. Height 1 inch; greater diameter $\frac{3}{4}$, smaller $\frac{1}{2}$ of an inch.

The color of the polyps is generally greenish, sometimes pale brick red.

Dredged in considerable number from 94 to 324 fathoms off the Florida reef; most abundant about 120 fathoms. It is frequently found growing on a living Cucullæa, much smaller than its parasite.

Oculina disticha Pourt.

Mode of branching unknown. Branchlets slender, with alternate calicles, distant about one diameter from each other. Costæ giving a plicated appearance to the border of the slightly prominent and moderately deep calicles. General surface faintly striated. Septa of the first and second order well developed, those of the third rudimentary, all finely granulated and dentate. Pali fronting the septa of the first and second order. Columella formed by one or two papillæ.

A few dead branchlets only were obtained in 43 fathoms off the American shoal, Florida. They bear a general resemblance to the fossil *Diplohelia raristella*, but the presence of pali prevents the generic association of these corals.

Diplohelia profunda Pourt. (Bull. Mus. Comp. Zoöl. No. 6.)

A few small pieces of this coral were obtained in 324 fathoms off Bahia Honda, Florida. They are in rather a decayed condition, like nearly all the specimens of this species that I have ever seen.

Lophohelia affinis Pourt.

Corallum branching irregularly, sometimes coalescing; the polyps budding in alternate series from the border of the calicle. Surface smooth, or very finely granulated. Calicles very deep. Septa smooth, entire, exsert. Systems unequal. No columella. Color white; polyps flesh-colored, with about twelve club-shaped tentacles, hiding the mouth when contracted. Dredged in some quantity in 195 fathoms off Coffin's Patches, Florida, but no trace of it was found in the numerous other dredgings in the vicinity.

I am unable at present to distinguish this coral from *Lophohelia prolifera* Edw. & Haime (*Madrepora prolifera* Pallas), except that the latter has the calicles a little less expanded, as figured by Ellis. It is rather singular that the largest coral of northern Europe has never been figured since Esper, whose representation is much inferior to Ellis's.

Stylaster erubescens Pourt.

Branching densely, flabellate, not coalescing; younger branchlets slender, with rather dense alternate calicles; older branches much thickened with calicles in irregular rows on one surface, interspersed with ampullæ. Cœnenchyma smooth. Calicles slightly prominent, about $\frac{1}{30}$ of an inch in diameter, deep. Septa nine to twelve, most commonly eleven, equal, shaped like folds of the wall, joined with each other at a little distance below the edge of the calicle, and thus forming pitlike interseptal chambers. Each one of these chambers encloses a small secondary septum in the shape of a dense vertical fringe of small points resembling hairs, which, when seen foreshortened from above, appears like a small columella.* Columella deep sunk rounded, and hirsute. Color white, with a delicate pink blush when fresh. Dimensions, 4 to 6 inches in length and breadth of flabellum. Rather common between 120 and 324 fathoms off the Florida reef.

Some of the branches are thickened and hollow, with openings near the end; and the cavities are inhabited by annelids, as has also been noticed by Professor Verrill, in *Allopora californica.* In our specimens the tube seems to be entirely formed by the coral, the annelid contributing nothing himself.

Allopora miniata Pourt.

Corallum branching, flabellate, the main trunk rather massive and flattened. Surface finely and sharply granular. Branchlets thick and obtuse. Calicles irregularly but densely distributed on one surface of the branches, becoming obsolete on the main trunk. Small ampullæ abundant between the calicles on the younger branches. Calicles slightly prominent about half a line in diameter, fossa deep, columella spherical, deeply immersed, hirsute. Septa from seven to ten, generally eight, formed as in *Stylaster erubescens*, but the enclosed secondary septa are much larger and distinct, giving the appearance of a calicle surrounded by a number of smaller ones, all pr[illegible]ded with columellæ. [illegible]ge of the calicle and of the folds is crow[illegible] with small sharp points.

The [illegible] to have grown in a horizontal trailing manner, as the lower surfac[illegible]n shows signs of contact with foreign bodies.

Color brick red; length, 5 or 6 inches; breadth, 3 or 4 inches. Dredged in depths from 100 to 324 fathoms off the Florida reef, not as frequently as *Stylaster erubescens.*

This species is the most massive of our deep-sea corals; it undoubtedly belongs to the genus Allopora as defined by Milne-Edwards & Haime, if

* This arrangement is particularly apparent in *Allopora miniata* next described, where it was first noticed. It is very distinct also in *Stylaster complanatus* Pourt. I have seen it also in *St. roseus*, Edw. & Haime, *elegans*, Verrill, *tenuis*, Verrill, and *Allopora californica*, Verrill (very distinct); but I failed to see the small septum in *Allopora bella*, Dana, where it is probably more deeply seated, as is the small columella. The character of closed interseptal chambers, containing or not small secondary (or tertiary?) septa, being so general, I see no necessity for separating the genus *Cyclopora*, Verrill, from the true *Stylasters.* This character, furthermore, unites still more closely the genera *Stylaster* and *Distichopora;* in *Errina*, also, the pores mistaken by Gray for calicles are probably only interseptal chambers, soon separated from the calicle by the irregular growth of the cœnenchyma.

we leave out from their generic characters the absence of ampullæ. The two genera Stylaster and Allopora are, however, very closely allied, and in very young specimens the difference in the mode of germination is hardly to be distinguished.

Distichopora foliacea Pourt.

Corallum branching, flabellate, much compressed, finely striated and granulated. The calicles in a somewhat irregular row a little on one side of the edge, which is sharp and finely serrated. One of the rows of lateral pores on the summits of the denticulations, the other not well defined, represented by scattered tuberculated pores. The plane towards which the calicles are situated is thickly studded with ampullæ, each of which has a small lateral opening. They are less numerous on the other surface. Columella deep-seated, but long, hirsute, in the shape of a pointed club. Color orange pink. Height about 2 inches; breadth of the branches about $\frac{1}{4}$ of an inch; thickness $\frac{1}{20}$ of an inch.

This species differs from *D. sulcata* Pourt., from the coast of Cuba, by its smaller calicles not placed in a furrow, irregular lateral pores, and serrated edge.

Dredged rather frequently between 100 and 200 fathoms off the Florida reef.

Errina cochleata Pourt.

Of the two species of Errina found quite abundantly on the coast of Cuba, only this one is found on the Florida side, and that is exceedingly rare, only one small specimen having been obtained in 183 fathoms off Sombrero Light-house.

Balanophyllia floridana Pourt.

Corallum elongated, conical, straight, pedicellate. No epitheca; wall porous, costate to the foot. Calicle rather deep, elliptical. Septa entire, slightly exsert, finely granulated, in six unequal systems of four cycles, with rudiments of the fifth in some of the systems. The septa of the fourth cycle, bent and united in front of the tertiaries, and protracted as one septum to the columella, which is flattened and papillose.

The polyps are red; the mouth very oblong; height about 1 inch; longer diameter $\frac{1}{2}$, shorter $\frac{3}{8}$ of an inch.

Dredged in abundance off Sand Key, Florida, in 26 fathoms. I refer also to this species some dead and worn specimens obtained off the coast of Cuba in 270 fathoms.*

* A *Dendrophyllia* was also obtained in the same dredging off the coast of Cuba, but too much worn to be identified or described.

Genus Thecopsammia Pourt.

Corallum simple, attached, without costæ, covered with a complete epitheca. This genus is intermediate between Balanophyllia and Heteropsammia; like the latter, it is destitute of costæ, but it has an epitheca like some of the Balanophyllia, but still more developed.

Thecopsammia tintinnabulum Pourt.

Corallum subcylindrical, or almost hemispherical, with turbinate base and small, abruptly constricted peduncle. Wall thick, very porous and vermiculated. Epitheca well developed, seldom rising quite to the border of the calicle, its tissue penetrating the mural pores and solidifying the wall. Calicle slightly elliptical, moderately deep. Septa in six unequal systems and four cycles, entire, thin, not exsert, covered with fine granulations; those of the fourth and fifth order scarcely bent towards those of the third, and not connected with the latter or with each other. The septa of the first and second order connected with the columella. The two opposite systems on the longer sides of the calicle always incomplete in one of their halves; and one or two of the other systems also sometimes incomplete in the same manner. The columella is papillose and porous, sometimes sublamellose, and forms three indistinct masses in the adult, of which the middle one is largest.

Height $\frac{3}{4}$ of an inch to an inch; longer diameter of calicle about $\frac{1}{2}$ an inch, shorter about 0.44. Common between 100 and 300 fathoms off the Florida reef.

The mouth of the polyps is elongated, and surrounded by not very numerous conical tentacles; the color, when living, is a handsome pinkish orange.

Thecopsammia socialis Pourt.

Corallum turbinate, rather long conical, with a thick, not constricted, peduncle frequently attached to each other. Wall and epitheca as in the preceding species. Calicle elliptical, fossa moderately deep. Septa entire, smooth, crowded, not exsert; thick, near the wall. Five cycles of septa in six unequal systems. The septa of the fourth cycle bent towards each other, and meeting in front of those of the third, in the deeper part of the calicle (only visible in a horizontal section). The septa of the sixth and seventh order appear only in a few of the systems in old specimens; they become larger than those of the preceding cycle; the tertiaries generally remain the smallest of all. The columella is papillose and porous, though more compact than in the preceding species, and nearly always forms three distinct masses, of which the middle one is largest.

Found in the same depths as the other, but more common towards Sombrero than near Sand Key.

Stephanophyllia folliculus Pourt.

Corallum free, without mark of adherence, purse-shaped, or broader at the base than at the calicle. Costæ broad, granulated, nearly meeting at the apex, the primary ones continuous, the tertiaries uniting with the secondaries. Intercostal furrows narrow. Calicle circular or subhexagonal, slightly concave. Septa in six complete systems of three cycles, covered with large papillæ, not exsert. The primaries and secondaries meet in the centre with each other, and with an indistinct columella; the tertiaries connect with the secondaries at about half the length of the radius.

Height 0.12, diameter of calicle 0.10, diameter of base 0.11 of an inch. Dredged in 237 fathoms off the Florida reef.

I refer this coral, of which I have but one specimen, to the genus Stephanophyllia with some doubt. It has most of the characters of the genus, except the discoid shape. It is, most likely, a very young specimen.

Diaseris pusilla Pourt.

Corallum subelliptical, very fragile. Wall flat or slightly concave, imperforate, very thin, finely costate. Costæ thin, alternatively large and small, finely dentate. The base shows the traces of lobes joined together, often very imperfectly. Septa strongly dentate, laciniate, and perforate, marked with strong ridges and furrows, connected with each other by synapticula near the base. Six unequal systems and five cycles of septa, one or two of the systems generally incomplete. The primary septa more lobed and much higher than the others; those of the lower cycles tending to unite with those of cycles preceding them. Fossa well marked, oblong. Columella rudimentary, in the shape of a narrow ridge. Mouth of the polyp in the shape of a long slit. Color dark brown. Diameter ½ an inch.

Numerous fragments of the living coral were obtained, but it is so fragile that only one was brought up entire. Found in 119 to 143 fathoms off Sand Key.

I suspect from some of the fragments the existence of a second species, with more equal, not lobed septa, and less distinctly costate base, but there is not enough of it for a good description.

The singular Coral next to be described strikes one at first sight by its resemblance to some of the members of the group of the Rugosa of Milne-Edwards & Haime. A closer examination tends to confirm that view, much as it seems improbable to find a living representative of a group so long extinct. In no other division of the corals is the septal apparatus subdivided into systems that are multiples of four; but such is the case in our specimen, though a little obscured by accidental causes. Another, though perhaps less important, character is the smoothness of the septa, which present neither perforations, nor synapticula, nor granulations.

Tabulæ, however, there are none, the interseptal chambers being open from top to bottom. Among the Rugosa this character is only found in the family of Cyathaxonidæ, to or near which, therefore, our coral must find its place. From the genus Cyathaxonia it differs in being attached by a broad base, and also by the absence of a septal fossula. The following genus is proposed for its reception : —

Genus Haplophyllia Pourt.

Corallum simple, fixed by a broad base, covered with a thick epitheca; columella styliform, strong, (sometimes double ?) very thick at the base. Interseptal chambers deep, uninterrupted by tabulæ or dissepiments.

Haplophyllia paradoxa Pourt.

Corallum subcylindrical, short, fixed by a broad base; epitheca thick, wrinkled, reaching higher than the calicle, and forming around the latter several concentric circles, as if representing the separated borders of several superposed layers. Calicle circular, fossa deep. Septa smooth, without granulations or perforations, not reaching the border of the calicle; like all the internal parts of the calicle, their surface is like enamel. Columella formed of two smooth conical processes, very thick at the base and tending to fill up the chambers. Eight septa larger, and connected with the columella, alternating with smaller ones, which touch the columella at a much lower level. A further cycle is indicated by small ridges of the wall surface, in some of the chambers. No distinction can be made between primary and secondary septa among the eight larger ones, as they all appear equal. This arrangement seems to be the norm. In the specimen before us, the only one unfortunately, there are disturbances in two of the systems or half-systems (systems if we call the eight larger septa primaries, half-systems if we suppose them equivalent to primaries and secondaries). In one case two of the larger septa are joined by a horizontal plate at the top, thus excluding the intervening chamber from the calicle. This structure is probably abnormal, and the result of an effort to exclude a parasite or other foreign matter. A small supernumerary septum has grown out in the next chamber. Nearly on the opposite side of the calicle, one of the secondary septa (counting eight as primaries) has grown to the size of a primary one, and the adjacent tertiary to the size of a secondary, thus disturbing the symmetry.

Height about ½ an inch; diameter of calicle the same.

This coral was living when obtained; the polyp was of a greenish color, but was not otherwise examined when fresh. After having been in alcohol, it could be lifted out entire from the calicle, presenting an exact cast of the chambers. The mouth is surrounded by a circle of about 16 rather long tentacles, bluntly tuberculated at the tip. Outside the circle of tentacles extends a membranous disc with radiating and concentric folds.

This unique specimen was dredged in 324 fathoms off the Florida reef.

Genus Pliobothrus Pourt.

Tissue more compact than in Millepora; larger pores scarcer, smooth, without any rudiments of septa; smaller pores tubulated; cœnenchyma with still finer linear pores. Form generally branching regularly. Differs from Heliopora by its tissue not being prismatic. I refer to this genus two species described by me as *Heliopora tubulata* and *carinata* (Bulletin Mus. Comp. Zoöl. No. 6), and a third species.

Pliobothrus symmetricus Pourt.

Corallum ramose, rising from an incrusting base and a short trunk, branching into a regular semicircular flabellum. Branches not much divided, cylindrical, and a little flattened and expanded at the tip, which is blunt and rounded. The tendency in branching is towards considerable symmetry between the two halves of the flabellum. Three kinds of pores; very small, linear, over the whole cœnenchyma; larger tubulated, with very minute aperture when unbroken, and larger round or oval ones scattered irregularly. Internal structure somewhat like Millepora, but much coarser. Larger pores interrupted by few but massive tabulæ, but communicating laterally with other canals.

This species is much larger and more branched than *Heliopora tubulata*, and has shorter tubes to the pores.

Color gray; height 1½ inches; spread about three inches; diameter of branches 0.63 of an inch. Not rare between 100 and 200 fathoms off the Florida reef.

Cambridge, Mass., December 8, 1868.

I deeply regret the absence of Count Pourtales from Cambridge at this moment, even though his return to the field of observations which has already yielded him such a rich harvest cannot fail to benefit science in the highest degree. My regret arises chiefly from the fact that he is thus prevented from reaching some conclusions which belong to him by right. But the very day he started on his third journey of exploration in the Gulf Stream, leaving with me the manuscript of this paper for publication, the memoir of Sars on the *Rhizocrinus* of the Lofoten reached me also, and I at once recognized the identity of the *Bourgueticrinus Hotessieri,* described above, with Sars's *Rhizocrinus lofotensis,* — as far as such relations can be predicated without a direct comparison of the specimens. The identity of animals found at great depths in the Gulf of Mexico and on the coast of Norway would show how extensive the influence of the great Atlantic current is in modifying the geographical distribution of organized beings. The close resemblance of these Crinoids will no doubt lead to a renewed comparison of the *Lophohelia affinis* Pourt. and *Lophohelia prolifera* Milne-Edw. & Haime (*Madrepora prolifera* Pallas). It is now highly probable that Pourtales's species is identical with that long known from the northernmost coasts of Europe, and to which it has very likely been transported by the Gulf Stream; and I doubt not that the identity of other species from Florida, in which a close resemblance to northern species has already been noticed, will also prove identical, as soon as an opportunity is afforded for direct comparisons. Thus happily blended with the investigation of the Gulf Stream, the study of the geographical distribution of animals at great depths cannot fail to make rapid progress, now that — thanks to the comprehensive views of the Superintendent of the Coast Survey — it will no longer be left to chance discoveries, but form a part of the systematic work of the Survey. In this connection it becomes highly important to explore the ocean floor in the vicinity of the Bermudas, as those islands form, as it were, a half-way station between Florida and Norway. On the other hand, the discovery of a coral, Haplophyllia, allied to the extinct type of the Cyathaxonidæ, foreshadows unexpected revelations, as soon as the animal population of the abysses of the ocean shall be extensively explored, instead of being obtained from a few localities only.

I may add that the Museum will supply other institutions with specimens of all the species described above of which duplicates were collected.

LOUIS AGASSIZ.

Cambridge, December 10, 1868.

No. 8. — *Catalogue of the Mammals of Massachusetts: with a Critical Revision of the Species.* By J. A. ALLEN.

THE original design of the present catalogue was simply to contribute a few data concerning the distribution of the Mammals of New England; but in order to explain certain views entertained by the writer in respect to the character of a number of currently received species, many critical notes were gradually incorporated, until finally it was thought best to extend the paper so as also to embrace a systematic revision of the species. The catalogue is based mainly on observations made by myself at Springfield. In its faunal characteristics this locality does not differ much from those parts of the State lying east of the Connecticut River generally. A few species which occur only in the western mountainous portions have been included on data afforded chiefly by the official report on the Mammals of the State by the late Dr. Ebenezer Emmons, but in part as the result of observations and inquiries of my own recently made in that section. Respecting the marine species, I have consulted Captain N. E. Atwood, of Provincetown, a gentleman well known as a reliable observer, and whose forty years' experience along our coast has rendered him very familiar with our larger marine Vertebrata. I have thus been able to add not a little to our knowledge of some of those species least known, and the most difficult to observe, of all our Mammalia. The great obligation I am under for his kind co-operation is fully evident from the valuable notes he has furnished on the Cetaceans. I am also greatly indebted to Professor E. D. Cope, of Philadelphia, to whom I transmitted the notes of Captain Atwood, for kindly identifying the species.

Less attention seems to have been paid by our naturalists to the Mammals of the State than to the Birds, or several of the other classes of our animals. This may be owing to the greater difficulty of observing and procuring the former, arising from either their scarcity or reclusive habits.

The first general scientific notice of Massachusetts Mammalia seems to have been a simply nominal catalogue by Dr. Edward Hitchcock, published in his Report on the Geology, Mineralogy, Botany, and

Zoölogy of the State (pp. 526, 527), in 1833. Forty-five species are there given, including the two Seals and three Cetaceans. To a few only are notes added respecting their relative abundance. Dr. Emmons's first Report, under the Act of the Legislature of 1837 for a Natural History Survey of the State, was published in 1838. In 1840 a second and final Report* was presented, containing the substance of the first, and considerably increased by additions. These Reports contain descriptions of all the land Mammalia then known to inhabit the State, with interesting notes on their habits and distribution, but nothing on the marine. The whole number of species given is forty-four, two of which (*Arvicola hirsuta* = *A. riparius*, and *A. albo-rufescens* = *A. riparius*, albino) were erroneously described as new. Eliminating three that have since been reduced to synonymes (*Condylura macroura*, *Sciurus niger*, *Arvicola albo-rufescens*) leaves forty-one as the number of valid species embraced in this report. The animal now known as *Hesperomys leucopus* Baird was described as *Arvicola Emmonsii* De Kay. On the whole, however, the work is remarkable for its accuracy, and, compared with those of most recent writers, for the small number of merely nominal species it contains.

The only other special treatise on our Mammals is an article by Mr. E. A. Samuels, in the Ninth Annual Report of the State Board of Agriculture,† in which thirty-nine species are described, excluding two merely nominal (a *Blarina* and *Arvicola rufidorsum*), mainly from Massachusetts specimens in the State Cabinet of Natural History; it also contains notes on their habits, and several woodcuts of the animals. Though not assuming to give all the species of the State, Mr. Samuels includes five or six described since the publication of Dr. Emmons's Report, but omits several of that author that are not uncommon in certain sections of the State, as well as all the marine species. In Audubon and Bachman's "Viviparous Quadrupeds of North America" (three volumes, 8vo, 1846 – 1853) are numerous references to Massachusetts Mammals, specimens of which were frequently furnished these authors by our well-known ornithologist, Dr. T. M. Brewer, of Boston. But since the publication of Dr. Emmons's Report, no one, excepting perhaps Dr. Brewer and

* Report on the Quadrupeds of Massachusetts. By Ebenezer Emmons, M. D. 1840. 8vo. pp. 86. This is the edition cited in the following pages.

† Agr. of Mass., 1861, pp. 137 – 191.

Mr. Samuels, has done more to increase our knowledge of their history than Mr. J. W. P. Jenks, of Middleboro'. From this locality Mr. Jenks has sent large collections of the smaller species to the Smithsonian Institution, which have been carefully worked up by Professor S. F. Baird in his invaluable Report on the Mammals of North America,* and by Dr. H. Allen in his recent excellent Monograph of the North American Bats.† In the Journal and Proceedings of the Boston Society of Natural History, among the very few notices of our Mammals, is an important paper by the Rev. John Bachman on the Mole Shrews (genus *Scalops*),‡ in which a new species (*S. Breweri*) is described from specimens from this State contributed by Dr. Brewer. In Professor Baird's Report on North American Mammals two species of *Arvicola* (*A. Breweri* and *A. rufidorsum*) are also described as new, solely from specimens from Massachusetts; the first was collected by Dr. Brewer on Muskeget Island. (On these see remarks beyond.) In February, 1863, Professor A. E. Verrill mentions, in a valuable contribution on the Shrews of New England,§ the first known occurrence of a *Neosorex* (*N. palustris*) in this State.

The more important publications on the Mammals of adjoining States, which in this connection demand a passing notice, are the Rev. J. H. Linsley's "Catalogue of the Mammalia of Connecticut,"|| Dr. J. E. De Kay's well-known Report on the Mammals of New York, and Professor Zadoc Thompson's notes on those of Vermont.¶ Mr. Linsley's list numbers seventy-one species, embracing the marine and domesticated, and nine that are merely nominal. Removing the latter, the eight domestic, and two ("*Arvicola floridanus* Ord" and "*Phoca grœnlandica?* Mull.") of doubtful reference, leaves fifty-two as the number of valid indigenous and naturalized species (the latter being the three species of *Mus*), ten of which are marine and the remaining forty terrestrial. Two bats (*Vespertilio subulatus* Say and *Scotophilus noctivagans* = *V. noctivagans* Cooper) and one shrew (*Sorex platyrhinus*) are given in

* Pacific Railroad Reports of Expl. and Surv., VIII, 1857.

† Monograph of the Bats of North America. By H. Allen, M. D. Smithsonian Miscellaneous Collections, June, 1864.

‡ Proc., Vol. I, p. 40, 1841; Journ., Vol. IV, p. 46, 1842.

§ Proc. Bost. Soc. N. H., Vol. IX, 164.

|| Am. Journ. of Science and Arts, XLIII (Oct. 1842), pp. 345–354.

¶ History of Vermont, Natural, Civil, and Statistical, etc. By Zadoc Thompson. 8vo. Burlington, 1842, and Appendix, 1853.

addition to the land animals described in Professor Emmons's Massachusetts report, while two of Emmons's *Cervidæ* and the Wolverine are very properly omitted.

Dr. De Kay's Report, which appeared but a few months later than Linsley's Catalogue, gives seventy-eight species as either actual or former inhabitants of the State of New York, including, in addition to the domestic and marine species of Linsley's list, five fossil species. No new ones are added, though several are described as such, and several previously well known are separated from their supposed distinct European allies and receive new names. Two species given by Linsley for Connecticut ("*Arviçola floridanus* Ord" and "*Phoca grœnlandica?* Mull.") are rightly omitted, and others, including the Opossum (*Didelphys virginiana*), added. This is a southern species which has not yet, so far as I can learn, been detected east of the Hudson. Deducting the nominal species and those of doubtful reference, nine in number, and the eight domestic and five fossil, leaves fifty-six as the number of living valid ones, forty-six being land and ten marine. This is an excess of four only, — two bats and two very small species of shrew, — excluding the marine and the extra-limital *Didelphys virginiana*, over the number given by Dr. Emmons for Massachusetts.

Professor Thompson's Natural History of Vermont, published at about the same time, contains forty-three valid species, with descriptions of them drawn up mainly from Vermont specimens, and short general accounts of their habits. It embraces but one or two species not given in Dr. Emmons's report, one of which is the common Seal (*Phoca vitulina*). A single specimen of this is reported to have been captured on the ice in Lake Champlain, and in the Appendix, published in 1853, another similar instance is recorded.

The present catalogue embraces sixty-five species, giving for the first time a probably nearly complete list of the marine, the Seals and Cetaceans. The latter are now supposed to number eighteen species. Four land species (*Scotophilus georgianus*, *Scalops Breweri*, *Neosorex palustris*, and *Arvicola pinetorum*) are also added, that are not mentioned by either Dr. Emmons or Mr. Samuels, or by either of the extra-limital authors mentioned above.

In Massachusetts, as far as Mammals and Birds are concerned, portions of two Faunæ are represented,— the Canadian and the Alleghanian;

the former occupying a large part of Berkshire and most of the western half of Franklin, Hampshire, and Hampden Counties, or those portions of the State having an elevation of and above fifteen hundred feet above the sea ; the latter the remaining and by far the larger portion.*

The recent or historic changes that have occurred in the Mammalian Fauna of the State consist mainly in the decrease in numbers of the larger species, amounting to a complete extirpation of a few of the large Carnivora and Cervidæ (*Felis concolor*, *Mustela Pennantii*, *Cervus canadensis*, *Alce malchis*, *Tarandus rangifer*), and the great reduction, almost to extinction, of several others (*Lynx canadensis*, *Lynx rufus*, *Canis lupus*, *Ursus arctos*, *Cervus virginianus*). None of these species are now anywhere common, though there is good reason to believe that several of them were once so, while a few are known to have been of very frequent occurrence. The smaller species, including most of the rodents, the bats, moles, and shrews, seem to be fully as numerous as they ever were, while it is not improbable that a few, especially the *Arvicolæ* and other field mice, and perhaps the woodchuck (*Arctomys monax*), are even increasing in numbers. The three species of exotic or eastern origin are the now almost cosmopolitan *Mus decumanus*, *M. rattus*, and *M. musculus*, which long since became annoying pests, and constitute the only additions to our feral Mammalia that have become fully naturalized.

Several of the species of this list are considered to be identical with species of the Old World, although most late writers have separated as specifically distinct all but one of our New England Mammals — the *Gulo luscus* — from their Old World relatives. Only two or three species of land Mammalia are now generally considered as common to any portions of both the Eastern and Western hemispheres.† Several

* The Canadian fauna, as represented in Massachusetts, may be characterized by the present or former occurrence among Mammalia of the following species: *Mustela Pennantii*, *M. martes*, *Gulo luscus*, *Alce malchis*, *Tarandus rangifer*, *Cervus canadensis*, *Arvicola Gapperi*, and *Erethizon dorsatus*. The Alleghanian may be distinguished by the absence of the preceding and the presence of *Vulpes virginianus*, *Scalops aquaticus*, *S. Breweri*, *Sciurus cinereus*, *Arvicola pinetorum*, and *Lepus sylvaticus*, which do not occur in the Canadian fauna.

† The same is also true of the land birds, while a large proportion of those marine species that are probably really common to both sides of the Atlantic are regarded as distinct. It should be observed, however, that the separations in both classes have been made mainly by the same persons. On the other hand, the highest authorities in entomology admit many species to be common throughout the northern hemisphere, par-

others, particularly of the genera *Arvicola* and *Blarina*, currently received as valid, are here treated as merely nominal. While our reasons therefor are given somewhat fully in their proper connection, a few general remarks in further explanation seem called for here.

In the present greatly increased state of our knowledge of American mammals, not a few characters once very naturally considered of great importance in a specific diagnosis are to be regarded as far from decisive, they now being known to be dependent either upon age, season, or locality, or to be mere individual variations. A difference in size, for instance, is at present well known in mammals, as well as in birds, to almost universally accompany differences in the latitude and elevation of their respective habitats, the southern representatives of species widely diffused being very appreciably smaller than the northern. The difference between the extremes amounts not unfrequently to nearly one sixth, and occasionally even to one fifth, of the average size, so that, considered apart from the connecting stages afforded by representatives from the intervening districts, they might well be regarded as belonging to distinct species. It is also now well known that mammals vary geographically in respect to color, though not yet fully to what extent, and also in the character of the pelage. These latter facts have been long recognized practically in respect to the fur-bearing species, but it appears equally true of most of the others. Experienced trappers and fur-dealers readily distinguish the Mink and Sable skins of the north from those of the south, by the comparatively greater fineness, density, and length of the fur of the northern animal;* similar differences are equally evident in the pelage of the Wolves, Foxes, Lynxes, and Hares. This difference is similar to that observable between winter and summer specimens from the same locality, the northern corresponding in the character of the pelage to the winter and the southern to the summer ones. The resemblance is perhaps still more striking in regard to the

ticularly among the Hymenoptera, Neuroptera, and Coleoptera, and not a few are regarded as primitively almost cosmopolitan. The same is true in regard to plants, quite a large proportion of the species of the northern North American flora being considered identical with European and Asiatic. Hence we naturally inquire, Is there really this discrepancy in the distribution of species in the different classes of organized beings, or is it only apparent through the biased opinions of one or the other of these schools of observers?

* In the case of the Minks, those of the prairies are distinguished as readily from those inhabiting the adjoining wooded districts, the former having coarser and browner fur, the difference being sufficient to materially affect their price in the market.

clothing of the feet, species with the soles thickly furred in winter often having them sparsely so in summer, northern individuals differing in like manner from southern. The variation in this respect increases with the distance in latitude between the localities whence the specimens compared are taken.

Besides these geographical or climatic variations, we have found by a careful comparison of scores of specimens of the *same species, collected at the same locality*, that there is a much greater range of variation between individuals of the same species — the variation extending to every part — than is commonly conceded; and also that differences depending upon season,* as in the color, thickness, length, and general texture of the pelage, and others depending upon age * and sex, instead of being always recognized by authors as such, have not unfrequently been taken to indicate a constant specific diversity. From this cause there has arisen, in numerous instances, an undue increase of so-called species. *Specimens* have too often been described instead of *species*. It is not surprising that these mistakes should have happened in the earlier days of our science, when the material for study was scanty and diagnoses were commonly drawn up from stuffed skins, the authors being in total ignorance of the appearance of the animal in life; when the extent of individual variation had not been especially investigated, and it was unknown that in animals possessing a wide distribution there were marked variations accompanying wide differences in locality. But even now

* In spring, as is generally well known, mammals shed the long, thick coat worn in winter; this is replaced by a much shorter, thinner, less soft, and generally differently colored pelage. In this there is a gradual change throughout the summer, and late in fall it becomes either entirely replaced or effectually concealed by the growth of the long winter coat. The winter differs from the summer pelage not only in being longer and thicker, but generally in the different character of the hair composing it, and in the fulness of the soft under fur, as well as more or less in color. The shortness of the summer coat renders the ears of such animals as have these members very short, as the different species of *Arvicola*, *Sorex*, *Sciurus*, &c., much more conspicuous at that season than in winter, when in some of them they are nearly concealed. In young animals, too, the first pelage differs much from the succeeding, being shorter, darker, and generally more or less crisp. The general health of the animal, as no one need be told who has attentively observed domestic animals, has a marked effect upon the character of the coat, and on the time it is changed, as does also scantiness or abundance of food.

As previously stated in the text, species with the soles of the feet furred have them less densely so in summer than in winter. It is perhaps needless to advert to the fact of the existence of a temporary set of teeth in young animals, which gradually give place to a permanent one differing from the first in number and character.

but few mammalogists have come to recognize these variations as manifestations of general laws, and we are consequently scarcely surprised at the glaring inconsistencies into which even our best authorities are frequently betrayed, they at times assigning to these several variations their true character, and again, in apparently equally clear cases, considering them as indications of specific diversity. It thus happens that species are still not unfrequently based solely on differences that are but individual peculiarities, from these differences being first detected in comparing specimens from widely separated districts, whereas they are not different from variations presented by occasional specimens of the same species at any given locality. Oftener still, perhaps, species are founded on slight geographical variations, either solely or in connection with exceptional individual peculiarities, or on differences depending upon age. A remarkable instance of this latter kind seems to have occurred in our *Sorecidæ*, and especially in *Blarina*, where no less than eight at present currently received species are apparently based on one. Imperfectly understood sexual variations, associated with other differences, in some cases render the complication still greater. This occurs in the *Mustelidæ*, where the female is found to be very much smaller than the male in almost or quite all species when the sexual differences are well known. In the weasels the large amount of this difference seems to have thus far generally escaped notice, especially by American writers. As wide a range of variation, aside from the sexual, obtains in these as in their near allies, the mink and the marten. In this group, differences in size and in the relative length of the tail as compared with the body — the latter an extremely variable element — have been taken as important specific distinctions, and on these grounds alone some five species (so called) appear to have been based on two.

In respect to the differences that have been claimed to separate specifically the Old and the New World representatives of those species in this paper considered identical, only those of very slight importance have as yet been adduced; they are only such as might be anticipated to occur when, as has repeatedly happened, the comparisons have been made between only a few specimens known to have been collected at localities widely differing in latitude, and hence in climatic conditions, and at different seasons of the year. More frequently, however, the exact origin and history of the specimens compared appears to have been wholly unknown. In no case are the differences greater, but generally less, than those presented by specimens from different localities on the same continent, where the species is admitted to be the same; sometimes not greater than is seen at the same locality. From similar unsatisfactory comparisons, and undoubtedly in part from theories of distribution, representatives from distant points in the United States of species ranging from the Atlantic to the Pacific have been described as distinct species. Not till large series of specimens from hundreds of localities have been carefully compared can all these disputed points be properly settled, through the tolerably exact determination of the influence of "locality on the individual"; and we believe that no work more important than this can at present be done.

In this connection I can hardly avoid a word or two in reference to the spirit which evidently incites many zoölogists in their researches. I refer, of course, to that eagerness for describing "new species" so patent in all their publications, — an influence highly derogatory to the advancement of scientific knowledge. It tends to divert attention from such a critical study of those species living in the naturalist's immediate vicinity as will alone acquaint him with the amount of variation a species may be expected to present.* Only by such a preparation can one be prepared to estimate properly the character and value of differences presented by specimens from remote districts, of which only a limited number of prepared examples can be examined. Almost all writers on the different classes of Vertebrata have fallen in a greater or less degree into the fault of describing species as new from either improper or insufficient material, or of founding them on characters that a critical study of numerous fresh specimens of a few well-known species would have shown were of very slight, and often of even no value as specific distinctions. The inquiry with many naturalists respecting doubtful specimens seems rarely to be whether they may not be referred to some already known species, and the points of resemblance to their nearest known ally accordingly carefully weighed against the differences, but rather are not they sufficiently different to warrant a description of them as new species. This greediness for *species nova* renders it

* In respect to Birds, I have already called attention (Memoirs Bos. Soc. Nat. Hist., Vol. I, p. 512) to the importance of collecting and comparing a very large number of specimens from the same locality, to learn the extent of the variation a species may present at the same point; it is no less essential in Mammals, where seasonal variations and those depending upon age are not always so evident.

difficult to eradicate from our systems those even but doubtfully admitted when once they have been proposed by authors high in authority, such species being ultimately accepted without having ever been scientifically established. Authors afflicted with this mania rarely reject any species of their contemporaries, but they virtually indorse the doubtful ones by adding others of their own based on similar characters. The great proportion of merely nominal species hence annually added to our lists is a detriment to science deeply to be regretted.

Perhaps the strictures contained in this article will by some be deemed too severe; they are nevertheless made, not only reluctantly and in all cases without the slightest personal feelings, but from a conviction of their necessity, and with the sole object of advancing the truth. Gladly would I have left to others the unpleasant task.

While much of the material forming the basis of this list has been, as previously stated, that of my own collecting at Springfield, I am deeply indebted to the Museum of Comparative Zoölogy for additional data, and especially for a large amount of invaluable material for the revision of the species.* It has also afforded me the opportunity of comparing American with European specimens of the species of *Mustelidæ* and *Canidæ*, and of examining specimens of most of the Mammals of North America. The very complete collection of Massachusetts mammals in the Springfield Museum of Natural History, mainly collected and prepared by Mr. C. W. Bennett, embracing as it does several unique specimens, has likewise been freely consulted, and with much profit. I have already referred to my indebtedness to Captain N. E. Atwood, of Provincetown, for notes on the Cetacea, and to Professor E. D. Cope for the identification of the species of this group.

The names used in Dr. Emmons's Report are generally added as synonymes when different from those now adopted. A tabular comparison of the species given by Dr. Emmons from this State, by Dr. De Kay from New York, and by Mr. J. P. Linsley from Connecticut is made with those of the present list, in order to indicate their synonymy. In general only such synonymes are given, always from original examination, as are necessary to render clear the views of the writer on the

* Probably no other Natural History Museum in the world affords facilities for the investigation of the individual variation of species equal to those presented by the immense collections of New England, and especially Massachusetts, Vertebrata contained in this Institution, brought together by the Director in great part for this especial purpose.

points in question. The thorough and exhaustive manner in which this part of the subject has already been treated by Professor Baird and Dr. Allen has rendered anything further than this unnecessary.

FELIDÆ.

1. **Lynx canadensis** Raf. Canada Lynx. Rare, and generally occurring only in the more thinly settled and mountainous parts of the State. A very large one was killed in November, 1866, in the town of Ware. Reports of their capture in the towns of western Hampden, Hampshire, and Franklin Counties, as well as in Berkshire, are not very infrequent.

2. **Lynx rufus** Raf. Bay Lynx. Apparently rather more common than the preceding species, but, like this, it is generally confined to the more wooded and mountainous districts. One was taken at Ipswich a short time since, and they seem to occur at intervals in all sections of the State.

The *Felis concolor* Linn. (Panther) has probably been for some time extinct in Massachusetts, though undoubtedly once occurring here. There is a stuffed specimen in Springfield said to have been killed a year or two since in the Adirondack Mountains of New York. A few months since the writer saw another that was captured on Pine Hill, in Weathersfield, Vermont, January 31, 1867. This specimen is said to have measured seven feet from the tip of the nose to the tip of the tail, to have stood two feet nine inches high, and to have weighed one hundred twenty-two and a half pounds. It had lived for some time previously on Ascutney Mountain, a few miles from where it was captured. Very good photographs of this rare animal, taken from this specimen before it was skinned, can be obtained of Mr. J. D. Powers, of Springfield, Vermont.

Professor Thompson states, in his Natural History of Vermont (p. 37), that for some time after the settlement of that State had commenced the Panther was so common there as to be considered dangerous to travellers unless they were well armed. In his Appendix (p. 12) he states that the last one he had known to be killed in that State, and also the only one for many years, was captured in Bennington, in February, 1850.

CANIDÆ.

3. **Canis lupus** Linn. (*C. occidentalis* var. *griseo-albus* Baird.) Gray Wolf. Occasional in the sparsely populated districts of the western counties. Like the species of *Felidæ*, it has been nearly extirpated.

Authorities have differed greatly in their views respecting the identity of the American and European wolves; some, forming the majority, and among them apparently those whose opportunities for judging have been most favorable, have considered them the same, while others, and among them many who seem to have but casually examined the subject, have regarded them as distinct. Not only so, but — omitting certain varieties based on color and commonly received as merely nominal, though repeatedly raised to the rank of species — specimens from the middle and western portions of the continent have been described as specifically distinct, both from the Old World wolves and those of the eastern side of the continent.* Dr. Richardson, than whom probably no one has had better opportunities for studying American wolves, after pointing out some trivial differences in physiognomy and in the character of the pelage between the wolves of Arctic America and the Pyrenees, observes: "Notwithstanding the above enumeration of the peculiarities of the American wolf, I do not mean to assert that the differences existing between it and its European congener are sufficiently permanent to constitute them, in the eye of the naturalist, distinct species. The same kind of differences may be traced between the foxes and native races of the domestic dog of the New World and those of the Old; the former possessing finer, denser, and longer fur, and broader feet, well calculated for running on the snow. † These remarks have been elicited by a comparison of live specimens of American and Pyrenean wolves; but I have not had an opportunity of ascertaining whether the Lapland and Siberian wolves, inhabiting a similar climate with the American ones, have similar peculiarities of form, or whether they differ in physiognomy from the wolf of the south of Europe." For this reason he considered it "unadvisable to designate the northern wolf of America by a distinct specific appellation"; "the word *occidentalis*" (*Canis lupus occidentalis*), he further observes, "which I have affixed to the Linnæan name of *Canis lupus*, is to be considered as merely marking the geographical position of the peculiar race of wolf which forms the subject of this article."

Audubon and Bachman, the former having been long familiar with the American wolf in all its different varieties, unhesitatingly pronounced, after

* As *C. nubilus* Say, *C. variabilis* Maximilian, *C. gigas* Townsend, &c.

† The comparisons in this case, it should be remembered, are between specimens from localities possessing widely differing climates.

careful and extended comparisons of specimens from the two continents, the common wolves of the Old World and the New to be, in their opinion, identical. But Dr. De Kay, giving but two lines to a consideration of the subject, very summarily separates the American wolf from its Old World congener under the name of *Lupus occidentalis.* Professor Baird, after admitting the weight of authority to be in favor of the supposition of their specific identity, considers them distinct, and adopts the name of "*Canis occidentalis*" for the American species. In referring to the different varieties of the North American wolf this author says: "For the present I prefer to consider all as one species, and to assume this with good reason as distinct from some at least of the European wolves, if that continent possesses more than one." Although previously admitting the unsatisfactory character of his materials,* such a conclusion is but in accordance with his usual apparent predilection for considering American animals as distinct from their intimate affines of the Eastern continent, sometimes even where the weight of authority is by far in favor of their identity, and his own materials for an original examination of the subject are either entirely wanting or too scanty to be of much account.†

In his article on the Wolf (p. 108) Baird gives us, however, a most interesting and very valuable table of measurements of twenty-six skulls, chiefly from the Platte River, but which includes others from Sweden and Russia, as well as such remote points in North America as New York, Oregon, Texas, and Mexico. Aside from the markedly smaller size of those from the southern localities, the specimens do not appear to differ more than the same number might from either of the localities mentioned. The table shows variations in the proportion of breadth to length in the muzzle and in the whole skull, and in its relative breadth at similar points; but a careful examination of all the measurements given shows that these differences are inconstant, specimens from near the same locality differing as much or more than those from distant points. Neither are the differences greater nor different in kind from those New England specimens of the common fox (*Vulpus vulgaris*), the woodchuck (*Arctomys monax*), the northern hare *Lupus Americanus*), or the gray rabbit (*L. sylvaticus*), present, and which in some of these species are sometimes exceeded.

* "In the lack of perfect specimens of the North American wolf, I find it very difficult to throw any light upon the long-vexed questions of our species, all before me being mutilated in some way, and not allowing a satisfactory comparison with each other and with descriptions." — *N. Am. Mam.*, p. 105. After stating his conclusions in regard to the matter, however, he in a later paragraph mentions the receipt of additional specimens from the Yellowstone River.

† But one species, the *Gulo luscus*, is admitted in the Report on North American Mammals as specifically identical with any species of the Old World. In this case a strong probability, in his estimation, of distinctness is hinted at.

The variations, particularly in point of color, presented by the species under consideration do not appear restricted to its American representatives, in the north of the Old World the wolves, according to authors, varying from the white ones of Lapland and Siberia to the gray, pied, dusky, and even black ones of the more southern States; and here also the differences in color have been considered as indicating different species. In North America, where the wolf is quite fully known, the differences between the large white, or nearly white, races of the extreme north of the continent and the smaller dusky and rufous races of the south, in size, color, in the character of the pelage, and perhaps in other points, are so great that, without the intermediate links through which these widely differing extremes almost insensibly pass into each other, through individuals inhabiting the intervening districts, these extremes might be considered as well-marked species. At the far north, and "particularly in districts nearly destitute of wood," says Dr. Richardson, "wolves totally white are not uncommon," while grayish white is the prevailing color. The gray occupy, in general, the northern and elevated parts of the continent, including the elevated and more northern sections of the United States, and pass into the white and lighter gray wolves occupying the region farther north, and into the darker colored ones existing at the south. Southwards the color increases, tending more and more towards black and red, till in Florida * and the Gulf States dusky and black wolves predominate, and in Texas red or rufous. Yet in no portion of the continent is the color of the wolves at all uniform, the same packs generally presenting a great variety in this respect, even those of the same litter often widely differing. Dr. Richardson mentions, under his "variety *sticte*," that of five young wolves, "leaping and tumbling over each other, with all the playfulness of puppies of the domestic dog," which he thought were probably of one litter, one was "pied, another entirely black, and the rest showed the common gray colors." In speaking of the black American wolf, which forms his "variety *ater*," he says the Indians do not consider them to be even a distinct race, but report that one or more black whelps are occasionally found in a litter of a gray wolf. Audubon and Bachman, in referring to the red wolf of Texas ("*Canis lupus* Linn. var. *rufus*" of these authors), state that this variety is by no means the only one found there, "where wolves black, white, and gray are to be met with from time to time. We do not think, however," say they, "that this red wolf is an inhabitant of the more northerly prairies, or even of the lower Mississippi bottoms, and have therefore called him the Red Texan

* "The varieties, with more or less of black, continue to increase as we proceed farther to the south, and in Florida the prevailing color of the wolves is black." — AUD. & BACH., *Quad. of N. Am.*, Vol. II, p. 130. These observations of Audubon my own inquiries made during a recent journey in this State tend to confirm.

Wolf." On the Missouri we find, according to Lewis and Clark, that the wolves are chiefly yellow, as also, according to Professor Baird, on the Platte and Yellowstone (N. Am. Mam., p. 110), where they appear to gradually merge into the gray and white ones of the north. These latter evidently form the so-called varying wolf (*C. variabilis*) of Prince Maximilian,* some of which, he says, are entirely white, others yellowish white, some more mixed with gray, and others still entirely gray, in the same pack. The black wolf noted by Say on the Missouri, and which he describes as *C. nubilus*, like the gray and white ones, seems to occur everywhere, but apparently much more abundantly at the south, thus corresponding in its distribution, as in general character, with the black variety of Southern Europe, described by Linnæus, and afterwards by Cuvier, as *Canis lycaon*. This name was also applied by Dr. Harlan to the American black wolf. The red, or rufous, seems likewise southern, occurring in great abundance in Texas, and thence northward through the middle region of the continent, passing gradually through paler rufous and yellowish to the prevalent gray and grayish-white wolves of the north. Though perhaps our data are at present too few to warrant positive conclusions on the subject, the facts appear to point rather strongly to a localization of these different colors; it is nevertheless true that, as already stated, the wolves present at every locality a wide range of variation, and that neither variety of color is entirely restricted to any particular region. The gray is apparently the most widely diffused, occurring in greater or less numbers almost everywhere.† We find, however, that authors have considered these color differences as indicating not only permanent varieties, worthy of distinctive names, but even species, as is shown by a glance at the subjoined table of synonymes of the American animal. Not a few, including Audubon, Bachman, Dr. Richardson, and others, have been so inconsistent as to name and characterize as "varieties" what they at the same time admit to be either positively or probably only individual variations, occurring sometimes in the same litter with the common form.‡

* Reise in das innere Nord-Amerika, Vol. II, 1841, p. 95. Ib., Archiv für Naturgeschichte, Vol. XXVII, 1861, p. 247.

† Dr. Coues observes, in a series of interesting papers on the "Quadrupeds of Arizona," in the American Naturalist (Vol. I, p. 288), that all the wolves seen by him in Arizona were of the grizzly or grayish-white variety, which in winter, at a distance, appear almost white.

‡ Dr. Richardson, after saying "these variations of color, however, not being attended with any differences of form, nor peculiarities of habit, I deem them to be no more characteristics of proper species, or *even permanent varieties*, than color would be in the domestic dog," proceeds at once to formally name and describe five "varieties," as though they were tangible, permanent forms, — so great apparently is the fascination to some minds of bestowing names, to be followed by their own as authority, in Natural History.

In some previous citations of the synonymes of this species, I find that Dr. Richardson has on several occasions been incorrectly quoted, first by De Kay and afterwards by Baird; his name, *Canis lupus, occidentalis*, having been rendered by them "*Canis* (*Lupus*) *occidentalis*," thus incorrectly conveying the impression that he regarded the wolf of North America as distinct from the European, and as also having placed it in a sub-genus (*Lupus*) of *Canis*. Dr. Richardson, however, expressly states that he did not regard them as distinct, and did not wish to further burden the science by imposing a new name to indicate what at most he thought might be but a geographical race.

Canis lupus.

Canis lupus LINNÆUS, Syst. Nat., I, 1767, 58.
" *mexicanus* IB., 60.
" " SHAW, Gen. Zoöl., I, 1800, 296.
" " DESMOREST, Mam., I, 1820, 199.
" " FISCHER, Syn., 1829, 183.
" " BERLANDIER, Proc. Acad. Nat. Sc. Phil., V, 1851, 157.
" *lupus, albus* SABINE, Franklin's Journ., 652.
" *lupus, griseus* IB., 654.
" *lupus, occidentalis* RICHARDSON, Faun. Bor. Amer., I, 1829, 60.
" " " var. A, *griseus*, Ib., 66.
" " " " B, *albus*, Ib., 68.
" " " " C, *sticte*, Ib., 68.
" " " " D. *nubilus*, Ib., 69.
" " " " E, *ater*, Ib., 70.
" *lupus* HARLAN, Faun. Amer., 1825, 84.
" *lupus*, var. *ater* AUDUBON and BACHMAN, Quad. N. Am., II, 1851, 126, pl. 67.
" " " *albus* IB., 156, pl. 72.
" " " *rufus* IB., 240, pl. 82.
" " EMMONS, Quad. Mass., 1838, 26; Ib., 1840, 28.
" *nubilus* SAY, Long's Exped. R. Mts., I, 1823, 168.
" " HARLAN, Faun. Amer, 84.
" *lycaon* IB., 126.
" *variabilis* MAXIMILIAN, Reise in das innere Nord Amer., II, 1841, 95.
" " IB., Arch. Naturgesch., XXVII, 1861, 247.
" *gigas* TOWNSEND, Journ. Acad. Nat. Sc. Phil. (2d series), II, 1850, 75.
" *occidentalis*, var. *griseo-albus* BAIRD, N. Am. Mam., 1857, 104, pl. 31.
" " " *nubilus* IB., 111.
" " " *mexicanus* IB., 113.
" " " *ater* IB., 113.
" " " *rufus* IB., 113.
Lupus occidentalis DE KAY, Nat. Hist. N. Y. I, i, 1842, 42, pl. 26, fig. 2.

4. **Vulpes vulgaris.** (*V. fulvus* RICH., and of most modern authors.) RED FOX. More or less common throughout the State.

The varieties called "Silver Fox," "Black Fox," and "Cross Fox," are taken at long intervals.

These so-called varieties, to which have been given such distinctive names as *Canis decussatus*, *C. argentatus*, *C. fulvus* var. *decussatus*, etc., etc., and which some authors have regarded as species and the majority as permanent "varieties," are but different degrees of melanism of the common red fox, as they sometimes all occur in the same litter of young.* They appear exactly parallel to the dusky and black varieties of marmots, which are usually considered as only variations of this character. The dusky of the preceding species (*C. lupus* Linn.) and the black form of several species of *Sciurus* are probably but the result of the same tendency more highly developed. Foxes in other countries, and particularly the European, are well known to present corresponding dusky and black variations, which have likewise been described as permanent varieties, and even as species.

Respecting the identity of the red fox of North America with that of Europe there is a diversity of opinion. Most of the old authors considered them specifically the same, while later they were almost as generally regarded as distinct. Recently their identity has been maintained by several high authorities in Europe, among whom are Giebel, Wagner, and Maximilian, and not without a fair show of reason. Professor Baird observes, that careful comparisons of the two show "appreciable differences, although the resemblance is very close in external appearances, and scarcely to be expressed except comparatively."† The

* Audubon and Bachman, in their account of the Cross Fox ("*Vulpes fulvus* Desm., var. *decussatus* Pennant"), in Quadrupeds of North America (Vol. I, pp. 52, 53), incidentally relate the following: "In the spring we induced one of our servants to dig for the young foxes that had been seen at the burrow which was known to be frequented by the Cross Fox. With an immense deal of labor and fatigue the young were dug out from the side of a hill; there were seven. Unfortunately, we were obliged to leave home, and did not return until after they had been given away and were distributed about the neighborhood. Three were said to have been black, the rest were red. The blackest of the young whelps was retained for us, and we frequently saw, at the house of a neighbor, another of the litter that was red, and differed in no respect from the common Red Fox. The older our little pet became the less it grew like the Black, and more like the Cross Fox. It was, very much to our regret, killed by a dog when about six months old, and, as far as we can now recollect, was nearly of the same color as the specimen figured in our work."

In the following autumn the female was killed: "It was nearly jet black, with the tip of the tail white. This was the female that produced the young we have just spoken of; and as some of them, as we have already said, were Cross Foxes and others Red Foxes, this has settled the question in our minds that both the Cross Fox and Black Fox are mere varieties of the Red."

† Mamm. of N. Am., p. 126.

differences in the color and texture of the fur, to which he and others have called attention, seems the most tangible difference, though not one of high value. Several specimens from different parts of Europe, in the Museum of Comparative Zoölogy, show that some of the other differences specified by Professor Baird, particularly that of the form of the tail and the greater length of its hairs in the American animal, are far from constant, there being no such differences in this respect between them and others from the United States, as has been claimed. One of the European has the tail remarkably full, the longer hairs being fully an inch longer, instead of an inch shorter, as according to authors they should be, than average American specimens. Prince Maximilian has also observed that this distinction in regard to the form of the tail is inconstant and invalid.* While, as Professor Baird remarks, European specimens can be readily separated from American, as in the case of most species commonly admitted as identical on the two continents, it does not follow necessarily that they are specifically distinct, since in very many species of animals specimens from not very remote localities can be similarly distinguished, where naturalists never question their identity. The very exact agreement in the southward distribution of the red fox in the Old World and in the New, — their southern limitation on both continents, as nearly as can be judged, coinciding with the same isotherm, — and the occurrence of the same varieties, as "cross," "black," and "silver," and in about the same relative proportion of individuals, if indicating anything, seems to point to their identity. In considering this subject it is necessary to take into account the remarkable tendency to variation presented by other members of this family in a state of nature, and the readiness with which widely distinct breeds are developed under domestication in the common dog. The European specimens to which we have referred differ considerably among themselves, these differences being in some cases greater than between some of them and the average type of the American animal. I hence do not hesitate to consider the North American red fox as identical with the common red fox of Europe, the average amount of difference being not greater than might be anticipated in specimens from so distant localities.

5. **Vulpes virginianus** De Kay. Gray Fox. Though essentially southern, this species is said by De Kay to be rather common in the southern counties of New York, and particularly on Long Island; † Audubon and Bachman give it as not uncommon in the vicinity of Albany, N. Y., but as scarce in New England, and state

* Arch. für Naturgesch., XXVII, Theil 1, p. 259.

† Zoöl. of New York, Vol. I, p. 46.

that they had not heard of it to the north of the State of Maine.* Dr. Emmons gives it as "rare in Massachusetts." † Mr. C. W. Bennett informs me that he knew of the capture of two specimens in Leominster a few winters since. The skins of this species frequently seen in our fur stores come, so far as I have learned, altogether from Eastern Virginia and the Southern Atlantic States.

MUSTELIDÆ.

6. **Mustela Pennantii** Erxl. (*M. canadensis*, Emmons Rep.; *Martes* ‡ *Pennantii* Gray.) Fisher. Probably still of rare occurrence in the Hoosac ranges. In 1840 Dr. Emmons wrote: "It is occasionally found in the vicinity of Williamstown, particularly in that range of mountains which extends northeast through Stamford, Vermont." §

This species seems to be the only one of the old Linnæan genus *Mustela* (*Martinæ* of recent authors) peculiar to the northern parts of North America, with no very near ally in the corresponding portion of the Old World.

7. **Mustela martes** Linn. (*Martes americana* Gray; "*Mustela americana* Turton" of recent American authors; *M. zibellina* Brandt.) Pine Marten. Sable. Occasional in the mountains of Berkshire County. Thirty years since Dr. Emmons mentioned it as not infrequent there, but as most common "where pine forests abound. It is, however," he says, "often found in beech woods, where it is sure of a more ready supply of food. Its nocturnal habits, and native shyness, effectually screen it from observation, even in districts where it abounds." ‖

The variations presented by the sables and martens, at single localities as

* Quad., Vol. I, p. 172.

† Rep., p. 31.

‡ Each of the three generally recognized genera of the sub-family *Martinæ* ("tribe *Mustelina*" of Gray) — *Mustela* embracing the sables and martens; *Putorius*, the minks, weasels, and ermines, and *Gulo*, the wolverine — has been recently subdivided, the sections being ranked by some as sub-genera, and by Dr. J. E. Gray as genera. In his "Revision of the Genera and Species of *Mustelidæ*" (Proc. London Zoöl. Soc., 1865, pp. 100–154), he restricts *Mustela* to the weasels and ermines, and *Putorius* to the polecat, while the sables and martens he places under *Martes*, and the minks under *Vison*; the distinctions, based on differences either in the dentition, form of the skull or color, are, however, very slight.

§ Rep., p. 39.

‖ Rep., p. 41.

well as in different districts, have been very perplexing, and have given rise to a considerable number of supposed species and a very great number of "varieties," the alleged distinctions between which are quite uncertain and inconstant. Some of these variations are doubtless referable to seasonal changes,* and not a few others to individual peculiarities. Dr. Gray admits six species as inhabitants of the North Old World,† several of which he divides into three to five varieties each. To a few of them only, however, does he assign separate geographical districts; in general they vary in such a way as to render the forms recognized by him as species quite intangible, the varieties forming gradations between them. Two of the three attributed to Japan (*Martes japonica* and *M. brachyura*) rest on exceedingly unsatisfactory data, while the third (*M. melanopus*) has a striking resemblance to the common form of the American species, and to varieties of both the so-called *M. abietum* and *M. zibellina* of Europe and Asia. Aside from these divisions of Dr. Gray, three principal races or forms (species of many writers) have for a long time been recognized as occurring on the Eastern continent, — the sable (*Mustela zibellina* Linn.), the pine marten (*M. martes* Linn.), and the beech marten (*M. foina* Brisson; *M. martes*, var. *fagorum* Linn.). The principal distinctions between them consist in the relative length of the tail, which varies in being sometimes longer, equal to, or shorter than the body, and in the color, which varies in general tint, and differently in the different regions of the animal, and especially on the throat, which is sometimes white, or nearly so, but more commonly yellowish or yellowish-brown; occasionally the "throat patch" is nearly obsolete. The color of the head is sometimes like that of the body, and again much lighter; the general color varies from blackish through different shades of brown to light yellowish brown and whitish. But instead of either of these differences being limited, or peculiar, to either "species," "variety," or race, or to special localities,* they are all given by Dr. Gray under the five divisions of his fifth species, — "*Mustela zibellina* Linn."; while he says of his *M. abietum*, var. *altaica*, that it is "intermediate between *M. abietum* and *M. zibellina;* but the feet are not so hairy"!* Brandt, in his Beiträge Säugtheire Russlandt, recognizes three species. The American animal (*M. americana* auct.) he considers as a yellowish or more yellowish-brown and less densely furred variety of the Asiatic sable than as a pure marten (*M. martes*), and calls it *Mustela zibellina*, var. *americana*.

Dr. Gray of course regards the American as distinct, and divides it into three varieties, — *abietinoides*, *huro*, and *leucopus*, — which seem to vary only in intensity of color, the first being "black-brown," the second

* See *postea*, pp. 165 - 167. † Proc. Lond. Zoöl. Soc., 1865, p. 104.

"yellowish-brown," and the third much lighter than the second. The habitat of the first is given as the "Rocky Mountains"; of the second, "Fort Franklin"; that of the third is not stated, and may be supposed to be general, or at least those districts not occupied by the others. It is evident, however, that these different varieties are not local, as they occur more or less frequently at the same localities, and likewise at as distant points as the two sides of the continent. Dr. Gray refers to a series of specimens of the American pine marten in the British Museum, collected by Dr. Lord during his excursion with the Boundary Commissioners, that "vary greatly in color, from pale brown to nearly black," and have "the throat variously mottled with yellow." * Mr. Bernard R. Ross says that the farther north the skins are obtained the darker the pelage, and that on the Youkon River they strongly resemble the Siberian sable.† While in general the specimens from North America are of the white-headed or sable rather than of the marten type, dark-headed ones also occur, not exclusively on the western side of the continent, as some have supposed, but more or less frequently at all points.

Professor Baird has described ‡ specimens from the West Coast that do not differ essentially from others from the Adirondacks, though having the head much less white. Dr. Brandt's series of American skins from the Northwest Coast, as far south as Columbia, on the contrary, had the head very light colored, and hence resembled in this respect the generality of specimens from New York, Maine, and Nova Scotia. In other general characters he also found a close agreement with the Asiatic sable, and, as already stated, he believed them specifically identical. Dr. Gray also mentions a close resemblance in the color of the head between specimens from Russia and the Northwest Coast of America. Professor Baird, after comparing American with Swedish specimens, states that "in some respects, as in certain features of the skull and teeth, the American marten approximates to the beech marten, *M. foina*, more than to the European true marten"; and that it differs from the latter (*M. martes*) in certain proportions of the skull, in the texture and paler colors of the pelage, in the relatively longer tails of the latter, and in the extent of the naked pads of the feet. He also finds resemblances in color to the Russian *M. zibellina*, but finally concludes, after quoting Dr. Brandt's reasons for considering them identical, by saying that he is "far from admitting the identity of the American marten with the Russian sable, although it occupies a position intermediate between the latter and the *M. martes* in size,

* Mam. N. Am., p. 107.

† List of Mammals, Birds, and Eggs observed in the McKenzie's River District. Nat. Hist. Rev., July, 1862, p. 272.

‡ Mam. N. Am., p. 153.

length of tail and coloration, as well as in intrinsic value of the fur. The white-headed varieties of New York are most like the sable; the darker-headed ones of the Western country like the pine marten." He is "inclined to the belief," he says still later, in an interpolated note, "that we have two species, one representing the pine martin, with dark head, the other similar to the sable, with whitish head, — both probably distinct from the corresponding Old World species, the martens at least."

In Dr. Brandt's diagnosis of the martens, the relative length of the tail is dwelt upon as an important character. In *M. zibellina* the tail without the hairs is given as one third the length of the body; in *M. martes*, one half or more than one half. Professor Baird says the tail vertebræ in *M. americana* are about one half the head and body; hence not differing much from the same proportion in *M. martes*, while quite different from the same in *M. zibellina*, which Dr. Brandt considers the *M. americana* to most resemble; while Dr. Gray observes that the tail of some of Dr. Lord's specimens from Western America is almost as short as it is in the Russian sable. A marked discrepancy is evident in these statements, explainable on the ground of the inconstancy of the distinction based on the relative length of the tail. Brandt also states that the *M. foina* differs from *M. martes* somewhat in general color (but apparently not essentially, considering the much wider differences in this respect his varieties of *M. zibellina* present among themselves), and in having the tail generally longer, with more vertebræ. Since, however, the number of tail vertebræ is far from constant in most mammals with this member considerably developed (as I have myself observed in the mice, squirrels, ermines, and foxes), this latter character must lose much of its weight till repeatedly verified. Dr. Gray says, in urging the non-identity of the American and Old World martens, that "It is curious that both Brandt and Baird seem to have overlooked the small size of the last tubercular grinder, which separates the American from the Old World pine martens"; a fact he claims to have discovered. From variations I have observed in this respect in our common *Mephitis*, it would be interesting to know whether Dr. Gray has found this difference constant in a considerable series, or whether the observation rests on a single specimen, as, in the same connection, he refers to "the skull of the American specimen we have in the Museum," in speaking on another point.

I have shown in the foregoing remarks that the martens and sables of the Old World and the New are not without close points of affinity in all essential particulars; that on both continents they present almost innumerable differences, principally in respect to color, but few of which, if any, appear to be geographical, or even constant; that on both continents the variations are similar; that the points of distinction between the supposed species are slight, and rest mainly on characters which in mammals are the most likely of all others to be variable; that authors, in their statements and opinions, are widely discrepant and often contradictory; finally, that the American animal is most closely allied to the Asiatic, grading through it into the European. At present there seems to be no middle ground between considering all as forming one circumpolar species and admitting a considerable and indefinite number, since some of the so-called "varieties" seem as strongly marked forms as some of the "species." If we must consider the American as distinct from those of the Old World, we can hardly do less, on parallel grounds, than to recognize two or more in America. It seems probable that in time the greater part will be found to be not permanent or uniformly transmissible varieties, but merely irregular individual variations; — in other words, that more than one so-called variety may be represented in the same family, as has been shown is the case in the foxes and wolves, and as is well known to occur in *Mephitis*.* The comparison of a great number of specimens from many localities will be necessary before we can consider the matter as satisfactorily settled.

Since writing the foregoing, I have met with a very valuable paper on the Fur-Bearing Animals of the Mackenzie's River District,† and another on the Martens and Weasels of Nova Scotia; ‡ I have also had an opportunity of comparing a large number of skins of the Siberian sable with an extensive series of others from Hudson's Bay. Much additional information has been derived from these sources, which tends to confirm the opinion above expressed; namely, that most of the so-called varieties and species would prove to be based on seasonal and individual variations of a single circumpolar species. The writer of the first of these papers, Mr. Bernard R. Ross, is well known from his extensive Natural History explorations in the boreal regions of this continent, and his experience of thirteen years in this district as a successful trapper entitles his statements and opinions to more than ordinary weight. He seems to have been a critical observer, and in this paper adds much to our knowledge of the fur-bearing animals of North America. His remarks on the seasonal changes in the color and character of the fur in several species are particularly valuable. The following extracts from them explain to a great extent the nature of the wide variations which, in many characters, the martens and sables everywhere exhibit.

* See *postea*, p. 173 *et seq.*

† A Popular Treatise on the Fur-bearing Animals of the Mackenzie's River District. By BERNARD ROGAN ROSS, C. T. — *Canadian Naturalist and Geologist*, Vol. VI, January, 1861, pp. 5-36.

‡ On the Mammals of Nova Scotia, No. III. By Dr. J. BERNARD GILPIN. — *Transact. Nova Scotia Inst. of Nat. Science*, Vol. II, Part I, pp. 8-16.

"It is difficult to describe," he says, "the color of the marten fur accurately. In a large heap of skins (upwards of fifty) which I have just examined minutely, there exists a great variety of shades, darkening from the rarer yellowish-white and bright orange into various shades of orange-brown, some of which are very dark. However, the general tint may with propriety be termed an orange-brown, considerably clouded with black on the back and belly, and exhibiting on the flanks and throat more of the orange tint. . . . . The ears are invariably edged with a yellowish-white, and the cheeks are generally of the same hue. The forehead is of a light brownish-gray, darkening towards the nose, *but in some specimens it is nearly as dark as the body.** The yellowish marking under the throat (considered as a specific distinction of the pine marten) is in some *well defined,* and of an *orange tint,* while in others it is *almost perfectly white.* It also varies much in extent, reaching to the forelegs on some occasions. At other times it consists merely of a *few spots, while in a third of the specimens under consideration it is* ENTIRELY WANTING." In respect to other characters he observes: "The tail is considerably less than half the length of the body *generally,* though it is sometimes longer; it is well covered and tolerably bushy. The feet are comparatively large, densely covered with short woolly fur, mingled with stiffer hairs, which prevent the naked balls from being visible in winter, *though they are distinctly so when the animal is in summer pelage.*" † Respecting the seasonal changes he says: "When casting its hair the animal has far from a pleasing appearance, as the under fur falls off, leaving a shabby covering of the long, coarser hairs, which have then assumed a rusty tint. . . . . After the fall of these long hairs, and towards the end of summer, a fine, short fur pushes up. When in this state the pelage is very pretty, and bears a strong resemblance to a dark mink in its winter coat." He further observes: "In summer, when the long hairs have fallen off, the pelage of this animal is darker than in winter. The forehead changes greatly, *becoming as deeply colored as any other part of the body, which is of an exceedingly dark brown tint* on the back, belly, and legs. The yellow throat markings are much more distinct at this season, but vary much both in color and extent, though in only our summer skins are they entirely wanting." Mr. Ross also adds, that the martens of the Mackenzie's River district "bear a greater resemblance to the sable of Eastern Siberia than to the martens of Europe, holding, as it may be with propriety said, an intermediate position."

Dr. Gilpin, in his paper on the Nova Scotian Mammals already cited, has the following remarks on the variations presented by different indi-

* The italicizing in these quotations is my own.

† This may explain the differences in the hairiness of the soles pointed out by different authors, and claimed as a distinctive character of considerable importance.

viduals at the same locality: "When we begin to study this species, we soon find a very great variety in color, not only between the summer and winter specimens, but between winter skins themselves, that are all in the highest condition. Whilst they all coincide in what may be called typical marks, such as color of legs, tail, and especially ears, all of which have a very pale but conspicuous rim or border, *they vary much in color of face*, some having black, others faces so pale as to be nearly white, and the pale faces have a lighter brown color, and the orange throat much less vivid." Of seven skins described by this gentleman in detail, two "are nearly uniform mahogany brown" from the nose to the tail; the other five, though varying somewhat among themselves, are generally lighter, with much lighter faces, and the orange spot on the throat very bright, "almost fulvous." He adds that the skins from "Newfoundland and Labrador are much finer, darker in color, and more lustrous in pelage" than those from Nova Scotia.

Through the kindness of several of the fur-dealers of Boston I have had an opportunity to make a careful comparison of scores of skins of the Siberian sable from Russia with as large a series from the Territory of Hudson's Bay. The differences between them, although through the whims of fashion producing considerable difference in the mercantile value of the skins, are really quite slight. The fur of the Hudson's Bay skins is a little coarser, and the color slightly more rufous, with much fewer of the white-tipped hairs that in the Siberian skins are sometimes sufficiently numerous to give them a slight grayish cast, and which is considered to greatly increase their value. As one of the dealers practically remarked, they differ no more than the horses raised in Pennsylvania do from those bred in Massachusetts. Some of the skins of both varieties had tails much shorter than the average, showing the unreliability of this character. In a few instances this member was distinctly tipped with white, in both the Hudson's Bay and Siberian skins.

In the light of the now well-substantiated facts of a wide range of seasonal and intergrading, inconstant individual variation, it seems to me to be beyond reasonable doubt that, as I have already stated, the martens and sables, at least all thus far described, belong to a single circumpolar species, with possibly two or more well-marked and tolerably constant continental races.

8. **Putorius vulgaris** Cuv. (*Mustela vulgaris* Linn.; *Putorius pusillus* Aud. and Bach.) Least Weasel. Rather rare. Far less numerous than the next.

9. **Putorius ermineus** Cuv. (*Mustela erminea* Linn.; *Putorius noveboracensis* De Kay; *Mustela Richardsonii* and *M. Cicognanii*

Bon.; *Putorius fuscus*, *P. agilis*, and *P. ermineus* Aud. and Bach.) COMMON WEASEL. ERMINE. Comparatively common. It varies considerably in size, like other members of this family, according to sex and age.

I have obtained specimens at Springfield, identified some years since as belonging to the three species currently admitted by American authors as inhabiting Eastern North America, — "*P. Richardsonii* Bon."; "*P. Cicognanii* Bon.," and "*P. noveboracensis* De Kay." I have not access to the specimens for re-examination, but that these forms, or so-called species, occur in Massachusetts there can be little doubt, since Professor Baird, in his Report on the Mammals of North America, cites eleven examples from Middleboro', collected by Mr. J. W. P. Jenks, of his *P. Cicognanii*, two of *P. Richardsonii* and one of *P. noveboracensis*. As indicated by the synonymy already given, I consider all these as forming but a single species, which, after careful comparison of American with European specimens, I fully believe to be identical with the ermine (*P. ermineus*) of the Old World. I also feel obliged to consider the common American weasel, after similar comparisons, as identical with the common weasel (*P. vulgaris*) of the Eastern continent.

Although three species of ermines, or stoats, have been supposed to inhabit New England, in common with Eastern North America generally, no constant character has yet been indicated by which more than a single one can be positively distinguished. In size there is an almost imperceptible gradation from the smallest specimens to the largest, and similar gradations in all other characters, not excepting the relative length of the tail to the body. This latter character and that of size have formed the two distinctions most strongly urged as specifically separating them.

Previous to 1838, all the known weasels of North America were considered as belonging to two species, identical with the *Mustela vulgaris* and *M. erminea* of the Old World. At this time Bonaparte, in his Fauna Italica, added a third, which he called *Mustela Cicognanii*. He gave of it the following short and very unsatisfactory diagnosis: "*M. rufo-cinnamomea, subtus flavo-albida; cauda corporis dimidio sub-breviori, apice nigricante*"; which contains the single tangible character of "tail rather less than half the body." In the same year, in Charlesworth's Magazine of Natural History,* he added a fourth, which he called *Mustela longicauda*. This species was based on a variety mentioned in the Fauna Boreali-Americana,† by Dr. Richardson, as differing from the common ermine in being larger and in having a longer tail. Bonaparte, in the same communication, changed the name of the ermine weasel of Rich-

* Vol. II, p. 38. † Vol. I, p. 47.

ardson's work from *M. erminea* to *M. Richardsonii*, he believing them to be distinct species, and thus separated all the larger American weasels from those of the Old World. At this point begins the uncertainty and confusion that has long existed in regard to the number of species of American weasels and their distinctive characters. But no changes were currently adopted by American authors till ten or twelve years later, when, in 1841, Audubon and Bachman, in the Proceedings and Journal of the Philadelphia Academy of Natural Sciences, described a specimen taken on Long Island, New York, as a new species, under the name of *Mustela fusca.** In the following year Dr. De Kay, in his Report on the Mammals of New York, redescribed this specimen under the name applied to it by Audubon and Bachman, and at the same time separated the larger representatives of the ermine as a species distinct from the Old World ermine and from the supposed northern *M. Richardsonii* of Bonaparte. But this author very frankly adds: "I have never seen the true ermine in its summer dress, and only know it from Pennant's description (Arct. Zoöl., Vol. I, p. 75)." He calls the American ermine weasel *Putorius noveboracensis*, and regards it as differing generically from two other species of weasel (*M. pusilla* = *M. vulgaris* Linn, and *M. fusca* Aud. and Bach.) described by him as also inhabiting New York. In 1853, the authors of Viviparous Quadrupeds of North America, in the third volume of that work (p. 184), characterized another species as new, also from New York specimens, which they called *Putorius agilis*. In the same volume, under *P. fuscus*, they observe that whereas the number of North American weasels was believed by the older authors to be at most two, while some admitted but one, "there are now five, four of which are found in New York." If we add to the new names of Audubon and Bachman and De Kay the three bestowed on American weasels by Bonaparte, we have seven specific designations for those of Eastern North America alone; to these may be added *P. erminea* and *P. vulgaris*, Audubon and Bachman fully believing these species to be common to both continents, thus making nine.

This was the condition of the subject when Professor Baird revised the group in his Report on the Mammals of North America, in 1857. In this work eight species are admitted as inhabitants of North America. Two (*P. frenatus* and *P. xanthogenys*) are considered as exclusively southern and western in their distribution; one (*P. Kaneii*) as northwestern ("Behring's Straits and Siberia"), and three *P. Pusilla*, *P. Cicognanii*, and *P. Richardsonii*) as distributed throughout the northern parts of the continent and extending southwards into the United States. Another (*P. noveboracensis*) is regarded as ranging from Massachusetts and Northern New

* Proc., Vol. I, p. 92; Journ., Vol. VIII, 1842, p. 280.

York west and south to Southern Pennsylvania, Illinois, and Arkansas. The locality of still another is given as Carleton House, H. B. T., this being the variety described by Richardson as occurring at that locality, and named *Mustela longicauda* by Bonaparte. But Baird doubtfully refers to it also some long-tailed ermines from the Upper Missouri.

Concerning the Least Weasel (*P. pusillus* Aud. and Bach. of Baird's Rep.), the only queries relating to it have been principally in reference to its relationship to *P. vulgaris*, *P. pusillus* forming its principal synonyme. Bonaparte, however, doubted its occurrence in America, supposing his *P. Cicognanii* had been generally mistaken for it, as he claims he found it had been in some of the Middle States, and on his authority Dr. Godman excluded it from his American Natural History. Afterwards, however, Dr. Richardson, in the Zoölogy of Beechey's Voyage, applied to it the name of *P. Cicognanii*.

For the smaller weasels with a distinct black tip to the tail, Professor Baird retains the name of *P. Cicognanii*, referring to it the *Mustela* (afterwards *Putorius*) *fusca* of Audubon and Bachman. He gives as its distinctive character, "Length to tail, eight inches or less. Tail vertebræ, one third this length. Black of tail, two fifths its length," etc. He adds, this "species is readily distinguished from the other American weasels by the small size, and the tail, which, with the hairs, is rather less than half the body." In a note he mentions the later reception of some hunter's skins from Nova Scotia and Labrador, among which were some that agreed very well with typical specimens from Massachusetts, while others were considerably larger, though in general preserving the same proportions. The average length of the body in the measurements of twelve specimens given by him is 8.25 inches, the largest being 10, and of tail 3.62; but between the extremes of the series there is a variation in total length of thirty-six per cent of the average, and in the relative length of tail to the body of twelve per cent.

Putorius Richardsonii is characterized by the same author thus: "Length to tail, nine inches or less. Tail vertebræ, about half this length. Black of tail, nearly one half to one third its length," etc. "Is readily distinguished from *Putorius Cicognanii* by the longer tail, the vertebræ alone of which are fully half the length of the body, instead of requiring the entire tail to effect this proportion." * Of this "species," the measurements of two speci-

* In the account of *P. Richardsonii* in the Mammals of North America there occurs the following singular but important discrepancy, probably the result of a typographical error. In the third paragraph of page 165 it is stated, "This species, a true *Putorius* differs materially from the larger North American Weasels *in the absence of a black tip to the short tail; in this respect resembling* P. Cicognanii." But in the specific diagnosis of *P. Richardsonii* the author says: "*Black of tail nearly one half to one third its length*"; and in that of *P. Cicognanii*, "*Black of tail two fifths its length.*"

mens from Eastern Massachusetts are given, both of which, in general size, fall within the average of the twelve of *P. Cicognanii;* thus showing that "small size" fails to sufficiently distinguish the latter, and also that short tails and small size do not always go together in specimens from the same locality; the tails in these two exceed the average in the *P. Cicognanii* by about thirty per cent of the average of the whole series. The distinction based on the relative length of the black tip seems also intangible, "two fifths" coming just between "nearly one half" and "one third." To this species he refers the *P. agilis* of Audubon and Bachman, and of course the *Mustela* (*Putorius*) *erminea* of Richardson, for which the name *Richardsonii* was substituted by Bonaparte for *erminea*. Yet the dimensions given by Richardson accord in the proportions of the tail to the body, not with Baird's diagnosis of *P. Richardsonii*, but with that of *P. Cicognanii*, the tail vertebræ being but little more than one third the body, and the hairs and vertebræ together being *less* than one half.*

Putorius noveboracensis of Baird's Report is characterized as "Length to tail about ten inches. Tail vertebræ about half this length. Black of tail about half its length," etc. It thus differs from the last only in being larger. Yet one of the three specimens of which measurements are given scarcely exceeds the size of the larger of the two specimens of *P. Richardsonii*, and falls considerably below several of the *P. Cicognanii* in length of body. One of the *P. Cicognanii* specimens even equals the average of those of *P. Richardsonii*, although *P. Cicognanii*, as previously observed, is supposed to be distinctively characterized by its small size. Some differences in the proportional length of the feet, and in the color, are mentioned as existing between this and *P. Richardsonii*, but they are evidently merely individual, and would disappear in a comparison of a large series. To this species he refers the *P. ermineus* of Audubon and Bachman and the *P. noveboracensis* of De Kay.

In comparing some of the "*noveboracensis*" specimens with a short-tailed one of the European *P. ermineus*, I am not surprised that Professor Baird found "very decided points of distinction," "notwithstanding the assurance of authors" to the contrary. The principal one mentioned, however, is the greater brevity of the tail in the European, in which the proportion of the tail to the body is about as it is in *P. Cicognanii.*

In *Putorius longicaudus* the dimensions are given as, "Length to tail about eleven inches. Tail vertebræ about half this length. Black of tail about one fourth its length," etc. The measurements given of three specimens average 10.78 inches in the length of the body, one only reaching eleven, while the tail vertebræ alone equal fully half of this length. It

* "Length of head and body, 11 inches; of tail (vertebræ), 4 inches; of tail, including fur, 5 inches." — *Faun. Bor. Am.*, Vol. I, p. 47.

differs, then, from *P. Richardsonii* only in its slightly larger size, the *proportion of length of tail to length of body being essentially the same in both.* Some smaller specimens are referred to this from the Upper Missouri, of which measurements are not given. Two of the large specimens are marked males; the sex of the other is not indicated. To this species is of course referred the long-tailed Carleton House variety mentioned by Richardson, to which, as already observed, Bonaparte gave the name *longicauda.*

From the preceding comparisons and remarks the inconstancy and the arbitrary character of the distinctions claimed as specific are fully evident. It appears that short tails by no means always accompany small size, nor long tails large size; that both occur at the same localities, as well as at points as remote from each other as the most distant localities at which the species has been found, as Hudson's Bay Territory and the Arctic Regions on the one hand, and Massachusetts, Pennsylvania, and Illinois on the other; that between the "species," as characterized by Professor Baird, there is an almost insensible intergradation in all the essential characters, some of the so-called species resting on distinctions that are by no means differences (as *P. Richardsonii* and *P. longicauda; P. Cicognanii* and *P. noveboracensis*, very nearly); finally, that, contrary to the belief of this author, the short-tailed species (*P. Cicognanii* and *P. noveboracensis*) have a range to the northwards equal to that of the others, the *P. erminea* of Richardson being distinctly referable in its proportions to *P. Cicognanii.*

Although differing radically with the eminent author of the Report on the Mammals of North America in respect to the number of valid species of this group in America, — the only American zoölogist who has given it special attention, — I can but commend the candor he has exhibited in his attempt to clear up the discrepancies of former authors, and to sift the subject of its obscurities, as well as the manner in which he has presented his material.

An examination of numerous specimens from the New England and other Northern States has shown me that the variations in the relative length of the tail to the body are merely analogous to similar individual variations in the squirrels and other small mammals that have this part considerably developed, — a variation not always due merely to the lengthening or shortening of the vertebral segments, but occasionally to an increased or diminished number of the vertebræ themselves. Also, that the variation in size so noticeable in specimens from the same locality is in great part sexual, — the males in nearly all species of *Mustelidæ* being considerably larger than the females, — but in many cases to immaturity, and somewhat also to the natural individual range in this respect, which, as in their allies, the mink and marten, and in the Carnivora generally, is much greater than in some other groups. The differences in color claimed now and then as distinctive of different species are generally either such as are evidently seasonal, or such as, like those of the form and proportions of the feet, etc., would disappear in a large series. I hence feel convinced of the existence of but two species of weasels in Northeastern North America, and that these are circumpolar, identical with the *P. vulgaris* and *P. ermineus* of the Old World. These two are always distinguishable with certainty, while their representatives do not present a wider range of variation in size and other characters than is currently admitted for several of their congeners. More than this number being admitted, the whole question as to how many should be recognized, and what constitutes their distinctive characters, becomes involved in the greatest uncertainty.

Two interesting facts in respect to color in the weasels should not in this connection pass unnoticed. One is that both species generally become white in winter; apparently invariably so at the far North, and usually so as far south as Northern New England, but in Massachusetts only the larger one (*P. ermineus*) thus changes, and this not always. Still farther south such a change in *P. ermineus* occurs only occasionally, and in the extreme southern portion of its habitat not at all.* This whitening of the pelage in winter corresponds in geographical relation to the white or light gray color seen in the common wolf at the north, and the gradual darkening of its color southward. The other fact is the usual greater intensity of the yellow on the under parts in specimens from the central portions of the continent, — a variation parallel with the rufous form of the common wolf of the same region, and the comparatively more rufous tint of the pelage seen in specimens from the same district in most continentally distributed species.

Another fact in respect to size is also noteworthy, as corroborative of the general law of the larger size of the representatives of a species from the northern parts of its habitat than those from the southern. The measurements given of the length of the body by those authors who have had only southern specimens for examination is seven inches for *Putorius vulgaris*, and eight to ten inches for the corresponding measurement of *Putorius ermineus*, but Richardson, whose specimens were extremely northern, gives nine inches for the same measurement of the former, and eleven and twelve for that of the latter.†

* Respecting this seasonal change of color, compare the observations of Richardson (Fauna Boreali-Americana), Audubon and Bachman (Quadrupeds of N. Amer.), and Baird (Mam. N. Amer.).

† Professor Baird, in order to reconcile the identification of Richardson's specimens with his *P. Richardsonii*, supposes the body to have been overstretched, as he says he never saw any American ermines that would measure eleven inches before skinning;

In concluding this brief review of the American weasels, I will add that, whether *P. frenatus* and *P. xanthogenys* prove ultimately distinct from each other, as they are likely to from the northern species (*P. ermineus*), I regret to feel obliged to assign the *P. Kaneii* Baird to the synonymes of *P. ermireus*, not less from my regard for its describer than for the memory of that admirable man its name is so appropriately designed to commemorate. To the same category I think must also be referred the *P. bocamelus* Bonaparte, founded on the southern race of this species in Europe (Sardinian specimens), as his *P. Cicognanii* was on a similar American race.

Since writing the above I have found that Dr. J. E. Gray, of the British Museum, has recently referred *Putorius Kaneii* Baird to *Mustela erminea* Linn., it forming his "variety 2, *Kaneii*" of this species.* To the same species he has also referred the *Putorius noveboracensis* De Kay, and the *Mustela Cicognanii* and *M. longicauda* Bonap., he calling them altogether "variety 3, *americana*," of *ermineus*. Dr. Gray adds: "Dr. Spencer Baird, in his work on the Mammals of North America, divides the stoats into six species [*P. Richardsonii*, *P. noveboracensis*, *P. longicauda*, *P. Cicognanii*, *P. ermineus*, and *P. Kaneii*], by the length of the tail and the black on the tail. . . . . When the bodies of several English stoats have been compared they show how deceptive that character is. I do not say that they may not be distinct; but if they are, there must be other characters to separate them besides the mere length of the tail." He accordingly gives as "species 2" of the stoats, *Mustela Richardsonii*, on Professor Baird's authority, and as chiefly distinguished by the upper lips and legs being "entirely brown." He adds, "I have not seen this species." He further observes: "The specimen formerly named *M. Richardsonii* [by Bonaparte?], in the British Museum, has the hinder part of the upper lip white, but the hair is bent back and lost off the front part." In respect to the white on the upper lip, he states that English specimens sometimes have it reduced to a very narrow margin.

The American weasel (*P. pusillus* auct.) Dr. Gray likewise considers identical with the European *P. vulgaris*. But Bonaparte's *Mustela bocamela* of Southern Europe he admits as a valid species, under the section of weasels, or of species with the "back and tail uniformly colored," and extends its habitat to include North Africa (Algiers and Cairo). The correctness of this view seems highly questionable, since New England specimens of *P. ermineus* sometimes have the tip of the tail merely

forgetting apparently for the time being this law of variation which he was one of the first to recognize, and towards establishing which no one else has done so much.

* Proc. Lond. Zoöl. Soc., 1865.

dusky, the black being almost obsolete, in which condition they seem not essentially different from the figure and original description of *P. bocamela* in the Fauna Italica.

10. **Putorius lutreolus** Cuv. (*P. vison* Gapper; *Vison lutreocephala* Gray; *Mustela lutreola* Linn.) Mink. Common.

I am not prepared to admit Audubon and Bachman's Little Black Mink (*P. nigrescens*) as distinct from the above. Specimens referable to this supposed species are not of uncommon occurrence. Mr. B. R. Ross considers that the *P. nigrescens* "is nothing more than the young of the *P. vison*," * an opinion I have also long entertained.

In this species we again have an animal of questioned identity, some authors considering it the same as the European *Mustela lutreola* Linn., while others maintain its distinctness. But the differences seem very slight, and have generally been supposed to consist in the front of the upper lip being white in the European, while there is no white on that of the American; in size, proportions, and general color, no one claims that they materially differ. This single character is one of great variability in their near allies, the ermines, some having the white margin of the upper lip very broad, while in others it is very narrow and occasionally entirely obsolete. The other white markings on the mink are notoriously variable, some specimens having this color restricted to a very narrow chin patch, or even *entirely wanting*, while in others there are spots of white on the throat and between the fore legs; in still others white spots occur also along the middle of the abdomen and between the hind legs, forming an interrupted median line of white patches. I also feel confident that I have seen specimens of the American animal with a white margin to the upper lip. Experienced trappers positively assure me that such examples are of occasional occurrence.† Dr. Gray, however, gives a second character of

* Natural History Review, July, 1862, p. 273. In a later paper in the Canadian Naturalist and Geologist (Vol. VI, p. 30), Mr. Ross says the *P. nigrescens* of Audubon and Bachman are "merely common minks under three years of age." He states in another place (l. c. p. 29), "I have remarked that the color of this animal, as well as that of the otter and beaver, grows lighter as it advances in years, and that the white blotches or spots are of greater size and more distinct in the young than in the old. The color of a young mink (under three years), when killed in season, is very handsome; its color is often an almost pure black." I have myself observed a similar variation in color with age in the common black rat, and in other mammals, as well as in many birds.

† Since writing the above I find Mr. Ross says, in referring to Professor Baird's remark that the American mink *never* has the edge of the upper lip white, "I have never seen *the whole* of that part so colored, but in one specimen now on my table there is a white spot beneath the nostril."

distinction between the American and European animals, — a difference in the size of the upper tubercular tooth, — the value or constancy of which I have at present no means of determining.

Of the American animal Dr. Gray makes three "varieties." The first is dark, with unspotted throat and chest, whose habitat he gives as "Vancouver's Island"; but it also occurs in Massachusetts, Michigan, and Illinois, as I have myself observed, and probably throughout the habitat of the species. The second is characterized simply as having the "chin entirely brown," while the third is Audubon and Bachman's *P. nigrescens.* No special habitat is given for the last two. Neither of them, however, is a permanent variety. In the general color, as well as in the white spots, there is a wide variation, different specimens varying from pale brown to quite intense black. There is also an extensive variation in size, but as very large and very small individuals occur in each stage of color it is very difficult to consider any of these variations as other than individual, or such as are evidently to be referred to season, sex, or age.

Numerous supposed species of the Old World mink have also been characterized, chiefly from the warmer regions, five of which are recognized as valid by Dr. Gray. The first of these is the common *M. lutreola* of Linnæus, the habitat of which is given as "Europe." The second is the *M. siberica* of Pallas, which Dr. Gray says is paler and smaller than *M. lutreola*, with the tail relatively longer and the end paler colored, or like the back, instead of darker than the back.* He observes that it "varies greatly in the quantity of white on the chin and throat," and adds that the "*males are much smaller.*" The last statement, if true, indicates a remarkable exception to the sexual law of variation in size in this family. The habitat is given as Siberia, Himalaya, Japan, China, and Formosa. Dr. Gray's third species is the *Mustela canigula* of Hodgson, originally described from specimens from the Nepaul Hills of India. Its chief distinction seems to be an unusual amount of white on the face, chin, throat, neck, and chest, although Gray mentions as a variety a specimen with darker fur and much less white. His fourth species, *Mustela* (*Vison*) *Horsfieldii* Gray, seems not to differ particularly from the others, or from frequent American specimens, as its "variety two" is characterized as "chin brown, *edge of under lip only* white." This is likewise from India (Bootan) and Japan. The fifth, from Nepaul, the *Putorius subhemachalna* of Hodgson, differs from the preceding in being generally lighter or redder, — in other words, having less intensity of color, — with minor differences in the amount and distribution of the white. If all these species are valid, it will be seen that Southern and Eastern Asia and Japan are peculiarly rich in species of this

* The relative shade of color of the tip of the tail as compared with the back is a character too inconstant in this group to merit serious mention.

group.* But, in view of the well-known similar variations presented by our American mink, they seem to rest on very unsatisfactory distinctions, especially as the "varieties" admitted under some of them cover the differences considered as distinctive of the different species. The general paler color and somewhat smaller size of the southern forms † is paralleled by similar differences in specimens of the American animal from the southern portion of its habitat. In view of all these facts, I strongly incline to the opinion that we have here again but one circumpolar and widely dispersed species, with possibly two continental or geographical races that may be more or less easily recognized. Else, as in similar cases previously discussed, we must admit an indefinite number, subject in this respect and in their limitation to the caprice of those authors whose forte is in the description of "supposed new species." ‡

11. **Gulo luscus** SABINE. WOLVERINE. Dr. De Kay, in his

* It is a fact especially noteworthy that regions whose Natural History is considered as but partially explored are far richer in species (I refer more especially to mammals and birds), accepting only such as are currently allowed, than those much longer and more familiarly known. To be assured of this one needs but to compare Southern and Middle Europe with the corresponding parts of Asia, or Eastern and Northern America with Mexico and Central America, adopting as a basis for the comparison only those types or groups widely distributed. This fact is especially illustrated in the Carnivora, as the present family of *Mustelidæ* exemplifies. While distinct types appear in different regions, as some in the warmer latitudes that are not found in the colder, and *vice versa*, the martens and sables, as well as the minks, under not very different physical conditions, far outnumber in Eastern Asia alone, in reputed species, their representatives in Europe. While I would not deny the possibility of this being a fact, the intimate relationship which these several supposed species bear to each other, as well as to the European, and the unsatisfactory distinctions on which they are founded, seem to render it extremely improbable. If we extend the comparison to other groups, and to other regions, we constantly meet with cases parallel in all respects to this. This excess of species also almost always happens, in mammals, among those least known, either through their great scarcity or their nocturnal or recluse habits rendering them difficult to obtain. The explanation of this seems to be that new species are not anticipated to occur in a region that has been for a long time thoroughly explored, while specimens from imperfectly known districts, or of species in groups where the species are supposed to be difficult to distinguish, are most critically examined, and those differing slightly from others previously described — though not more, in many cases, than specimens unquestionably of the same species and obtained at the same locality frequently do — are presumed to represent undescribed species.

† See Gray's table of comparative measurements of the skulls of his several species Proc. Lond. Zoöl. Soc., 1865, p. 118.

‡ In the mink, as in the marten, it is an interesting fact that the Asiatic specimens bear a stronger resemblance to the American than the European do. According to authors, specimens not unfrequently occur in Japan and portions of Eastern Asia that are hardly distinguishable from average American ones.

Report on the Mammalia of New York, published in 1842 (p. 28), says: "Professor Emmons states that they still exist in the Hoosac Mountains, Massachusetts." But the species is not given in Emmons's Report, published two years before; it occurs, however, in Dr. Hitchcock's List, with the following note: "On Hoosac Mts.; rare. — Emmons." It is more or less common from Northern New England to the Arctic coast.

This species is remarkable for being the only one in the Mammalian Fauna of the State usually regarded as common to both the Eastern and Western Hemispheres. The existence in all together of but two or three circumpolar species of land mammals is admitted by many naturalists. It must also present an unusual constancy of character, since not only has it escaped subdivision into pseudo-species, but even no "varieties" have been generally recognized.

12. **Lutra canadensis** Sabine. (*Latax canadensis* Gray; *Lutra canadensis* and *L. destructor* Barnston.*) Otter. Not rare; still not often captured. At Springfield I have known some half-dozen specimens taken in the last ten years.

13. **Mephitis mephitica** Baird. (*M. chinga* Tiedemann; *M. varians* Gray; *M. mesomelas* and *M. chinga* Maximilian.) Skunk. Abundant. Individuals from the same locality, and even from the same litter, are very variable in color, some being almost entirely black, while others have a very large proportion of white. The amount of baldness on the soles of the feet is also very variable, independently of season or age, although this has been deemed by some naturalists, as Lichtenstein and others, as a character of great importance. Attention has been previously called to its inconstancy.†

Probably no other North American mammal is so strikingly variable in color as the common skunk; it is hence not surprising that foreign naturalists, unacquainted with the animal in life, have made of it a considerable number of supposed species. So well known is this variability to most persons at all familiar with the animal that it is all the more unexpected to find from a naturalist so justly reputed for accuracy as the author of the Report on the Mammals of North America a statement like the following: "This species varies considerably in its markings, *though individuals from the same locality are usually quite similar.*"‡ Especially is this so after the

* Canadian Naturalist and Geologist, April, 1863, p. 147.

† See Dr. J. E. Gray's Review of the Mustelidæ, Proc. Lond. Zoöl. Soc., 1865, p. 147.

‡ Mam. N. Amer., p. 195.

detailed account given by Audubon and Bachman of very wide differences in color between individuals of the same litter.* The majority of the Massachusetts specimens I have seen accord very well with Professor Baird's diagnosis, the general color being black, with a narrow white streak down the face, a large white nuchal patch, and a broad white streak on each side of the back reaching commonly nearly to the tail, which is tipped with the same color. Sometimes the face streak is united with the nuchal patch, but oftener it is separated by a narrow space of black, and is occasionally absent. The dorsal streaks vary in breadth and posterior extent, generally enclosing a narrow band of black; but the latter is sometimes wanting, when they, uniting along the median line, form but one; they run nearly parallel or widely diverge posteriorly, where frequently each is deeply bifid; more frequently than otherwise they entirely cease near the loins. The nuchal patch also varies in form and extent; generally it is continuous with the dorsal streaks, but is often entirely separate from them, and is itself sometimes divided, forming two small lateral patches; its general outline is variable almost beyond description. The white on the tail is sometimes terminal and sometimes basal; now and then it is quite absent, but occasionally it preponderates over the black. The distinct terminal pencil of long white hairs in the tail, so often described, seems generally best defined in young specimens; in full-grown ones it is frequently absent. Individuals occasionally occur that are either entirely, or almost entirely, black; much more rarely others with nearly the whole of the dorsal surface white, as in a specimen in the Museum of Comparative Zoölogy, collected in Newton, Mass., by Mr. C. J. Maynard. This has the black restricted to a narrow dorsal line, a few scattering hairs in the tail and to the lower surface of the body, the white dorsal band being nearly two inches broad on the neck and seven at the loins. Mr. Maynard has another specimen, taken at the same locality, which has still more white, there being no black median line, and the white extends still lower on the sides of the body. In short, the variations in color in the skunks are almost endless, scarcely any two specimens being quite alike. It therefore seems preposterous to found species on particular styles of coloring, or on the relative proportion and distribution of white and black, as several authors have done.

Eight species were described by Lichtenstein in his monograph of the genus *Mephitis* † from Mexico and the United States alone, while from North and South America together he gave sixteen! Professor Baird recognized six in his Report, and mentions three others described by

* Quad. N. Amer., Vol. I, p. 319.

† Ueber die Gattung *Mephitis*, Afhand. Akad. Wiss., Berlin, for 1836, 1838, pp. 249–315, and 2 plates.

Lichtenstein from Mexico as probably valid and also likely to occur in the United States. Dr. Gray * has very judiciously reduced the number to five, including those of both North and South America, but he places them in what he considers three genera, — *Conepatus* (1837, nearly equal to *Thiosmus* Lichtenstein, of subsequent date), *Mephitis*, and *Spilogale*. He gives all as occurring in North America. To the first, *Conepatus nasutus* Gray (*M. nasuta* of Bennett †), he refers, and it appears to me very properly, the *M. leuconota* and *M. mesoleuca* of Lichtenstein and Baird, and numerous other species of other authors, thus greatly reducing the number previously received. He separates it, however, into four " varieties," which are based on the distribution of the colors, although they seem to be about as uncertain in extent and relative proportion in this species as in the more northern one. Of *Mephitis* proper Gray gives three species, two of which (*M. vittata* Licht. and *M. mexicana* Gray, = *M. macroura* Licht.) are from Mexico, and the other (*M. varians* Gray, = *M. mephitica* Baird, = *M. chinga* Tiedemann) is generally distributed over North America, from Great Slave Lake ‡ southwards; of *Conepatus* and *Spilogale* one each. It is highly probable, however, that Mexico is not thus pre-eminently rich in species of these animals, and that Gray's two Mexican species may be referred to the common North American one, since they rest almost solely on distinctions of color that are far from peculiar to the Mexican examples. This being true, we have three supposed genera containing a single species each, or, what seems to me more probable, the alleged differences being slight, a single genus with three species, which agree rather closely in their general style of coloring and in possessing a remarkably large range of indefinite color variation. In distribution, one (*M. mephitica*) is northern, ranging from Mexico almost to the Arctic regions, and the others (*M. mesoleuca*, = *Conepatus nasutus* Gray, and *M. bicolor*) southern, inhabiting from Mexico and the Southern States to Patagonia.

Our common species (*M. mephitica* Baird) Dr. Gray divides into five "varieties," based on the relative extent of the white dorsal streaks, which form among themselves a graduated series. The inconstant nature of the characters assigned to these as distinctive it seems to me renders them unworthy of recognition, since they not only all occur at single localities, but, as Audubon has shown, § several of them sometimes appear in the

* Proc. Lond. Zoöl. Soc., 1865, pp. 145 *et seq.*

† Ibid., 1833, p. 29.

‡ B. R. Ross, l. c., p. 273.

§ "In the winter of 1844 we caused a burrow to be opened in Rensselaer County, N. Y., which we knew contained a large family of this species. We found eleven; they were all full grown, but on examining their teeth and claws we concluded that the family was composed of a pair of old ones, with their large brood of young of the previous season. The male had a white stripe on the forehead; and from the occiput down the same litter. Most of these pseudo-varieties and others of a similar character have been described by authors as distinct species. Prince Maximilian in his latest work * still maintained the existence of two species, *M. mesomelas* Licht and *M. chinga* Tiedem., in the United States. The latter (*M. chinga*) he seems to have known only from imperfect skins brought by the Indians of the Upper Missouri from, as he presumed, the Red River of the North and the Saskatchewan. They were used by them as trappings for the legs, and were all very white, differing only in this respect from the common skunk. As specimens similarly colored occur more or less frequently throughout the United States, it seems more probable that the Indians may have selected skins of this color for the special use to which we are informed they applied them than that the skunks of any given region are generally so colored.

Without going into the synonymy of the subject in detail, I may add that for the common North American species Dr. Gray strangely adopts the specific name of *varians* (*M. varians* Gray, 1837), this name being superseded in priority by both *chinga* of Tiedemann (1808) and *americana* of Sabine (1823), as well by *mephitica* of Shaw (*Vivera mephitica*, 1792). This latter being the one first given, has very properly been adopted by Professor Baird.

URSIDÆ.

14. **Procyon lotor** Storr.† Raccoon. Formerly numerous,

whole of the back had another white stripe four inches in breadth; its tail was also white. The female had no white stripe on the forehead, but had a longitudinal stripe on each side of the back, and a very narrow one on the dorsal line; the tail was wholly black. The young differed very widely in color; we could not find two exactly alike; some were in part of the color of the male, others were more like the female, whilst the largest proportion were intermediate in their markings, and some seemed to resemble neither parent. We recollect one that had not a white hair except the tip of the tail and a minute dorsal line." — Audubon and Bachman, *Quadrupeds*, Vol. I, p. 319. See also the two young figured by these authors (Plate 42), one of which has white stripes on the back and a black tail, and the other no stripes and the end of the tail white, though both were of the same litter. I have myself met with similar variation in the same litter of young.

* Verzeichniss Nordamerikanischer Säugethiere, Archiv fur Naturg., XVII, 2, p. 218.

† *Ursus lotor* Linnæus, Syst. Nat., I, 1758, 48, Ib., I, 1766, 70.

Procyon lotor Storr, Bod. Meth. Anim., 1780.

" *Hernandezii* Wagler, Isis, XXIV, 1831, 514.

" " Baird, N. Am. Mam., 1857, 212.

" " Ib., U. S. & Mex. Bound. Surv., II, Mam., 1859, 22.

" " var. *mexicana* Baird, Ib., 22.

" *lotor*, var. *mexicana* St. Hilaire, Voyage de la Venus, Zoöl., I, 1855, 25, pl. VI.

" *nivea* Gray, Charlesw. Mag. Nat. Hist., I, 1837, 580.

" *psora* Ib., Ann. & Mag. Nat. Hist., X, 1842, 261.

and still more or less common in the mountainous and sparsely settled parts of the State.

Quite variable in color, the variations on the one hand tending strongly towards melanism and on the other towards albinism. On specimens presenting the latter kind of variation seems to have been founded the *Procyon nivea* of Gray from Texas,* as probably also the *P. psora* of Gray † from California. ‡ With the variations in the general tint the markings usually become more or less indistinct. In even what may be considered as the normal or average type the dark rings of the tail vary from four to six in number, in intensity of color, and in relative breadth to the interspaces; sometimes the dark rings are only about half the width of the intervening lighter ones, but, as I have observed to be the case in numerous specimens killed in Massachusetts, Western New York, and Florida, they often equal, and not unfrequently exceed them. The tail varies also in its form and size, as it does in the foxes and marmots, sometimes tapering considerably towards the tip, though generally but slightly. Yet these characters have been assumed by some authors to be indicative of specific differences, the *Procyon Hernandezii* of Wagler § having been founded originally on such slight variations. Professor Baird, however, has gone quite fully into a discussion of its merits as a species, ‖ but the distinctions he particularly mentions as separating it from *P. lotor* — the more tapering form of the tail, the rings of which he deems "narrower and better defined," with "the light intervals wider," and a "*nearly constant* difference in the color of the upper surface of the hind feet," which he says is darker in *P. Hernandezii* — are so slight, and based withal on characters so exceedingly liable to variation, that they can scarcely be considered as of specific value. Though apparently of somewhat larger size the relatively larger and stouter feet claimed by him to distinguish *P. Hernandezii* his measurements seem to scarcely sustain. He admits that *P. Hernandezii* bears a very close relationship to the *P. lotor*, and says that "without close comparison the differences are perhaps intangible," and that "its characteristics are more comparative than absolute." Still "an examination of a large number of North American raccoons," he affirms, "has resulted in the appreciation of certain differences which appear quite constant." They are those above specified, and, as I have already ob-

* Charlesworth's Mag. Nat. Hist., Vol. I, 1837, p. 580.

† Ann. and Mag. Nat. Hist., Vol. X, 1842, p. 267.

‡ In his recent revision of the "Ursine Animals," Dr. Gray has referred both these to the *P. lotor*. See Proc. Lond. Zoöl. Soc., 1864, p. 684.

§ Isis, XXIV, 1831, p. 514.

‖ See N. Am. Mam., p. 213, and Mex. Bound. Survey, Vol. II, Mammals, p. 22.

served, are very slight, and pertain to the most variable parts of the animal. Some of them I feel sure are but individual differences, depending mainly, especially those in respect to the form of the tail, on age or season. In respect to the black annuli, hardly two specimens can be found that do not vary more or less. In the large series of New England specimens in the Museum of Comparative Zoölogy, the variation between the extremes in this respect covers the whole range of the differences assumed to distinguish the two supposed species. The single authentic specimen of *P. Hernandezii*, labelled apparently by Professor Baird himself, that I have seen * is not appreciably different in general color from many Massachusetts specimens. The supposed differences, it seems to me, are hence reduced to the single one of absolute size, which a large number of specimens of the so-called *P. Hernandezii*, from different localities, might very considerably modify. From a comparison of authorities, as will be seen from the remarks that follow, this seems to be indeed the fact. The example of *P. Hernandezii* above referred to (No. 67, Smithsonian Cat.), from Bodega, California, is actually smaller than the average of New England specimens.

Professor Baird remarks that some of the characters of *P. Hernandezii* given by Wagler and Wiegmann, as the prevailing color of the back and sides, differed from specimens he referred to it; in other words, they were more like his *P. lotor*. St. Hilaire, in the Zoölogy of the Voyage of the Venus, † also described and figured a specimen from Mazatlan that varied similarly from *P. Hernandezii* Baird, it being smaller and colored more like *P. lotor*. Under *Procyon Hernandezii* var. *mexicana*, Baird describes a single skin brought by the Boundary Commissioners from Espia, Sonora, that he says agrees with St. Hilaire's Mazatlan specimen (already referred to), which St. Hilaire considered to differ in nothing but in intensity of color from the common *P. lotor*. Professor Baird remarks that this Espia specimen exhibits a close relationship to *P. lotor*, though readily distinguishable from it, he claims, by its "larger and more naked feet and hands." These specimens, in resembling *P. lotor* more than some others from the same region referred to *P. Hernandezii*, show still more fully the inconstancy of some of the characters on which the latter is founded. In habits the two supposed species have not been found to differ. ‡ Hence, unless the more southern *P. cancrivorus* occurs in Cali-

* Contained in the Museum of the Boston Society of Natural History, and received from the Smithsonian Institution.

† Vol. I, 1855, p. 25, pl. VI.

‡ Professor Baird observes: "According to Dr. Berlandier, the habits of this species [*P. Hernandezii*] are precisely similar to those of the common raccoon." Dr. C B. Kennerly's notes are also of the same purport. — *Report on the Mammals of the United States and Mexican Boundary Survey*, p. 22.

fornia, as supposed by Audubon and Bachman, I see no reason why, in view of the known variability of *P. lotor* in the Eastern States and the relatively small differences only thus far pointed out between them and their Western relatives, all the raccoons of the United States thus far known should not be referred to *P. lotor*.*

15. **Ursus arctos** Linnæus. (*U. americanus* Pallas.) Black Bear. Extinct in the more thickly settled parts of the State; occasional among the mountains of the western counties.

In respect to the occurrence of this species in this State, Dr. Emmons remarked in 1840: "It is not many years since great numbers appeared there [on the Hoosac Mountain range] at once, and between twenty and thirty were taken in the course of one autumn, on the mountains in Adams and Williamstown. They are still to be found, and several have been taken every year since." (Rep., p. 24.) The local newspapers yet frequently chronicle their capture in Berkshire County.

Contrary to what was formerly supposed, bears everywhere appear to be among the most variable of mammiferous animals, not only in coloration, but in size, proportions, and in the conformation of the skull and other parts of the skeleton. Those familiar with them in life say it is rare to find two alike. A writer in the American Naturalist† has alluded to two females of the same litter, captured by him in Maine when young and raised as pets, that differed so essentially in their general build as to correspond respectively with what has been termed "ranger bear" and "hog bear," they differing also as much in disposition as in form. I am also informed by my friend Mr. C. W. Bennett that he has known two cubs of the same litter, taken in one of the Western States, that as they grew up differed very materially from each other in color, one being *black* and the other *brown*. They differed also widely in form and disposition, one being docile and playful while the other was ferocious and dangerous. The leading varieties in color of the American and European bears, as the brown and the

* This is also the view now taken by Dr. Gray, who remarks respecting *P. lotor* as follows: "This species varies rather in the tint of its colors in the different parts of North America. It is very apt to become white, and is thus the *Procyon nivea* (Gray, Mag. Nat. Hist., 1857, p. 580) from Texas; I described a specimen from California, with the tail imperfect, as *P. psora* (Ann. and Mag. Nat. Hist., 1842); and Wiegmann described two other varieties under the names of *P. brachyurus* and *P. obscurus* (Arch. III, 369). Dr Baird, in the Mammals of North America, considers *P. Hernandezii* as a species, and calls it the Black-footed Procyon, including *P. psora*, which has feet as *pale or paler than* P. lotor." — *Proc. Lond. Zoöl. Soc.*, 1864.

† Vol. I, p. 657.

black bears are now generally deemed to be but varieties and not species, though so regarded by Cuvier and the earlier naturalists generally. Great variations in the form of the skull in individuals from the same locality not unfrequently occur, aside from the differences caused by age and sex. Professor Baird mentions a skull from Saranac Lake, New York, which differs very appreciably from the ordinary type, agreeing quite nearly in some respects with the *Ursus arctos* of Europe. Concerning this specimen he remarks: "A large number of specimens from this locality may perhaps furnish a clew to this remarkable variation, which, under other circumstances, would be readily allowed as indicating a distinct species." * I some time since began to consider many of the so-called specific characters drawn from the skull as of very doubtful value, from the wide range of variation any considerable series of specimens from the same locality, and unquestionably of the same species, usually exhibit, aside from those arising from differences of age and sex. In the foxes and wolves, the common bear, the different species of *Mustelidæ,* and the larger rodents, such differences are often very considerable. On this point I find the following concurrent testimony from an author little liable to the charge of conservatism in respect to the multiplication of species or other groups.

Dr. J. E. Gray, of the British Museum, in his recent monograph of the bears, in the Proceedings of the London Zoölogical Society, † thus calls attention to the subject. "The examination of the series of skulls of bears in the [British] Museum, like the examination of the series of bones of the *Viverridæ*, has strongly impressed me with the uncertainty that must always attend the determination of fossil bones, or indeed of bones of all animals, when we have only the skulls or other bones to compare with each other. There can be no doubt that the study and comparison of the bones of the different species is very important, — that the skull and teeth afford some of the best characters for the distinction of genera and species; but few zoölogists and palæontologists have made sufficient allowance for the variations that the bones of the same species assume. In the bears, I have observed that there is often more difference in skulls of bears of the same species from the same locality than between the skulls of two undoubted species from very different habitats and with very different habits. Thus I have the skulls of some bears the habitat of which is not certainly known, which I have doubts whether they should be referred to the Thibet Bear (*U. torquatus*), or to the North American species (*U. americanus*), but I have referred them to the latter, as they were said to have come from that country. It is the same with regard to the skull of a bear that lived in the Zoölogical Gardens for years, which has the general form of the skull and the wide palate of the European bear, but the long last grinder

* N. Am. Mam., p. 227.

† 1864, p. 684.

and some other characters of the *U. ferox.* This similarity of skulls," he says, "is the more remarkable, as no two bears can be more distinct from each other than the species above named,* which have such similar skulls, showing that similar skulls do not always imply very nearly allied or doubtfully distinct species."

The bears have ever been a perplexing group, and accordingly the opinions advanced by different authors respecting the number of species vary widely. Several high authorities consider the land bears of Northern North America, Northern Asia, and Europe as forming but one, or at most two, species, among which are Blainville and Middendorff, the latter of whom, with access to a large amount of material, has especially and most minutely investigated the subject. Other authors are disposed to allow a much greater number. But, unfortunately, their statements in reference to the differences that should distinguish them are frequently contradictory. Dr. Gray recognizes eight † in his recent monograph, with numerous "varieties" and "subvarieties" of each. Of the *Ursus arctos*, or brown bear of Europe, he describes four varieties, and of the first of these eight subvarieties, to all of which he gives distinctive names. All of these are chiefly based on variations in color, the teeth, or the skull, although he states in the same paper that characters based on the latter are to a considerable extent unreliable for even the determination of species. ‡ Nilsson, in his Scandinavian Fauna, distinguishes six varieties that differ widely in color from Sweden alone. A careful study of Middendorff's tables of measurements, embracing some fifty specimens of bears from Europe and Asia, show how very extended is the range of variation in osteological and external characters, and how irregular is its nature. Schrenck has also called attention to the great variation in the size of the tuberculated grinders in the bears of Northern Asia, — a character which is unfortunately made the principal basis of Dr. Gray's specific and subspecific distinctions. Dr. Gray himself mentions that there are considerable variations in the series of skulls of American bears in the British Museum, particularly in the amount of depression in front of the orbits. His several tables of measurements of skulls that he himself refers to one

* In respect to this point I shall soon show that naturalists high in authority do not agree with Dr. Gray in regard to the great distinctness claimed by him for these species.

† It seems to me that no recent writer has been guilty of greater inconsistency than is exhibited by the author of the monograph on the *Ursidæ* above cited; for after calling attention to the variability of craniological characters, and their consequent unreliability as specific distinctions, he adopts some of those that can be readily shown to be the most trivial — even manifestly so from his own paper — as the basis of his classification of his species and varieties. So difficult is it apparently to overcome long-established habits of thought and modes of reasoning.

‡ See preceding page.

species indicate very considerable differences in the proportion of breadth to length in the entire skull, and in the relative length and slenderness of the muzzle. In consequence of such variations Dr. Gray and Professor Baird arrive at widely different conclusions in reference to the relationship of the *U. cinereus* Gray (*U. horribilis* Baird) to the *U. americanus.*

There is a strong tendency among naturalists to consider the Old World bears as all distinct from those of North America, and to recognize at least two species among the latter, — the grizzly bear (*Ursus horribilis*) of the West, and the continentally dispersed black and brown bears (*U. americanus*). Professor Baird, in his Mammals of North America, gives the probable number as five, four of which he seems to consider well founded, and thinks that there may be two others. But each of the recognized species presents so many varieties, which to a greater or less extent intergrade, that well-marked lines of distinction cannot at present be drawn. This has led a recent writer to observe, and it seems to me very justly, "If the same consolidation of species which some authors practise in plants was carried out in animals, we should have but one species [of bear] for the whole northern hemisphere." *

The present indications are that the *U. horribilis* is hardly so distinct from the common *U. americanus* as has been currently supposed; † it also presents close affinities in many respects with the *U. arctos* of Europe. Towards the north it shades into what is called the Barren Ground bear, which latter has been repeatedly referred, with more or less positiveness, by different authors to the *U. arctos* rather than to *U. americanus* or *U. horribilis.* Middendorff found the bears of Northeastern Asia equalling in size and generally resembling in other characters the *U. horribilis* (*ferox* of authors) of the Western Coast of America. The *U. americanus* also presents numerous variations in color and in other points quite parallel with similar variations in the European *U. arctos.*‡ Specimens often occur on the one continent that are strikingly like others from the other. Middendorff expressly states that the differences between *U. arctos* and *U. ferox* (*horribilis*) are not greater than occur between different specimens of *U. arctos.* Dr. Gray admits that it is only a knowledge of the locality that in some cases enables him to separate them.

* Andrew Murray, Geog. Distr. of Mammals, p. 119.

† See Professor Baird's N. Am. Mam., pp. 219 – 228.

‡ I learn from Mr. W. H. Dall, who has recently returned from a three years' exploration of Alaska, bringing with him important information relative to the natural history, geography, etc., of that country, that three kinds of bears are distinguished there; the larger and the more common being the grizzly, the second the so-called Barren Ground bear, while the third and smallest is a black bear; showing that there is found the usual variety, in point of size and color, seen on the Pacific Coast farther south.

In the Natural History Reports of the United States and Mexican Boundary Survey,* Professor Baird gives much valuable information, in addition to that contained in his Mammals of North America, respecting the bears of the Rocky Mountain and West Coast regions of the Continent. On the whole it tends to render the subject still more difficult and complex, if we recognize more than a single species in North America, as many of the different specimens described represent intermediate stages between the two commonly recognized American species. A specimen collected by Dr. Kennerly, at Los Nogales, Sonora, and others at the copper mines in New Mexico, by Mr. H. J. Clark, differ so much from the "grizzlies" of California that Professor Baird described them as a distinct variety of the latter, — *Ursus horribilis*, var. *horriæus*. Although the leading characters are the same, this "variety" differs in being smaller, with relatively shorter ears and a longer tail, these parts being nearly equal, instead of the ears twice the length of the tail, as in California specimens; it also differs in the texture of the fur, in the arrangement of the colors, in the greater relative breadth of the skull, its narrower and slenderer muzzle and more vaulted palate, and in the shape of the teeth. While the "*horriæus*" specimens are quite distinct from either of the so-called varieties of *U. americanus*, the variation from the typical *U. horribilis* of California is towards *U. americanus; U. americanus* of the Eastern States differing from them chiefly in being smaller. In the smaller size, compared with *U. horribilis*, and the great breadth of the head, "*horriæus*" also affiliates with the *U. arctos*. The latter is usually supposed to never attain the size exhibited by many specimens of the *U. ferox* (*horribilis*); but Prince Maximilian says that this is incorrect, as he has seen Russian bears that were fully as large as the latter; and Middendorff, as already stated, remarks that the bears of Northeastern Asia are as large as those of the Pacific coast of America.†

In reference to the peculiar bears of the Sonoran region, Dr. Kennerly has observed as follows: "In regard to the bears that are found along the northern frontier of Mexico and the southern portion of New Mexico, there seems to be some confusion. In addition to the common black bear,

* Vol. II, Mammals, pp. 24–81.

† The facility with which the bears can cross in winter from one continent to the other by way of Behring's Strait, and the known fact that they do thus cross (I am assured of this fact by Mr. Dall), renders the close mutual resemblance of the bears of Northeastern Asia and Northwestern America a matter of no great surprise. The similar resemblance between the martens and the representatives of the other circumpolar species from these countries, which has been already pointed out, though some of them may be able to pass less readily than the bears from one continent to the other, would seem to be fully accounted for by a similar occasional migration, if any hypothetical explanation for so natural a phenomenon as the great similarity of the animals specifically identical in these slightly separated districts is required.

Ursus americanus, and the large Grizzly, *U. ferox*, there is found another, intermediate in size to these, generally of a brownish color, with the tips of the hairs often silvered, especially in the old individuals, and in appearance, except in size, is almost identical with the *U. ferox* found in such great numbers in California. Among the people of the country they are known as *brown bears;* but this term is variously modified by the most experienced hunters, as we have heard applied by them, to the same individual, the name grizzly bear, touch of the grizzly, cross between the grizzly and brown bear, and common brown bear; but on no occasion have we heard them assign any relationship between these animals and the common black bear, causing us to believe that there must be a considerable difference between this animal and the brown bear of Oregon, which is called by naturalists only a variety of the black; in fact, its size generally, would necessarily preclude such comparison, while even the very old individual falls far short of the weight and dimensions of the *U. ferox* of California, of which we could much more easily consider it a variety than of the *U. americanus*." * One of the three of Mr. H. J. Clark's specimens, however, referred by Professor Baird to the *U. cinnamomeus* Baird, was "glossy black," and the others brown.

Audubon remarks that the *U. horribilis* varies in color from nearly white through various shades of pale and dark brown to black, it being difficult to find two specimens alike. The young are generally much darker than the adult. Yellowish gray and grayish brown are common varieties, while some are of a rufous tint. This account is confirmed by Prince Maximilian's observations on the bears of the Upper Missouri.†

The specimens from New Mexico and the adjoining country southwards, which present the peculiar characters mentioned above, have usually been referred to the *U. horribilis*, as previously stated; but others that are equally perplexing, but commonly referred to the brown variety of *U. americanus*, also occur in the same region. Some of these latter differ so much from other brown bears from Oregon, also referred to *U. americanus*, that Professor Baird has considered the probability of their proving distinct species very great, and proposed to call the former, in that event, *U. amblyceps*. These Sonoran specimens differ from representatives of *U. americanus* from the Eastern States in nearly the manner that the Sonoran variety *horriæus* of the grizzly, *U. horribilis*, does from the true *U. horribilis* of California; namely, in the greater relative breadth of the head, the relatively smaller size of the molar teeth, and the irregular character of the

* United States and Mexican Bound. Surveys, Vol. II, Mammals, p. 28.

† Verzeichniss der auf seiner Reise in Nordamerika beobachteten Säugethiere, Vom Prinzen Maximilian zu Wied. Archiv für Naturgeschichte, XXVII, 1861, Theil 1, p. 203, Taf. VIII.

coloration. Professor Baird provisionally refers them to the *Ursus americanus*, var. *cinnamomeus*, of Audubon and Bachman, to which, he says, they bear the nearest resemblance.

Prince Maximilian, in his memoir "Über die Selbständigkeit der species des *Ursus ferox* Desm.,"* urges strongly the distinctness of *U. horribilis* (*ferox* Maxm.) from both *U. americanus* and *U. arctos*, in which he is supported by the anatomical observations of Dr. C. Mayer, which form an appendix to his paper. Several specimens of the former, of different ages, from the Upper Missouri, are described in detail, but no differences other than those previously pointed out by other authors are mentioned. They consider that the shorter ears and longer claws of *U. horribilis*, with certain minor osteological peculiarities, sufficiently distinguish it from *U. arctos*. These authors admit that bears from northern countries present great individual differences; yet, in reviewing Middendorff's arguments, they offset their conclusions, based on an examination of a very limited number of specimens, against those of the latter, formed from probably as careful an elaboration of many times their amount of material. The differences that have been described by authors as occurring between specimens of *U. arctos* from different parts of Europe and Asiatic Russia, or between different specimens of either *U. horribilis* or *U. americanus* from different localities on this continent, are as great as those they urge as peculiar to their so-called species.

I have not space to notice in detail each point urged as distinctive by those authors who divide the bears into a large number of species. As they mainly rest on the shape and size of the molar teeth, the relative length of the claws and the ears, and the proportions of the skull, a few further remarks on these characters may not be out of place. In Professor Baird's table of measurements of skulls of American bears, the average proportion of breadth to length in the seven specimens cited is sixty per cent, with a minimum of fifty-five per cent, and a maximum of seventy-one. Only one of the series, however, exceeds sixty. Adding four other specimens referred by Baird to "*cinnamomeus?*" the average of the eleven is fifty-nine and a half per cent; the minimum is fifty-three, and two specimens range above sixty. The proportional breadth of the skull in eight specimens of *U. horribilis* is fifty-six per cent. Between the extremes of this series (Nos. 1218 and 2037) the variation amounts to ten per cent. In his comparison of *U. horribilis* with *U. arctos*, Baird cites two of Blainville's specimens in which the same proportion is sixty-six per cent; in reference to which he adds: "This width of head, far exceeding that of any well-known American species, would appear to be quite conclusive as to identity," — Professor

* Verhandlungen der Kaiserlichen Leopoldinisch-Carolinischen Akademie der Naturforschung, Band. XXVI, erste Abtheil., 1857, pp. 33 – 85, Taf. III, IV, and V.

Baird not having then received the Saranac (New York) specimen, with the breadth of the head seventy-one per cent of the length. In five skulls of the *U. arctos*, of which measurements are given by Dr. Gray, the average proportion of breadth to length is sixty-seven per cent; in five of the *U.* "*torquatus*," sixty-one; in two of *U.* "*syriacus*," sixty; in four of *U.* "*isabellinus*," sixty. The average of these sixteen European and Asiatic skulls is thus sixty-two per cent. Gray also gives measurements of five American skulls; viz., two of *U. cinereus* (= *U. horribilis* Ord) and three of *U.* "*americanus*"; the proportional breadth of the skull in the latter is sixty-one per cent, and in the former fifty-eight. This would seem to indicate a tolerable constancy in the greater narrowness of the skull in the American bears. But from Middendorff's table of measurements of fifty-five skulls, from different parts of Russia (chiefly from Northeastern Asia), the percentage of breadth to length falls to fifty-eight and a quarter, and is hence almost precisely that of the American. The maximum breadth of skull seems to be reached in Western Europe; thence eastward to Kamschatka there is a nearer and nearer approximation in this character, as in general appearance, to the American animal.

In respect to the variability of the skull in other particulars, Dr. Gray, in referring to two skulls of *U. horribilis*, remarks that they differ very considerably; the one is much broader, with the palate wider, the nose shorter, and the orbits higher and rounder.

In comparing the teeth of the American bears with those of the European, when but a single example of each is taken, the differences *may* be considerable, so great, indeed, that if constant they might be regarded as sufficient to decide the question of the distinctness of the species; but since specimens frequently occur from the same locality that differ as much, and others from the different continents that are almost or quite indistinguishable, the unreliability of such distinctions becomes sufficiently apparent.

Variation in the size and shape of the molar teeth are found in other groups than the bears, though rarely perhaps so great. According to Professor Peters of Berlin, in the *Otariæ*, or eared Seals, the variation in this respect seems to be even somewhat greater. Most authors have heretofore looked upon the teeth of the Otariæ as affording good generic characters, but Professor Peters has found them to be so exceedingly variable that he does not consider them reliable for even specific distinctions.*

The ears, in length and form, are found to vary greatly in specimens of *U. horribilis* from different localities, especially from points on different sides of the Rocky Mountains; whether variations of this sort are found in *U. arctos*, it is difficult from the few sufficiently detailed measurements given by authors to determine. That such do occur in specimens of bears referred

* Monatsber. Ak. Wiss., Berlin, 1866, pp. 261–281 and 655–672.

to the same species by authors who separate them into numerous species, lessens the importance of distinctions based on them as separating the bears of America from those of the Old World.

The claws are well known to vary in length at localities not very remote, in the Old World and in the New. Although the differences between specimens of *U. horribilis*, which seem to have them ordinarily the most developed, and others of *U. arctos* from Western Europe, is very great, they do not appear to have the importance as specific characters assigned them by Prince Maximilian and Dr. Mayer.

Finally, in weighing the evidence in reference to the number of species of North American bears and their relationship to those of the Old World, it is evident that the comparatively small number of specimens thus far examined, either from a single region or in altogether, and the vast areas from which no specimens have been received, should be carefully considered as showing how few the data are on which any opinion must be based. The inconstancy of character presented by those from the same locality, especially in the breadth and other proportions of the skull, in the shape and relative size of the molar teeth, in color, and in size, should also be duly considered, as well as the fact that however wide the differences between specimens from distant localities are, those from intermediate ones are generally of an intermediate character. In some districts bears find an abundant supply of animal food, while in others they are more or less restricted to a vegetable diet, and that these differences must give rise to modifications in the teeth and bones of the skull is to be expected. From the wide geographical range of even the different restricted so-called species, their representatives are subjected to widely different climatic and other modifying influences. In America, the coincidence of the greatest number of individuals with the maximum development in size seen in the region occupied by the typical *U. horribilis*, as in California, and the gradual transition in the easterly portions of the Rocky Mountain district to aberrant forms of this type, some of which indisputably approach quite near the common style of *U.* "*americanus*" of the eastern portions of the United States, and at the extreme north of the continent to the *U. arctos* of the Old World, especially to the Russian type of that animal, are facts which render the separation of the bears of these several regions into well-defined species quite improbable, if not impossible. I hence see no alternative but to consider with Blainville, Middendorff, and Murray, all the bears of the Northern Hemisphere, excepting *Ursus maritimus*, as forming but a single species. Here, as in other similar cases already considered in this paper, if the opposite view be adopted, it appears inevitable that still other species than those authors have already recognized must be allowed, with numerous "sub-species," or "varieties" and "sub-varieties" of each, in order to dispose of the constantly occurring intermediate forms.

PHOCIDÆ.

16. **Phoca vitulina** Linn. (*Callocephalus vitulinus* F. Cuv.) Common Harbor Seal. Abundant. I have observed it to be particularly numerous about Ipswich, as many as eight or ten being sometimes seen at once. In June the females are accompanied by their young, then apparently about one fourth grown. Though so common, their habits seem to be little known. They are rarely captured, as when killed they sink to the bottom and are thus difficult to obtain. A fine nearly adult male, now in the Museum of Comparative Zoölogy, was obtained at Wellfleet, in June, 1868, by Mr. C. J. Maynard and the writer. The specimen having been stranded, it had just died of exhaustion when discovered, from its frantic efforts to regain the water. It had repeatedly floundered several yards up the steep sand beach.

In reply to inquiries of mine respecting our seals, Captain N. E. Atwood, of Provincetown, has kindly written me respecting this species as follows: "At Provincetown we occasionally see a straggling specimen of what we call the Harbor Seal; in the vicinity of Cape Cod it is not very common; but there are localities on our New England coast where, in summer, they are found in great numbers. In Boston Harbor, west of Rainsford Island, there is a shoal-water bay of considerable extent, in which is a small ledge of rocks that at low water rise several feet above the surface; on these rocks many hundreds of these seals may be seen at any time during the summer. If the ledge is approached, they all dive into the water and rapidly disperse, but soon return again if they perceive no danger. These seals are small, and of little value, and are hence unmolested."

17. **Cystophora cristata** Nilsson. Hooded Seal. From accounts I have received from residents along the coast of a seal of very large size observed by them, and occasionally captured, I am led to think this species is not of very unfrequent occurrence on the Massachusetts coast. Mr. C. W. Bennett informs me of one taken some years since in the Providence River, a few miles below Providence, which he saw shortly after. From his very particular account of it I cannot doubt that it was of this species. Mr. C. J. Maynard also in-

forms me that a number of specimens have been taken at Ipswich within the past few years, that have weighed from seven hundred to nine hundred pounds. It seems to be most frequent in winter, when it apparently migrates from the north.

CERVIDÆ.

18. **Cariacus virginianus** Gray. (*Cervus virginianus* Boddært.) Virginia Deer. A few still exist in Plymouth, Barnstable, and Berkshire Counties, where they have been for some time stringently protected by law. Mr. Samuels, in the report of the State Board of Agriculture of Massachusetts for 1861 (p. 189), observes: "This beautiful animal is now rare in this State, and will soon, probably, be extinct; it is found in the woods in Plymouth and Barnstable Counties, in the neighborhood of the Hoosac Mountains, and on several of the islands on the southeast coast." It has for a long time been extinct in most parts of the State. They were last seen in the vicinity of Springfield about fifty years ago.

Respecting individual variation in species of the *Cervidæ*, and especially in *Cervus* (*Cariacus*) *virginianus*, I find the following important observations by Hon. John D. Caton, in the Transactions of the Ottawa Academy of Natural Sciences.* Referring to our standard works on the American *Cervidæ*, he observes: "The superficial marks which assign to each of these species its appropriate classification are properly described. Yet this description is generally from a single specimen, while in fact individuals differ very widely, both in color and form; so much so that even among the few I have in my parks we might almost persuade ourselves we have distinct varieties. Among the fifty or sixty deer which I have, there are three distinct shades of color, which also seem to be characterized by a peculiarity of form. The lightest colored have long legs and slim bodies; they have the largest horns, do not fatten readily, and are more wild and restless than the others. The next are of a considerably darker shade; in some instances quite black along the top of the neck and down the back, and a black tail, as distinctly so as the California deer; they have frequently other black marks. I have one specimen with a distinct black line over each eye, of a triangular form, passing towards the ear; and several others in which this mark is quite visible, though not so conspicuous, giving them rather a ferocious appearance. This variety has short legs, rather short, heavy bodies, are very tame, and always the fattest in the park. The smallest variety, both in

* Part I, 1868, p. 43.

size and numbers, is of a distinct russet color, and has less white under the throat and belly than either of the former. In one specimen the white is nearly wanting beneath the lower jaw, and there is very little under the neck. They are not so wild as the first class mentioned, but are more timid than the second, and, in their disposition to fatten, seem also to be intermediate between the other two."

In regard to the Elk he also observes: "There seem to be distinct classes of the elk, which are as manifestly hereditary as those of the deer, especially so as to form and size. Of these I recognize in my parks two classes, varying in form and size, but not materially in color. . . . . One variety is larger, and has longer legs, and is much more graceful in form and carriage than the other. The largest variety seems to be the most hardy, and fattens the most readily; it is also less vicious."

The Elk or Wapati (*Cervus canadensis* Erxl.), judging from what is known of its former distribution, undoubtedly once inhabited Massachusetts. According to Professor Baird and others, it is still found in the Alleghanies in Pennsylvania.*

The Moose (*Alce malchis* Ogilby; *Cervus alces* Linn.) also formerly undoubtedly existed in Massachusetts, though it has now been long extinct here. It still occurs in Maine, as far south as the Umbagog Lakes, whence specimens have been received at the Museum of Comparative Zoölogy.

As to whether the individuals found in America are identical with those of the Old World, there is at present some discrepancy of opinion, though formerly regarded as the same. The distinctions between them are very slight, and to what extent constant is hardly known. While the Moose of Asia and Europe are considered identical, Sir John Richardson has pointed out some slight differences in the skeleton of those of the New and the Old World, which incline him to the opinion that they may be distinct species, and as such he bestowed on the American the specific name of *muswa*. Whether these distinctions are more than individual, or such as would disappear in a large series of specimens, it is perhaps impossible to say. Their distribution, however, is remarkably alike, reaching the Arctic coast on both continents, and extending southwards to about the same isotherm; on the whole I consider their identity as extremely probable, if not absolutely certain.

* Audubon states that fifty years ago a few still lived in Kentucky, near the Ohio River, and that they were not very uncommon at that time in Southern Illinois, — localities much more southern than Massachusetts. — *Quad. N. Am.*, Vol. II, p. 88.

The Woodland Caribou, or Reindeer (*Tarandus rangifer* Gray; *Rangifer caribou* Aud. and Bach.), like the preceding, probably once inhabited Western Massachusetts, judging from what is known of their earlier distribution, though probably rather as an occasional visitant from the north than as a numerous or permanent resident. It is still found occasionally in Northern Maine, whence specimens have been received on several occasions at the Museum of Comparative Zoölogy, from Mr. J. G. Rich. In March, 1863, according to Professor Verrill,* this gentleman brought seven to Boston, killed on the head waters of the Kennebec, out of a herd of about twenty, supposed by Mr. Rich to have come from regions farther north, as the caribou had been noticed there by him but once before during the previous five years. It is said to occur also in the Adirondacks of New York.†

In this species we are again met by the old question of identity with a closely allied Old World congener. Several high authorities still maintain its identity with the European and Asiatic reindeer, while others, whose opinions are equally entitled to consideration, believe them distinct. Unlike the moose, the reindeer, if forming but a single species, are apparently easily separated into several very distinct races, in some cases differing in size, but chiefly in the character of the horns. In America, the woodland caribou constitutes a southern form, and inhabits the northern wooded districts of the continent; in the Arctic Barren Grounds it is replaced by a much smaller race, but which, it is said, has larger horns. This smaller race seems to be a circumpolar one, inhabiting the similar woodless tracts of the extreme north of the Old World, and also Greenland, but differing somewhat in different districts, it is claimed, by peculiar modes of branching of the horns, especially in respect to the form of the brow antlers. Whether these differences that have been pointed out are to be considered as constantly characterizing the reindeer of these different regions is still questionable, as but comparatively few specimens appear to have been yet compared. From the great variability in the branching of the horns presented by all the different species of the *Cervidæ*, the right and left horns in the same individual, as well as the successive sets, being often most notably unlike, it seems to be a distinction of doubtful value.

In reference to the disputed question of whether there are one or several

* Proc. Bost. Soc. Nat. Hist., Vol. IX, p. 226.

† In reference to the much farther extension southward of the habitat of this species in earlier times than even two centuries ago, see the general remarks on the geographical distribution of the Massachusetts Mammals, at the close of the paper.

species of reindeer, Mr. Andrew Murray, in his valuable work on the Geographical Distribution of Mammals (p. 151), observes: "But there are several varieties; how far some of these deserve to be reckoned species, and if so, which of them, is a more difficult question. There is, first, the fossil variety; next, the Lapland reindeer, which is nearest to the fossil type; then the Siberian, which, although very close to the Lapland, differs in the character of the horns; moreover, there are two varieties in North America, and one in Greenland and Spitzbergen. I believe all these to be altered forms developed out of one stock, modified to an extent corresponding with the degree of deviation of their respective climates from the original condition of existence of that stock." Mr. Murray gives figures, copied from various authors, of the antlers of these different varieties, and mentions in detail their points of difference and resemblance; concerning which he adds: "The resemblance between them is too constant, and, as will be seen by the figures, is too considerable to be a matter of accident or coincidence."

Dr. Richardson seems to have first clearly distinguished the two varieties of American reindeer, or caribou, now so generally recognized, but of the woodland variety ("*Cervus tarandus*, var. β *sylvestris*") he claims to "know little, having," he says, "seen few of them alive or in an entire state. It is," he adds, "much larger than the Barren Ground caribou, has smaller horns, and when in good condition is vastly inferior as an article of food." The Barren Ground variety he seems to have studied with great care. Respecting the character of the horns, the peculiar form of which seems to be the chief character yet discovered by which to distinguish the different so-called varieties, he observes: "The old males have, in general, the largest and most palmated horns, while the young ones have them less branched, and more cylindrical and pointed; but this is not uniformly the case, and the variety of forms assumed by the horns of the caribou is, indeed, so great, that it is difficult to comprehend them all in a general description. Some have the branches and extremities *broadly palmated* [the italicizing is my own], and set round with finger-like points; others have them *cylindrical, and even tapering, without any palmated portion whatever.* The majority of adult males have a brow antler, in form of a broad vertical plate, running down betwixt the eyes, and hanging over the nose. In some, this horn springs from the *right* horn, in others from the *left;* in many there is a plate from *each side*, and in a considerable number it is *altogether wanting;* the plate is, in general, widest at its extremity, and is set with four or five points, which are sometimes recurved. The *main stem* of the horn also exhibits an *endless variety* in its *thickness, altitude,* and *curvature.*" Major Smith observes, that a "probable distinction, by which some, if not all, of the varieties of caribou may be distinguished from the reindeer of the

Old Continent, is, that their horns are always shorter, less concave, more robust, the palm narrower, and with fewer processes than those of the former," — a view that has been adopted by other writers. Respecting this assumption Dr. Richardson thus observes: "I can with confidence say, after having seen *many thousands* of the Barren Ground kind, that the horns of the old males are as much, if not more, palmated than any antlers of the European reindeer to be found in the British Museum." If attention is given to the parts of the above quotation from Dr. Richardson that I have italicized, it will be seen how unreliable must be any distinctions based on the horns, unless the comparisons are more extended than they thus far seem to have been. That the horns of the Barren Ground form may differ from those of the wooded districts in other points than size is quite possible, but in the several pairs of horns of the latter in the Museum of Comparative Zoölogy there is a very close resemblance to those of the Barren Ground and Greenland caribous figured by Baird and Richardson, the Northern Maine specimens much more nearly agreeing with these than with Professor Baird's figures of the Lake Superior one (No. 900), which is evidently an extreme form. The horns of the northern or Barren Ground race of the American reindeer, according to the best authorities, do not differ essentially from those of the reindeer of the corresponding districts of the Old World. Mr. Murray quotes Mr. Alfred Newton as saying, in reference to the reindeer he saw in Spitzbergen: "The average type of a good Spitzbergen head is very well represented by the first figure in the Fauna-Boreali Americana (Vol. I, p. 240) of the so-called Barren Ground caribou (*Cervus tarandus*, var. *arcticus* Richardson)"; which testimony of Mr. Newton, he states, is supported by that of Mr. Lamont.* Mr. Newton, however, says the Spitzbergen reindeer are "certainly smaller than the Lapland reindeer."

Professor Baird observes, respecting the American woodland race, that its relationship to the European reindeer is not well ascertained. "The opinion," he says, "is gaining ground that the Barren Ground reindeer is distinct, and as this species cuts it off from the Arctic Circle, it would seem most probable that it cannot be the same with the animal inhabiting the circumpolar region of the Old World." But the recorded observations seem fully to prove, as is now, indeed, currently admitted, the existence of two similar races on the Old Continent, — a northern and a southern, differing from each other nearly as do the Barren Ground and woodland varieties in North America. Hence if we allow two species of reindeer for America, why not two for the Old World? But there, where the species has been longer and is better known, competent authorities seem not to doubt their identity, and from which some even regard the American as

* Geog. Distr. of Mam., p. 155.

inseparable. I have already shown that the characters used for their separation are by no means reliable. Concerning the Greenland reindeer, Mr. Robert Brown, in a recent valuable paper on the Mammals of Greenland,* says, "that after very excellent opportunities of comparison and study," he considers "the Greenland reindeer only a climatic variety of the European species. I have, moreover," he adds, "seen specimens of reindeer horns from Greenland, which could not be distinguished from European, and *vice versa*. On the whole, however, there is a slight variation."

As I have previously remarked, I see no good reason why all may not be considered as one species, within which may be distinguished several quite well-marked geographical races.

In relation to other facts, the differences in size presented by the two races of American reindeer, the woodland and the Barren Ground, becomes extremely interesting; for, supposing them to form one species, as there seems to be little reason to doubt, the variation in this respect is directly the reverse of that ordinarily presented by individuals of the same species from localities differing considerably in latitude; the general law being an increase in size at the northward. But here there is a marked decrease. It is yet not quite exceptional, as a point is reached in the habitat of the non-migratory circumpolar species where the rigor of the climate, and the consequent altered conditions of life, seem unfavorable to a maximum development of the animal. This is exemplified by the small stature attained by the circumpolar tribes of men, as the Esquimaux of Greenland and of the north of America, and the Laplanders of the Old World. The common wolf (*Canis lupus*) has its smaller northern form, which, in America at least, occupies the Barren Grounds and the region northwards to the Arctic coast, and which differs quite positively from its more southern relatives.†

A smaller circumpolar Arctic form of the fox has long been recognized, differing in color, in size, and in the texture of its fur from the common species (*Vulpes vulgaris* and *V. fulvus* auct.). And there is a well-known corresponding race of bears, commonly referred to the *Ursus arctos*, which in America pass almost insensibly into the more southern and larger *Ursus horribilis*. Whether this decrease in size in the extreme boreal regions

* Proc. Lond. Zoöl. Soc., 1868, Part II, p. 352.

† "Of this species (*Canis griseo-albus* Rich.) I consider that there are two varieties, one of which is of a dark color and large size, inhabiting the wooded portions of the [Mackenzie's River] District as far north as the Youcon River. The other is usually of a dirty white tint, with, in general, a dark stripe down the back, and frequents the Barren Grounds northwards to the Arctic coast. It is of smaller size than the first-mentioned variety, and lives in much larger bands; indeed, it may possibly be a distinct species." — B. R. Ross, *Nat. Hist. Rev.*, July, 1862, p. 271.

extends to other species I have not at present the means of determining, though it is hardly to be expected that it will to all, since some of them are to a considerable degree migratory, going southward in winter, as the lynxes, martens, and some others. Hence extremes of climate, whether of heat or cold, seem to unfavorably influence the development of animal life generally, a mean or temperate region being as necessary for the highest development of the lower orders of mammalia as for that of man.

Besides the marked climatic modifications in size and in other features in the species cited above, certain other variations in them may be here appropriately referred to. These, though slight, so commonly appear in a number of species inhabiting the same region as to lead one at once to suspect a common cause for such differences. Dr. Richardson * long since pointed out slight differences in the color and texture of the fur, and in the breadth of the foot, in species which he considered identical in North America and Europe, between their representatives from Northern North America and Central Europe; the former having a finer and thicker coat, and broader feet, to better adapt them to a colder climate and a more snow-covered country, as well as brighter and livelier colors. These modifications appear also, he says, in the native domestic dogs.*

Naturalists have repeatedly remarked the narrower form of the head in the moose, bear, fox, and wolf in Eastern North American specimens as compared with others from Western Europe. In the former, the absolute breadth of the skull is generally less, while there is at the same time a greater development of the facial portion. In these animals a difference in size has also been claimed to distinguish their representatives from the two continents; but, owing to the variation in size on either continent with the latitude and elevation of the locality at which they were collected, observations on this point are somewhat contradictory. The general indication, however, seems to be that the American somewhat exceed the European when both are from near the same isotherm.

I have already called attention to the fact of the same species varying in color in different portions of its habitat, as in the case of the *Canis lupus*. On both continents, this species gradually changes from nearly white (yellowish or grayish white) in the Arctic regions to very dark or "black" in the southern. Individuals of the black and cross varieties of the fox (*Vulpes vulgaris*) are most numerous on both continents towards the north; † at the south, while the general fulvous color prevails on the dorsal

* Fauna Boreali-Americana, Vol. I, p. 91.

† Mr. B. R. Ross gives the proportion of the different colors in the foxes killed in the Mackenzie River District as red $\frac{6}{15}$ths, cross $\frac{7}{15}$ths, silver $\frac{2}{15}$ths; or sixty per cent of the dark variety to forty of the red; while as far south as the United States the dark varieties probably scarcely exceed one per cent. — *Nat. Hist. Rev.*, 1862, p. 272.

surface, there is apparently a greater development of dusky on the ventral; this type forming the *Vulpes* "*melanogaster*" of the south of Europe. According to Professor Baird, the black varieties in some of the American squirrels reach their greatest numerical development in the northern portions of their habitat; * where also melanic specimens of the marmot and racoon are most frequent. On the Atlantic slope there is a noticeable tendency to a predominance of gray rather than rufous tints, while in the interior, particularly in the Mississippi Valley, and on the Plains, the reverse is the case, in at least a number of species. I have in another place † called attention to the faded appearance of the plumage of many species of birds on the Plains, in those that range across the continent; in others there is a tendency to an increase of fulvous and rufous, as is noticeable in some mammals. In the Sonoran region there is a marked inclination to pied varieties, such occurring in the weasels (*P. frenatus* and *P. xanthogenys*), skunks (*Mephitis bicolor* and also in *M. mephitica*), the bears and squirrels. The changing to white in winter of many species at the north which at the south constantly retain their summer colors, as the weasels, the Arctic fox,‡ the wolf, and some of the hares,‡ it seems to me is also to be properly classed in the category of climatic and geographical peculiarities of coloration. The prevalence of neutral mouse-gray tints in so large a proportion of the mammals of Australia, and of plumbeous and black in those of Africa, in contrast with the brighter and more varied colors of those of the other continents, is but a grander exhibition of the same kind. The hibernation of certain species in the cold regions that in the warmer are constantly active, as in the *Ursidæ* and *Vespertilionidæ*, for example, is in some respects a similar phenomenon.

There are differences in size between specimens of the same species from different localities that are not apparently explainable on the ground of difference in the latitude and altitudes of their respective places of birth. On the Mississippi prairies, for example, some species of *Muridæ*,

* North Amer. Mam., p. 244.

† Mem. Bost. Soc. Nat. Hist., Vol. I, p. 513.

‡ Concerning this point Mr. Alfred Newton observes: "I have never seen it remarked, but it is unquestionably the case, that nearly all the Icelandic examples of *Canis lagopus* are 'blue' foxes; that is to say, their winter coat is nearly the same color as their summer coat. This fact, I think, must be taken in connection with the comparatively mild climate which Iceland enjoys in winter; and if so, is analogous to the circumstance that of the Alpine Hare (*Lepus timidus* Linn., *non auct.*) always becoming white in Scandinavia, generally so in Scotland, but seldom in Ireland." (*Proc. Zoöl. Society of London*, Dec. 1864, p. 497.) Dr. Richardson also states that the Arctic fox is of a purer white on the shores of Hudson's Bay than at Bhering's Straits, where, as is well known, the climate is considerably milder. (*Faun. Bor. Amer.*, I, p. 87.)

Talpidæ, and *Soricidæ* attain an appreciably larger size than under nearly the same latitude and degree of elevation at the eastward. The same fact is also observed in the mink; while the bears of the Pacific slope are larger than from most other parts of the Continent. Whether a greater abundance of their proper food may be the cause of this, it is impossible now to determine. They are facts, however, that are worthy of careful consideration, and they are cited here simply to call to them further attention.

It may be observed, in passing, that allied species, as the fox and wolf, vary differently under the same conditions; melanism being most developed in the one at the south, and in the other at the north. It is also noteworthy that circumpolar species follow the same law in their climatal variations that obtains in the differentiation in both the fauna and flora of the northern hemisphere in passing from the north southwards. As is well known, there are many species of animals and plants at the north, where their habitats approximate, that are common to the two continents. Such species become less and less numerous to the southwards, and beyond the tropics very few occur on both the Eastern and Western continents. In like manner, specimens from towards the north of the two continents of circumpolar species that range over the north temperate regions are much nearer alike than those collected from near their southern limits of distribution.

For the following notes on the Cetaceans of the Massachusetts coast, and their local names, I am indebted, as previously stated, to Captain N. E. Atwood, of Provincetown. For their scientific names I am under obligations to Professor E. D. Cope, of Philadelphia, to whom I forwarded Captain Atwood's notes for the determination of the species. Professor Cope's identifications and remarks are distinguished by being enclosed in brackets.

BALÆNIDÆ.

19. [**Balæna cisarctica** Cope.] "Right Whale. Occasional.

"This well-known species is at times taken here; in former years they were much more frequent in their visits than now. Although a straggling specimen may be seen at any time, they are generally more common during the latter part of April and the early part of May. They yield a larger amount of oil than any other species that visits our coast; besides which they have a large quantity of whalebone that finds a ready market, known as the "black whalebone" of commerce.

The skeleton of the right whale in the Museum of Comparative Zoology was taken here. The specimen yielded eighty barrels of oil, and the bone that was taken from its mouth was sold for $ 1,000."

20. [**Agaphelus gibbosus** (Erxl.) COPE.] "SCRAGG WHALE. Rare. A species of whale known by this name, nearly allied to if not identical with the right whale, is sometimes taken here. It is the opinion of many of our whalemen that they are not a distinct species, but the young right whale that lost its mother while very young and grew up without parental care, which has caused a slight modification. The most prominent feature is that in its dorsal ridge, near the tail, there are a number of small projections or bunches, having some resemblance to the teeth of a saw. It has no dorsal fin or hump on its back."

21. [**Megaptera osphyia** COPE, or another **Megaptera**.*] "HUMPBACK WHALE. This species is common on our coast, and sometimes comes into Provincetown harbor, where it is attacked and killed by our whalemen. They yield but a small quantity of oil compared with the yield of the right whale, the usual quantity being from ten to fifteen barrels. The bone in its mouth, unlike that of the right whale, is of little value and not considered worth saving. When harpooned it will run with great swiftness, and continues to do so while it is being killed. Its affection for its young seems stronger than that of any other species, as the mother will expose her own life in defence of her offspring."

22. **Eschrichtius robustus** LILJ. Professor Cope informs me that he has found a jaw of this species on the New Jersey coast; it should in all probability be enumerated in the present list.

23. [**Sibbaldius tectirostris** COPE, and probably another species.] "FINBACK WHALE. Frequent.

"This species is the most common large whale found along our coast, and is frequently seen at all times in the year. They are not har-

* Professor Cope believes that under the name of "Humpback," of Captain Atwood's list, more than one species may be embraced; and also more than one under the species called "Scragg Whale."

pooned by the whalemen, as they run so swiftly they cannot be killed. I have known a few to be killed by shooting them with a bomb lance. When they have been killed in this way in our bay they always sink to the bottom (they being not a fat whale), and remain there some few days, during which time much of the blubber is eaten off by sharks. I have known two of this species to run on shore in the night, in our harbor, and be left by the receding tide. When they were killed there appeared to be no indications of disease, and the cause of their running on the beach could not be learned. One of them yielded fourteen and the other twenty barrels of oil." In a subsequent communication Captain Atwood adds: "The finback is a species that yields only a small quantity of oil compared with its size; the blubber is thinner than in other species. The right whale killed here, of which the skeleton is in the Museum of Comparative Zoölogy, was forty-seven feet long, and yielded eighty barrels and fourteen gallons of oil; a finback since killed here was fifty-four feet long, and made only twenty barrels of oil, though a good fat whale of its kind."

24. **Sibbaldius tuberosus** Cope. A specimen at first doubtfully referred to the *S. laticeps* Gray,* by Professor Cope, but since regarded by him as a new species,† was captured in Mobjack Bay, Virginia, in May, 1866. It being a somewhat northern species, it should probably be included in the present list.

25. [**Sibbaldius borealis** Fisch.] "Sulphur-bottom Whale. Rare. This species is said to occur on our coast. Like the finback, it has on its back a very small dorsal fin. Being very much elongated, it is a swift runner, and passes through the water with a velocity so great that the whalemen cannot kill them in the same way that they take the other species. I have never seen it dead, and know but little about it."

26. [? **Balænoptera rostratra**. I have not yet identified this one.] "Grampus. Occasional. When seen here alone, we know it by that name. It is the opinion of some of our whalemen, with whom I have conversed respecting this whale, that it is not a distinct species, but the young of the finback."

* Proc. Phil. Acad. Nat. Sci., 1866, p. 297. † Ibid., 1869, p. 16.

PHYSETERIDÆ.

27. **Physeter macrocephalus** Pander. Sperm Whale. Occasional off the coast; formerly much more frequent.

28. [**Mesoplodon sowerbiensis**.] To this species Professor Cope refers a specimen found stranded a short time since on Nantucket Island. I learn from Mr. S. C. Martin that it was called "Grampus" by the whalemen, and that its length was sixteen feet and three inches, and girth seven feet. The skull, presented by Mr. Martin to Professor Agassiz, is now in the Museum of Comparative Zoölogy, and is the specimen referred to by Professor Agassiz at the meeting of the Boston Society of Natural History, held November 6, 1867. He remarked that it was a species new to America, and that it belonged to the genus *Mesoplodon*, as characterized by Gervais, and ought to be separated from the fossil *Xiphius*, described by Cuvier.*

DELPHINIDÆ.

29. [**Orca gladiator** Sundeval.] "Killer. This species visits our bay occasionally in small schools. Their dorsal fin is several feet high when fully grown. They are at times in summer seen coming into our harbor. The horse-mackerel fears them, and will run in shore when they appear."

30. [**Globiocephalus melas** Traill. (*D. intermedius* Harlan and *G. intermedius* Gray.)] "Blackfish. Common. This well-known species sometimes come into our bay in large schools in summer and autumn. They are then attacked by a number of boats from the shore, and often driven into shoal water or on shore and hundreds killed."

31. **Hyperaodon bidens** Owen. A specimen referred by Professor Cope to this species came ashore at North Dennis in January, 1869; its skeleton, secured by Mr. J. H. Blake, is now in the Museum

* Proc. Bost. Soc. Nat. Hist., Vol. XI, p. 318.

of Comparative Zoölogy. A few weeks later Professor Cope obtained another that was stranded near Newport, R. I.

32. [**Beluga canadensis** Erxl. White Whale.] At the close of his list Captain Atwood thus mentions a species identified by Professor Cope as above: "Besides those already named, some few years ago a species was killed in our harbor and brought on shore which no one knew. I examined it, and found it to differ from all other species. Not long after it was announced in the papers that there was a white whale on exhibition at the Aquarial Gardens in Boston, that Mr. Cutting had brought alive from the river St. Lawrence; a species that had never been seen south of that river. Soon after I visited Boston and called to see it. I pronounced it to be identical with the unknown species taken at Provincetown." This undoubted occurrence of the white whale at Provincetown is the only instance of its having been found so far south that has come to my knowledge. The skeleton of the specimen exhibited at the Boston Aquarial Gardens, and referred to above by Captain Atwood, is in the Museum of Comparative Zoology. Is was presented by Mr. Cutting.

33. [? **Lagenorhynchus** sp.] "Cow Fish. Occasional.

"This species differs from the blackfish in being much smaller, and in yielding much less oil. Its blubber is thinner, and its color is a light marble. It is sometimes called white blackfish by our whalers. It is occasionally killed here, but it does not appear in large schools, like the blackfish. It is a distinct species, intermediate in size between the blackfish and the species we call porpoise (dolphin)."

34. [**Delphinus erebennus** Cope. ["Porpoise. This is not an abundant species here. They are at times in summer seen passing along the shore in large schools, going northward; in autumn they may be seen going back to the southward."

35. **Delphinus clymene** Gray. According to Professor Cope this species has been taken on the coast of New Jersey,* and it is not unlikely to occasionally visit our shores.

36. [**Phocæna americana** Agass. (or *P. brachycium* Cope; I

* Proc. Phil. Acad. Nat. Sci., 1865, p. 261.

do not know which name will stand as yet.)] "SNUFFER or PUFFING PIG (*Phocæna americana*). This is the smallest of all the species. It is very common here at all seasons, and is occasionally caught in nets set for mackerel or blue-fish." There are several skeletons in the Museum of Comparative Zoölogy.

VESPERTILIONIDÆ.

37. **Lasiurus noveboracensis** TOMES. (*Vespertilio noveboracensis* Erxl.) RED BAT. NEW YORK BAT. Common; in some sections of the State the most numerous species of the family.

This species varies greatly in color, but the difference seems to be chiefly sexual. The adult males are generally much lighter than the females. In the young the sexual variation in color seems to be often much less marked.

The only well-marked distinguishing characteristics between this species and the next, except in more highly colored specimens of the latter, is generally the black border to the ear, and the black on the lips in *L. cinereus.* In each there are the same bands of color on the hairs, distributed in the same way, — dusky, verging to black at the base, then pale yellowish brown, succeeded by darker or brighter bands of red, and tipped with whitish. In some specimens the terminal band of whitish is quite absent, particularly on the anterior part of the body, the subterminal bright red zone being thus continuous to the tips of the hairs. In other specimens the terminal band of white is developed to a great degree, so as to very much obscure the red or dark chocolate zone beneath. Such specimens often strongly approximate to what is called *L. cinereus* (*V. pruinosus* Say), where the terminal white zone reaches its maximum of development, and the subterminal russet zone its greatest intensity. I feel, in fact, far from sure that the species are distinct. In a series of about twenty Massachusetts skins, nearly all marked for sex by the collector (Mr. C. J. Maynard), all the males are of a beautiful light, bright, yellowish red, with scarcely a trace of the apical white; the females, though somewhat more variable, are universally darker, the light red of the males being replaced in these by dark russet, which is more or less obscured by the whitish tips of the fur. The alcoholic series, so far as carefully examined in reference to this point, indicates this sexual difference to be quite constant; but there are occasional exceptions.

Very little seems to be known respecting the time of copulation or the period of gestation of the bats. From Mr. J. G. Shute, of Woburn, I learn a fact in reference to this point observed by him some few years since. Soon after sunset one evening in October he observed a strange object pass him in the air, which seemed to fall to the ground not far from where he was standing. Repairing immediately to the spot he soon found it, which proved to be a pair of these bats *in coitu.* They were captured and thrown into alcohol, and thus forwarded to the Museum of Comparative Zoölogy. About the 20th of June I once found, in Northern Illinois, a number of the *Scotophilus georgianus* containing quite advanced fœtuses, usually four or five in number. Dr. C. C. Abbott says that the *V. subulatus* brings forth its litter of three to five young late in June.*

38. **Lasiurus cinereus** H. Allen. (*Vespertilio pruinosus* Say.) Hoary Bat. Not common. Probably the rarest species of the family found in the State. Though commonly given in New England lists, I have never seen it from Massachusetts. I have been able to find but two specimens in the Museum collection referable to it, and those are, unfortunately, without localities. I have often seen in local collections specimens labelled with this name, but they were only the more hoary form of the common *L. noveboracensis.* From Dr. Allen's list of specimens its range seems to be nearly that of the preceding, — throughout temperate North America at least, — as some of them are stated to have been received from Nova Scotia, Red River Settlement, Louisiana, Matamoras, New Mexico, California, &c. As already observed, I question the validity of this species.

39. **Scotophilus fuscus** H. Allen. (*Vespertilio fuscus* Pal. de Bouv.; *V. carolinensis* Geoff. St. Hil.) Carolina Bat. Common.

I not only consider the suspicion of Dr. Allen that *S. carolinensis* and *S. fuscus* "may prove to be the same" well founded, but to his list of synonymes of this species would add *Eptisecus melanops* of Rafinesque. I would remove from it the *V. gryphus* of F. Cuvier, which I consider refers to the *V. subulatus* Say.

40. **Scotophilus georgianus** H. Allen. Less common than several of the other species, but apparently not excessively rare. There are several specimens in the Museum of Comparative Zoölogy

* Geology of New Jersey, Appendix, p. 752.

from Massachusetts, and others from Maine, the latter being at present its most northern known locality. This species is believed to be now for the first time reported from the Eastern States.

It appears to me that it would have been better to have entirely ignored the synonymes considered by Dr. Allen as doubtfully referring to this species than to have adopted any of them for its designation. The *V. georgianus* of F. Cuvier seems to me to be undoubtedly referable to *V. subulatus.* If any of F. Cuvier's names are to be considered as referring to it, it seems to me it is the *V. Saleri* of the same data, though it appears highly questionable whether this also, as well as the *V. monticola* of Bachman may not be more appropriately referred to *V. subulatus*, judging from the very imperfect descriptions alone. Dr. Allen, however, has had the types of some of these for examination, and finds them to correspond with what he calls *S. georgianus*, and it is this that appears to have guided him in determining these references.

41. **Scotophilus noctivagans** H. Allen. (*Vespertilio noctivagans* Le Conte.) Silvery-haired Bat. Rather common.

42. **Vespertilio subulatus** Say. Little Brown Bat. Common, especially in the Connecticut Valley. At Springfield it is *one* of the most common, if not *the* most common species.

Prior to the publication of Dr. Allen's monograph, but one species of the genus *Vespertilio*, as now restricted, had been recognized from Massachusetts, though others, based however on very doubtful characters, had been given by different authors from the Middle States. All who have critically studied the bats are well aware that they are quite variable in color and in many other characters. Thus Dr. Allen, under *Scotophilus fuscus*,* in alluding to certain variations in the form of the ear pointed out by Major Le Conte as distinguishing certain species of European authors, which Dr. Allen very properly deems to be merely nominal, observes: "While acknowledging that these differences may exist, I do not consider them constant. In a species so extensively distributed, and in a family so well known for its Protean tendencies as that to which *S. fuscus* belongs, slight and variable changes, confined entirely to the parts of the ear, are hardly sufficient data for these separations." Under *Vespertilio* † he remarks: "Owing to the fact that species of this genus have a widely spread distribution, minute differences in form and color in specimens brought from distant localities

* Monograph, p. 33. † Ibid., p. 46.

have been made of more importance than they deserve. Species have thus sprung up, many of which have never been identified, and seem only to retard progress by a useless synonomy." We fear, however, that Dr. Allen, with all his care, and the almost unexceptionable character of his admirable Monograph, has fallen in this group into an error which he found it necessary to criticise in others. With original specimens of most of his species for examination, I am unable to convince myself, either from these or from his descriptions, that several of the species recognized or described as new by him — especially *V. lucifugus* and *V. evotis*, and also *V. affinis* — are not really referable to *V. subulatus*. Among the large lot of bats furnished by the Museum of Comparative Zoölogy for use in the preparation of his Monograph, including some two hundred specimens from different parts of North America (besides many from foreign countries), specimens of *Vespertilio* from various localities in Maine and Massachusetts were labelled by him, when returned, respectively *V. evotis*, *V. subulatus*, and *V. lucifugus*. Individuals of the same colony, and that I scarcely doubt in some cases belonged to the same litter, of what I call *V. subulatus*, vary considerably in color, and not a little in the form of the ear. Dr. Allen says: "The specimens of *V. subulatus* arrange themselves into two groups, one of which may be considered typical, the other tending in the shape of the ear to the *preceding* species [*V. evotis*]. Indeed, the changes from one species to the other is so gradual that it is difficult to assign a boundary to each. I have included under *V. subulatus* a number of specimens which have the ear higher than those from which the description has been taken, but agreeing with *V. subulatus* in other particulars." *

From a critical analysis and comparison of the tables of measurements given by him of the different species of this genus, they appear most decidedly to intergrade, no less in the size and form of the ear — the character on which their separation is mainly based — than in other points. The *V. lucifugus* has, perhaps, the best claims to be regarded as a species, but these seem to be highly equivocal. *V. evotis* is the form with the highest, and relatively the largest ear, grading in this particular into *V. subulatus*, the more common form, and this again into *V. affinis* (of which but one specimen had been received) and *V. lucifugus*, in which the ear exhibits the minimum of size. In the latter the snout is blunter, and in the first more produced, this character correlating with the narrowed and elongated or shortened and blunted ear. In other words, the *V. evotis* is the slender form, the *V. lucifugus* the robust form, *V. subulatus* coming in between the two.† They all appear to have the same geograph-

* Monograph, p. 51.

† Naturalists seem to overlook the fact that feral animals may vary in size, in general form, in physiognomy, in temperament and disposition, in the same way as different

ical distribution, and specimens of each generally occur in collections from the same localities, whenever the number of specimens received is at all large. They are sometimes found in cool weather clinging together in the same "festoons."

Each species ranges, according to Dr. Allen, from ocean to ocean, and from very far north nearly or quite to the tropics.

Prior to 1864 only five species of bats were currently reported from New England; Dr. Allen's Monograph nearly doubled the number, increasing it to nine. Only six, however, are recognized in the present catalogue, one only (*Scotophilus georgianus*) having been added to those previously well known.

In respect to the many species of bats imperfectly described by some of the earlier authors, I have little hesitancy in referring to *V. subulatus* of Say the following: —

V. lucifugus Le Conte, Cuv. An. King. (McMurtrie's ed.), 1831, p. 431.
V. Caroli Zimm., Man. de Mam., II, 1835, p. 236.
V. gryphus F. Cuv., Nouv. Ann. du Mus. d'Hist. Nat., I, 1832, p. 15.
V. Salari Ibid., p. 16.
V. crassus Ibid., p. 18.
V. georgianus Ibid., p. 16.
V. subflavus Ibid., p. 17.
V. brevirostris Pr. Maximilian, Verzeich. Beobach. Säugethiere in Nord Amer., p. 19.
V. monticola Aud. and Bach., Journ. Phil. Acad. Nat. Sc., Vol. VIII, 1842, p. 280.
V. virginianus Ibid., p. 282.
V. californicus Ibid., p. 285.
V. Leibii Ibid., p. 284.

SORICIDÆ.

43. **Neosorex palustris** VERRILL.* (*Sorex palustris* Rich.;

individuals of any given nationality of men or breed of domesticated animals, in which such variations are patent to the most casual observer. In wild animals it needs only a critical comparison of many individuals of any species, concerning the identity of which there is no question, to satisfy careful investigators that it is equally the case here. It fails to be as well recognized only because it is impossible for us to be in sufficiently intimate relation with animals in a state of nature. In many instances where they are brought under the same conditions relatively for observation, as in the case of different species of *Cervidæ*, when kept in parks, it is soon detected. In this connection compare the observations of Judge Caton on "American Cervidæ" (see *antea*, p. 194).

* Notice of a *Neosorex* from Massachusetts, and of *Sorex Thompsoni* from Maine. By A. E. Verrill, Proc. Bost. Soc. Nat. Hist., Vol. IX (Oct. 1862), p. 164.

Neosorex albibarbis Cope.) Marsh Shrew. But three specimens of this species are as yet known from New England, two of which were captured by Professor E. D. Cope, at Franconia, N. H., and the other by Mr. F. W. Putnam, at Warwick, Mass. Professor Cope's specimens were swimming in a lake when first seen, about forty feet from the bank. As observed by Professor Verrill, the species of this genus are eminently adapted to an aquatic mode of life, they having large fringed feet and valvular ears.

44. **Sorex platyrhinus** Linsley. Broad-nosed Shrew. Comparatively common. I have taken a considerable number at Springfield, and Professor S. F. Baird, in his Mammals of North America (p. 26), cites nineteen examples in his list of specimens of this species from Massachusetts, eighteen of which were from Middleboro', and collected by Mr. J. W. P. Jenks.

45. **Sorex Cooperi** Bachman. Cooper's Shrew. This rare species I have never seen myself from this State; Professor Baird mentions two specimens from Middleboro', received from Mr. Jenks. Professor Verrill, in his paper already cited, refers to a specimen from Danvers, in the collection of the Essex Institute, as being the only one he had seen from New England. Last winter I received it from Wayne Co., N. Y., from my friend, Mr. Charles Potwine. The specimen was captured in the daytime, while running on the snow in the woods.

46. **Sorex Forsteri** Rich. Forster's Shrew. From its known range* this species is most likely to occur in Massachusetts. It has, in fact, been reported as often met with here, both in summer and in winter.†

Thompson's shrew (*Sorex Thompsoni* Baird) is also to be expected to occur in this State, it having been received by Professor Baird from Halifax, N. S., and Zanesville, Ohio, and by Professor Verrill from Maine.

* "Hudson's Bay to Carlisle, Pa." — Baird.

† "In the latter season they are found beneath a pile of wood or logs, and their tracks in the snow show their wanderings in search of food." — E. A. Samuels, *Agriculture of Mass.*, 1861, p. 142.

47. **Blarina brevicauda.** (*Sorex brevicaudus* Say, Emmons's Rep., p. 13; *Blarina talpoides* Gray). MOLE SHREW. Common. By far the most numerous species of the family.

A second species of *Blarina*, the *B. brevicauda* of Gray (*Sorex brevicaudus* Say) was formerly reported to exist in this State, Connecticut, New York, and throughout Eastern North America generally. But Professor Baird supposes it, if distinct from *B. talpoides*, to be exclusively Western; he has, however, failed to point out any differences of much weight between specimens he refers respectively to *S. brevicaudus* Say and *S. talpoides* Gapper (*B. talpoides* Gray). In his diagnosis of *B. brevicauda* he says: "Largest of all American shrews hitherto discovered (?)," and gives its dimensions as "Length, unstretched, over four inches to the root of the tail"; while he gives the "average length of head and body" of *B. talpoides* as "three and a half inches." Say gives the length of the head and body of *S. brevicaudus* as three inches and five eighths, or 3.62, which but slightly exceeds Professor Baird's average for *B. talpoides;* the two largest specimens of which he gives measurements (No. 2,078, from Massachusetts, and No. 2,146, from Illinois) slightly exceed this size. A Massachusetts specimen before me measures fully four inches, and two others exceed 3.75. Under *B. talpoides* he says, "With a large number of specimens before me, I have been more than usually perplexed in the attempt to determine the species of short-tailed shrews, as given by authors, and especially to distinguish between *S. brevicaudus* and *S. Dekayi*, of Bachman, De Kay, and others. I am satisfied that the latter species is identical with *S. talpoides* of Gapper (which indeed has priority of date), having found no essential differences between Canadian specimens and those from Massachusetts, Vermont, New York, Michigan, Wisconsin, and elsewhere. Gapper's specimen, it will be remembered, was taken in the district between York and Lake Simcoe, in Upper Canada.

"Thus far," he continues, "I have not been able to find any shrews from Massachusetts, New York, or adjoining States, possessing all the characters assigned by Bachman and De Kay. The hair of the same species varies with the season, being longer, softer, and fuller in winter; the precise shade of color is likewise not constant. The proportions of the shrews, unless taken from alcoholic or fresh specimens, vary exceedingly in the same species, according as the skin is under or over stuffed.

"For the present, therefore, I shall refer all the large shrews with short tails from the Atlantic States to the *S. talpoides.* I have, however, before me some specimens from the Upper Missouri and Iowa, which, as they differ in size from any in the East, and agree rather more closely with the *S. brevicaudus* of Say, I shall refer to this species." *

* North American Mammals, p. 41.

Under *B. brevicaudus* Professor Baird further observes: "I have found very great difficulty in identifying with any certainty the *S. brevicaudus* of Say, at least in the references to this species, as supposed to be found in the eastern portion of the continent. I have, however, I think, discovered it in some specimens of very large size from Nebraska and Iowa, localities nearer to that of the original specimen (Council Bluffs) than of any specimen yet discovered." In his list of the specimens referred to this species Professor Baird gives two from Nebraska, two from Iowa, and one each from Illinois and Wisconsin. The latter four are, however, referred with a mark of doubt. It is to be regretted that full measurements of all these specimens are not given for comparison with the excellent series of *B.* "*talpoides*";* as the size of two out of the three given is equalled by several of the *B. talpoides*, they being respectively but 3.50 and 3.65 inches in length. In view of the generally admitted variability of this species in size, color, length of tail, &c., at single localities, and which some seventy specimens now before me from Massachusetts fully demonstrate, and the but slightly larger size of Mr. Say's single example from Council Bluffs (which forms the original of *S. brevicaudus*) than the average of our short-tailed shrews, I refer to one species, and to this of Say, all the short-tailed shrews of the Northern and the Eastern States, Canada and the adjoining Provinces, of which the more recent name (*S. talpoides*) of Gapper becomes a synonyme. Also, in view of the already known wide distribution of this species, and the law of variation in size with respect to latitude and elevation, I must also consider the *S. carolinensis* of Bachman, which only differs from the northern specimens of *S. brevicaudus* (*B. talpoides* Gray, Baird's Report) in its slightly smaller size, as merely the more southern and hence the smaller race. Indeed, in consequence of the large size allowed it by Dr. Bachman, Professor Baird is inclined to consider this name as a synonyme of *B. talpoides*, as under this species he states: "Nor do I feel quite sure that the *Sorex carolinensis* of Bachman is really anything else than a small *S. talpoides*. The measurements given by him (length three inches) agree

* There has never been a more valuable contribution to the Natural History of the Mammals and Birds of North America, or of any country, than the lists of specimens and tables of measurements published by Professor Baird in his great and invaluable works on these two classes of the North American Vertebrata, contained in Volumes VIII and IX of the Reports of the Pacific Railroad Explorations and Surveys. They show not only, to a considerable extent, the geographical range of the different species, but their variation in size and proportion at different localities, and, when the number is large from one locality, the variation at single localities. The possession of these tables and his accompanying minute descriptions is next to having in hand the specimens themselves. It is very much to be regretted that so small a proportion of our natural history descriptions have been written with this great care and minuteness of detail.

precisely with many from Massachusetts and elsewhere, and are essentially the same in proportion with those of the largest-sized specimens of *S. talpoides*." But he adds: "There is, however, a distinct species in the Southern States, considerably smaller than *S. talpoides*, to which Bachman's name may be applied." Further on he gives a diagnosis of a "*B. carolinensis*," under which he cites Bachman's "*S. carolinensis*" as a synonyme. He describes it as "size considerably less than adults of *B. talpoides*," and gives the length of head and body as "about 2.50 inches." Comparing it with *B. brevicauda*, he says it differs from that species in its considerably smaller size, proportionally smaller feet, and in having the "third and fourth lateral teeth larger in proportion to the first and second," etc. Under this head he cites four specimens, three of which are from Missouri, and the other from South Carolina. These, he says, "agree in the main very well together, and as indicating a southern species smaller than *B. talpoides* or *brevicauda*." After finally referring *S. carolinensis* of Bachman to this species, he says: "I am by no means clear, however, that the particular measurements cited by him do not belong really to a specimen of *B. talpoides*; but," he strangely adds, Dr. Bachman having given us no such intimation, "he [Dr. Bachman] undoubtedly was acquainted with a species smaller than the latter" (*S. carolinensis* Bachman). That there is a somewhat smaller race in the South is unquestionable, but its specific rank is not to me so clear. This smaller form seems to occur generally throughout the Southern States, and along the low coast border as far north as New Jersey, and even perhaps to New York, corresponding in the limits of its distribution northward with the northern boundary of the Carolinian Fauna; the larger form occupying the Northern States generally, and the highlands of the Alleghanies south to Georgia; it thus occurring throughout the whole extent of the Alleghanian Fauna, and possibly throughout the Canadian. The range of *B. brevicauda* is now carried southwards to Florida and Texas, with only such differences in size between northern and southern specimens as are admitted to occur in other unquestioned species of mammals that have the same geographical range; the difference in size being the only constant or tangible distinction yet pointed out. The difficulty experienced by Professor Baird in determining the species of the older authors, it seems to me results chiefly from two causes: first, the imperfect character of the descriptions, which are generally of single specimens only, and of skins and stuffed examples; second, the by far too great number indicated.

In this connection it is proper to notice a species of *Blarina* described as new in the Report on North American Mammals (p. 47) from a single specimen from Burlington, Vermont. This specimen, its describer says, "in external appearance perfectly resembles specimens of *B. talpoides*," but "has some remarkable peculiarities of the skull. While it has no satisfactory external characters by which to designate it," "the skull is so entirely different from all others" he had seen, he says, as "almost to make a distinct subgenus." This difference consists in its being much narrower than in other short-tailed shrews, and in the greatest interorbital constriction being placed a little in front of the middle, instead of behind it, as in the others, and in its being greater in amount. In regard to this specimen, I need only add that, in respect to its skull, and in this character alone,* whether really a distinct species or an abnormal individual variation, it still remains unique, no other like it having yet become known to naturalists.

In continuing this preliminary revision of the *Blarinæ*, we find that ten species of this strictly American genus † of the short-tailed shrews have been described, all from the United States, three of which were first characterized by Professor Baird in his North American Mammals. Seven are recognized in this work as valid; two are given as doubtful or unidentified, and one is doubtfully referred to one of the others. These are arranged in two sections, according to the number of premolars; section "A" having five, and section "B" four. Their dental formulæ are as follows: —

$$\text{Section A, } \frac{2}{2}+\frac{5-5}{2-2}+\frac{4-4}{3-3}=32; \text{ section B, } \frac{2}{2}+\frac{4-4}{2-2}+\frac{4-4}{3-3}=30.$$

A lengthy diagnosis is given of each section, but no other essential differences are pointed out, the distinctions in respect to color, &c., being, as is evident from the descriptions of the species that follow, inconstant and invalid. In section B the first premolar is said to be slightly larger than the second, and in section A to be smaller than the second. But in the de-

* That is, judging from Professor Baird's description; but from the figures of its skull (Pl. XXX, Fig. 7), it seems to have had an imperfect or abnormal dentition, the number of visible premolars being three instead of four, in the upper jaw, and one instead of two in the lower, with a naked space between them and the incisors. It is possible, however, that the first premolar in each jaw had become accidentally lost before the skull passed into the hands of the artist.

† *Sorex brevicaudus* SAY, Long's Exped., I, 1823, 164.
" *parvus* SAY, Ibid., 163.
" *talpoides* GAPPER, Zool. Journ., V, 1830, 208, Pl. VIII.
" *carolinensis* BACHMAN, Journ. Phil. Acad. Nat. Sc., VII, 1837, 366, Pl. XXIII, Fig. 1.
" *cinereus* Ibid., 373, Pl. XXIII, Fig. 3.
" *Dekayi* Ibid., 377, Pl. XXIII, Fig. 4.
" (*Brachysorex*) *Harlani*, DUVERNOY, Mag. de Zool., 1842, 40, Pl. III, Fig. 6.
Blarina angusticeps BAIRD, N. Am. Mam., 1857, 47.
" *exilipes* Ibid., 51.
" *Berlandieri* Ibid., 53.

scriptions of *B. cinerea*, *B. Berlandieri*, and *B. exilipes*, which constitute section B, it is distinctly stated that the first premolar is *smaller* than the second. Figures of the skulls of all the species of both sections are given in Pls. XXVIII and XXX, but in no case does the first premolar *appear* to be quite equal to the second. In regard to section B, there are several circumstances suggestive of its being founded on immature examples of section A, in which the dentition is incomplete.* All the species are diminutive, and vary but little in size; the teeth are generally proportionally large compared with the size of the skull, as is always the case in young animals, and other characters seem to indicate immaturity. The missing premolar is the one we should expect the animal to acquire latest.† All the species of section B come from within the admitted geographical range of the species of section A, one only (*B. Berlandieri*) possibly excepted. Unfortunately, very young specimens of shrews are extremely rare in collections, and in the large series of *Blarinæ* in the Museum of Comparative Zoölogy there are none so small as those embraced under Baird's section B. In several of the smallest of them the fifth premolar is scarcely visible, forming a minute uncolored point on the inside of the jaw. In a single specimen from Middleboro', the smallest of the lot, it is wholly wanting. I regret that I have been unable to examine any of the original types of the species of section B. Between the three supposed species of this section (*B. cinerea*, *B. exilipes*, *B. Berlandieri*) the differences (which seem to consist chiefly in color, especially between the first two) are not greater nor different from those seen in a large series of specimens from Massachusetts or other localities. The differences between the different specimens referred to either of the species are also very appreciable, and in some cases (see under *cinerea* and *exilipes* in North American Mammals) so great that their assignment was very doubtfully made. While the evidence of the existence of so many species of *Blarina* in the Eastern United States, if really of more than one, is evidently very slight, I do not claim to have fully shown that but the one exists; my design has been mainly to call attention to the great need of a thorough revision of this

* It is well known that in *Scalops aquaticus* the number of teeth in the young is less than in the adult, and this difference has resulted in discrepant statements in respect to its dentition. (See BACHMAN on the Mole Shrews of North America, in Proc. Bost. Soc. Nat. Hist. I, 40. Also, Quad. N. Amer., Vol. I, p. 92.)

† The species of *Sorex* are divided into two sections on similar characters, where small size again accompanies the lesser number of teeth. There are other circumstances that render it not improbable that we have here again a section "B," based on immature representatives of a section "A." The number of species of *Sorex* admitted for the United States, twelve or more, is probably quite too large, though undoubtedly there may be half that number.

group. What I do claim is, that there is as yet no good evidence of the existence of more than the common and widely dispersed *B. brevicauda;* that the numerous other supposed species that have been described are mainly based, in the first section, on variations in size dependent upon locality, and that there are strong indications that those of the second section rest on variations, dependent upon immaturity, of the representatives of the first; that if other species do exist, as is not of course improbable, naturalists have thus far failed to satisfactorily establish the fact. In number of species, *Blarina* thus corresponds with *Condylura,* and in distribution, with *Scalops aquaticus.*

In the following comparative analysis of the diagnoses of sections A and B of *Blarina,* given in the Report on North American Mammals, some points but casually alluded to above are more fully discussed. A table of synonymes is also added.

Genus **Blarina** Gray.

List of the Species.

Section A.	Section B.
B. talpoides.	B. cinerea.
B. brevicauda.	B. exilipes.
B. carolinensis.	B. Berlandieri.
B. angusticeps.	

Diagnoses.

Color.

"Nearly uniform plumbeous on the body and tail; scarcely lighter beneath."

Exceptions. — Specimens of *B. talpoides* are mentioned as "slightly paler beneath," "fading to the belly into a still paler tint," &c.; of *B. carolinensis* as being "a little paler beneath." Massachusetts specimens of *Blarina* are generally *nearly* uniform, but many specimens occur that are considerably lighter beneath. The general color also varies from ashy and brownish through grayish plumbeous to exceedingly dark, almost black. Occasionally the hairs are so varied with light and dark as to present a hoary appearance.

"Lower parts of the body usually lighter than the upper, with *the line of demarcation* distinctly visible."

Exceptions. — *B. cinerea:* Hoary above, "somewhat resembling pepper and salt"; below, "a lighter tint of brownish gray or light ash; the *line of demarcation* in one specimen indistinct, in another more evident." *B. Berlandieri:* "In one [specimen] the prevailing tint is a chestnut brown at the tips of the hairs, with paler next to the tips, producing a slight hoariness. The under parts are a yellowish-brownish white; *the line of demarcation on the sides quite indistinct.*"

Dental Formulæ.

$$\frac{2}{2}+\frac{5-5}{2-2}+\frac{4-4}{3-3}=32 \qquad \frac{2}{2}+\frac{4-4}{2-2}+\frac{4-4}{3-3}=30$$

Incisors.

(1)* "The upper anterior incisor with the basal portion of the cutting edge formed by a nearly rectangular lobe, (2) the entire tooth forming only a single hook."

"Lower anterior incisor (1) *stout,* (2) *much curved,* (3) *with two or three lobed dentations.*" (4) "It extends back as far as the middle of the first molar." (5) "*The first and second premolars are placed above this incisor.*"

The variation presented by different specimens renders null distinction 4.

(1)* "Anterior upper incisor with the basal lobe more conical and further forward than in the other section."

"Lower anterior incisor (3) *with two or three lobed serrations,* (1) *stout,* (2) *much curved,* (4) not reaching posteriorly as far as the middle of the first molar; (5) *the two first lateral teeth entirely above it.*"

On page 9, the teeth in section A are described as "nearly uncolored," — that is, brown to the base, and in section B as "bicolored," — white at the base and tipped with brown. But in *B. brevicauda,* the second type of coloration is also quite frequent.

Upper Premolars.

(1) "The first two premolars are nearly equal, (2) the second *usually* a little larger; (3) the next two much smaller; (4) the fifth very small and usually not visible externally. (5) The first four with a basal-colored point on the inner side."

(1) "The first premolar tooth slightly larger than the second. (2) The third decidedly smaller than either, though larger than in the other group. (5) The small cusps on the inner side of the base of the first three lateral teeth, either wanting or very small."

Exceptions. — *B. cinerea:* "The first premolar tooth is a little *smaller* than the second."

B. exilipes: "The first lateral tooth is *rather smaller* than the second," &c.

B. Berlandieri: The first lateral tooth is "rather shorter than the second." See also the figures, which so represent them. Hence this main distinction of "first premolar tooth slightly larger than the second" by no means holds.

* The numbers prefixed to the characters in the diagnoses refer to the same character in each section. Those that seem to be nearly or quite synonymous in the two sections are italicized.

Hands.

"Hand contained about two and a third times in the hind feet."

In forty-seven specimens of *B. talpoides* the proportion is 74 to 100; in three specimens of *B. brevicauda* the proportion is 72 to 100; in three of *B. carolinensis* it is also 72 to 100. The range of variation, however, in *B. talpoides* (see Baird's table) is from .55 (specimens No. 2,076, 2,080, &c.) to .80 (specimen No. 2,083).

"Feet smaller than in section A; the anterior contained about one and a half times in the posterior."

In four specimens of *B. cinerea* the proportion is 75 to 100; in six specimens of *B. exilipes* 68 to 100; in four of *B. Berlandieri* 66 to 100.

Before closing my remarks on this subject I should call attention to the fact of the repetition of the same character, described in slightly different language, that so constantly occurs in diagnoses of the different species of the same genus, of different genera of the same sub-family, &c., and even of characters of ordinal value in specific descriptions, in the writings of even some of the best naturalists; — to the mixing up of non-essential or irrelevant characters with, and thus obscuring, those peculiar to the group in question. Sometimes, in fact, the really essential points are omitted, the diagnosis being almost as equally applicable to several species, or to any of quite a large group, as to one. All naturalists are not, of course, equally culpable in this respect. But in general, by sifting descriptions of their generalities, they could be greatly reduced and their definiteness and accuracy proportionally increased. The labor of preparing diagnoses would of course be thus increased, but the advantages arising therefrom would be immense. I am not the first, I am happy to find, to make strictures of this character, and hope that the matter will soon receive at the hands of descriptive naturalists the consideration it merits. Neither, I should say, are these strictures introduced at this time as a special criticism upon any particular author.

Blarina brevicauda.

Sorex brevicaudus Say, Long's Exped., I, 1823, 164.
" " Harlan, Faun. Amer., 1825, 29.
" " Godman, Am. Nat. Hist., I, 1831, 79. (From Say.)
" " Bachman, Journ. Phil. Acad. Nat. Science, VII, 1837, 381.
" " Emmons, Quad. Mass., 1840, 13.
" " De Kay, N. York Fauna, I, 1842, 18.

Sorex brevicaudus LINSLEY, Am. Journ. Sc., XLIII, 1842, 346.
" " THOMPSON, Hist. Vermont, 1842, 27.
" " PLUMBER, Am. Journ. Sc., XLVI, 277.
Blarina brevicauda BAIRD, Mam. N. Am., 1837, 42, Pl. XXX, Fig. 5.
" " SAMUELS, Agr. Mass., 1861, 144.
Sorex talpoides GAPPER, Zoöl. Journ., V, 1830, 208, Pl. VIII.
Corsira (*Blarina*) *talpoides* GRAY, Proc. Lond. Zool. Sc., V, 1837, 124.
Blarina talpoides BAIRD, Mam. N. Am., 37, Pl. XXX, Fig. 6.
" " SAMUELS, Agr. Mass., 1861, 145.
" " VERRILL, Proc. Bost. Soc. Nat. Hist., IX, 1863, 172.
Sorex parvus SAY, Long's Exped., I, 164.
" " HARLAN, Faun. Am., 29.
" " BACHMAN, Journ. Phil. Ac. N. Sc., VII, 394. (From Say.)
" " DE KAY, N. Y. Fauna, I, 19.
" " LINSLEY, Am. Journ. Sc., XLIII, 346.
" " AUD. & BACH., Quad. N. Am., II, 1851, 145, Pl. LXX.
" *Dekayi* BACHMAN, Journ. Phil. Acad. Nat. Sc., VII, 377, Pl. XXIII, Fig. 4.
" " DE KAY, N. Y. Fauna, I, 17, Pl. V, Fig. 2.
" " LINSLEY, Am. Journ. Sc., XXXIX, 388, Ib. XLIII, 346.
" " AUD. & BACH., Quad. N. Am., III, 1853, 246, Pl. CL, Fig. 2.
" *cinereus** BACHMAN, Journ. Phil. Acad. Nat. Sc., VII, 373, Pl. XXIII, Fig. 3.
Blarina carolinensis BAIRD, Mam. N. Amer., 45, Pl. XXX, Fig. 8, skull.
" *angusticeps* Ib., 47, Pl. XXX, Fig. 7, skull.
" *cinerea* Ib., 48, Pl. XXX, Figs. 9 & 10, skulls. (Young.)
" *exilipes* Ib., 51, Pl. XXVIII. (Young.)
" *Berlandieri* Ib., 53, Pl. XXVIII. (Young.)

TALPIDÆ.

48. **Scalops aquaticus** FISCHER. (*Scalops canadensis* Emmons, Rep., p. 15.) COMMON MOLE. Common.

49. **Scalops Breweri** BACH. HAIRY-TAILED MOLE. Apparently rare in Massachusetts, and not numerous anywhere. The original specimen described by Dr. Bachman came from Martha's Vineyard, and was collected by Dr. L. M. Yale, and presented by Dr. T. M. Brewer

* Afterwards considered by Dr. Bachman to be the young of *S. carolinensis*. See Quad. N. Am., III, p. 344. Same as *B. cinerea* Baird.

to Dr. Bachman. There is a specimen in the Museum of Comparative Zoölogy from Warwick, and others from Upton, Maine, and Halidaysburg, Pennsylvania.

50. **Condylura cristata** Desmorest. (*C. longicauda* Desm. and *C. macroura* Harlan of Emmons's Rep., pp. 17, 18.) Star-nosed Mole. Common, but apparently more so in some parts of the State than in others. At Springfield this and *Scalops aquaticus* are about equally numerous, but in the eastern part of the State the present species seems to many times outnumber the other. From considerable variations in the length and size of the tail presented by different individuals, it was formerly incorrectly supposed that two species of *Condylura* existed in Massachusetts, and the eastern parts of the United States generally. The thickening of the tail appears to be connected with the rutting season.

SCIURIDÆ.

51. **Sciurus cinereus** Linn. (? "*S. vulpinus* Gmel.," Emmons's Rep., p. 66.) Fox Squirrel. Rare in most parts of the State.

52. **Sciurus carolinensis** Gmelin. ("*S. leucotis* Gapper" and "*S. niger* Linn.," Emmons's Rep., pp. 66, 67. *Macroxus** *carolinensis* Gray.) Gray Squirrel. Generally distributed, but much more common in some sections than in others, being most numerous where the forests have been least disturbed. Generally they are of the gray type, but the black variety is quite prevalent at some localities. In Wayne County, New York (on the south shore of Lake Ontario), I have found the black variety to be the most common, with every gradation between the two. All those observed that were pure glossy black seemed to be very old individuals, while the young generally presented a mixture of tawny, gray, and black, the hairs being annulated

* Dr. J. E. Gray, in his several Synopses of the Asiatic, African, and American Squirrels (Ann. and Mag. Nat. Hist., 3d Ser. Vol. XX, 1867), has recently divided the old genus *Sciurus* into several genera. *Sciurus*, as restricted by him, and *Macroxus* contain all the American species, by far the larger part of which are placed in *Macroxus*. Only the group to which *S. hudsonius* belongs, the *S. cinereus* or Northern fox squirrel, and Abert's squirrel from New Mexico (called by Gray *S.* "*Albertii*" = *S. Abertii* Woodhouse), remain in the genus *Sciurus* as restricted by Dr. Gray.

with these colors, varying in the proportion of each in almost every individual. The intensity of the black appears to increase with age.

Dr. Emmons's *S. vulpinus* seems to refer to large examples of this species rather than to the true fox squirrel (*S. cinereus* Linn.).

53. **Sciurus hudsonius** Pallas. Red Squirrel. Chickaree. Abundant.

The variations in color, in the hairiness of the soles, the presence or absence of ear-tufts, according to the season of the year, in this and other species, have already been pointed out by Professor Baird.* The lateral dusky stripe is perhaps the most variable feature in the present animal, in many specimens it being quite absent, and in the greater portion but faintly indicated, but it is not unfrequently one of the most conspicuous features of coloration. In fall specimens, particularly around Springfield, the black lateral line is generally conspicuous, being a well-defined, quite broad black band. Specimens from Northern Maine † differ from the majority of Massachusetts specimens in possessing a relatively very much shorter tail, somewhat in general color, the back being "rusty-yellow" rather than ferruginous, and in the greater fulness and softness of the fur. The black at the end of the tail is much broader and more conspicuous. In several points these specimens thus approach *S. Richardsonii*. Specimens entirely black have been received from Mr. G. A. Boardman from near Calais, Maine. In view of the wide range of variation presented by *S. hudsonius*, the descriptions of some of its near allies, especially of *S. Fremontii* and *S. Richardsonii* of Townsend and Bachman, seem scarcely to indicate more than slight local variations of one species. The specimens of the latter thus far examined have been too few to establish any very important differences between them and *S. hudsonius*, if such exist.

Professor Baird in his admirable article on the *Sciurinæ*, or typical squirrels of the United States, was able, through the very abundant material at his disposal, to eliminate a very large proportion of the invalid species that had from time to time crept into the works of preceding authors, including many described by Bachman and other Americans as well as by foreign naturalists. The variations pointed out by him as being dependent upon season and locality are important discoveries, since such variations are also of common occurrence among other groups. Two or three species only, besides those above specified, of the twelve species of *Sciurus* admitted in the work of this author seem at all questionable. These

* N. Amer. Mam., pp. 244 and 270.

† In the Mus. Comp. Zoöl., and C. J. Maynard's collection.

are the *S. castanonotus* and *S. limitis* from the little known region of Northern Mexico and the adjoining Territories northward, whose somewhat doubtful character is particularly mentioned.

Dr. Gray, in his "Synopsis of American Squirrels,"* quotes Professor Baird's remarks respecting the wide variation in color presented by individuals of the same litter, the geographical variation in size, the variations in the hairiness of the soles of the feet at different seasons and between northern and southern representatives of the same species at the same season, and also in respect to the absence or presence of the ear-tufts in different individuals of the same species from the same locality; and so far as he has followed Baird's memoir his paper is to be commended. As soon, however, as extralimital species are encountered he seems to have lost sight of all these important facts quoted by him, and takes every considerable variation in color as the basis of a species. Hence the greater part of those described by previous authors receive his approval, and some *ten or twelve*, apparently, are added as new! The whole number of American *Sciuri* is thus increased to thirty-nine species. That some of the Mexican species are as variable as those of the United States is beyond question, while it is probable that some of the still more southern ones also are. According to Dr. Gray, the number of species of Asiatic *Sciuri* is forty-nine, an improbably large number, from which the excess can only be properly eliminated by a careful observer residing where these animals live, and the elaboration of a mass of material far greater than has thus far been brought together.

54. **Pteromys volucella** Desm. Flying Squirrel. Common, but, from its nocturnal habits, not often seen.

Apparently equally mature individuals from the same locality are quite variable in size, and somewhat in other characters. One, remarkably large, collected by Mr. S. Jillson at Hudson (Mass.), corresponds very well with the *P. hudsonius* Fischer (*P. sabrinus* Rich.), which supposed species is almost unquestionably but the large northern race of *P. volucella*.

Richardson described, in the "Fauna Boreali-Americana,"† a variety of his *P. sabrinus* from the Rocky Mountains, to which he gave the name *alpinus* (*P. sab.*, var. *alpinus*). Wagner, in his Supplement to Schroeber's Säugethiere,‡ and Audubon and Bachman in their North American Quadrupeds,§ afterwards raised it to the rank of a species, but apparently with insufficient reason. Professor Baird also admits *P. alpinus* as a species in

* Ann. and Mag. Nat. Hist., 1867, p. 415.
† Vol. I, p. 195, pl. 18.
‡ Vol. III. p. 230.
§ Vol. III. p. 206.

his Mammals of North America (p. 289), but remarks that, from insufficient data, he was unable to arrive at a definite conclusion as to whether it was really distinct from *P. hudsonius*. The *P. oregonensis* of Bachman seems also very doubtfully distinct from *P. volucella*, as it does not differ very appreciably from the Eastern animal. The following remarks from Audubon and Bachman's North American Quadrupeds* in respect to the number of species of North American *Pteromys* are very suggestive. "As long," they observe, "as only two species of flying squirrel were known in North America, — the present species (*P. sabrinus*) and the little *P. volucella*, — there was no difficulty in deciding on the species, but since others have been described in the far West, the task of separating and defining them has become very perplexing."

Specimens in the Museum of Comparative Zoölogy from Lake Superior, Northern Maine, New Hampshire, Massachusetts, and the Middle States, form a graduated series in size, the first-mentioned, or northern, corre-ponding with the *P.* "*sabrinus*"; the southern, of course, with the true *P. volucella* of authors. Difference in size has been the only appreciable character that has been advanced as distinguishing them.

55. **Tamias striatus** BAIRD. (*T. americanus* Kuhl. *Sciurus striatus* Klein, Emmons's Rep., p. 68.) STRIPED SQUIRREL. CHIPMUNK. Abundant. Usually first seen abroad in spring towards the close of March, when they are readily detected by their loud clucking note.

A series of nearly fifty specimens in the Museum of Comparative Zoology, from various localities in Eastern Massachusetts, are extremely uniform in color, the variations being so slight as to be scarcely appreciable. A considerable number of others, from different localities in Maine, are generally very much lighter or paler colored. These, also, vary a good deal among themselves, chiefly, however, in the character of the stripes, which in several specimens are much less distinct than usual. In one they are quite faint and irregular, the light central one on the sides being alone well defined, and this is at one point interrupted. The difference in general tint between these Massachusetts and Maine specimens is quite marked in the rufous-colored regions of the animal, and especially on the posterior part of the back.

56. **Arctomys monax** GMELIN. WOODCHUCK. Abundant. At Springfield a number of specimens of the black variety have been taken within the last few years, and also three albinos. One of these is nearly white (pale grayish-white), and the other two are pale yellowish-brown

* Vol. III, p. 205.

or cream-colored. The latter are preserved in the Springfield Natural History Museum.

I have known of a few instances of the capture of this species in nearly midwinter. Once a specimen was taken running in the highway early in February, when the snow was a foot and a half deep. They generally leave their burrows very early in spring, often before the ground is fully thawed, but for some time after are irregular in going abroad, and are able to remain six or eight days inside their burrows without food, as they will often do when a trap is set for them. Till the season and vegetation are somewhat advanced they seem to take or require but little nourishment. Later, and especially after the birth of the young in June, they are forced in a much shorter time to leave their holes to obtain food. In fall they become very fat, and early in October generally permanently retire to their burrows, or at least go abroad then much less frequently than earlier, and apparently take very little food.

The Beaver (*Castor fiber* Linn.; *C. canadensis* Kuhl) is to be reckoned among those few animals that, in this State, have become fully exterminated.

The few differences pointed out by authors between the European and American beavers, including the distinction based on a comparison of the skulls, are too trivial, in the light of the extensive individual variations now so well known to be almost invariably presented by a large series of specimens of the same species from any given locality, to be taken as satisfactory evidence of their diversity. The weight of authority is also by far in favor of their identity.

57. **Jaculus hudsonius** Baird. (*Meriones* * *hudsonius* Aud. and Bach.) Jumping Mouse. Rather common, but far from numerous.

This species has distinct cheek-pouches, — a fact I have not before seen stated.

58. **Mus decumanus** Pallas. Brown Rat. Wharf Rat. Norway Rat. Abundant in the cities and larger villages generally; rare or quite unknown in the remote farming districts.

* *Meriones*, F. Cuvier, Dents des Mam., 1825, 187; type, *Dipus americanus* Barton. Not *Meriones* Illiger, Prod., 1811.

59. **Mus rattus** Linn. Black Rat. Abundant in the farming districts, but rare wherever the brown rat is numerous. In the vicinity of Boston and of the larger cities generally it seems to be quite unknown. Twenty or thirty miles from the coast, and at a little distance from the large towns along the railways, it becomes numerous, and the only species there found. The brown rat is its mortal enemy. With age this species changes from black to gray, very old individuals becoming very light colored.

60. **Mus musculus** Linn. House Mouse. Everywhere a numerous pest. Is frequent in the fields under stacks of grain as well as in houses and outbuildings.

61. **Hesperomys leucopus** LeConte. (*H. leucopus* and *H. myoides* Baird.) White-footed Mouse. Deer Mouse. A common species of the fields and woods. In winter it (sometimes at least) retires to a warm nest in a hollow stump or log, in which in severe weather I have found five or six together in a torpid state.

No species of our *Muridæ*, excepting possibly the *Jaculus hudsonius*, presents so great variations in color with season and age as the present. The young for the first two or three months, or till nearly full-grown, are dark slate or plumbeous above, somewhat lighter below. From the casting of the winter coat in spring till late in autumn the adult differs more or less in color with almost every individual, none presenting the bright yellowish or ferruginous brown seen in winter and early spring, but every stage between it and the plumbeous hue of the young; the adult being also more or less dusky for some time after moulting. Generally there is a darker band along the back, varying in width in different specimens, and in distinctness of outline; sometimes, however, the back is uniform in color with the sides. The variation in size is also considerable between specimens apparently fully adult. The tubercles on the soles of the hind feet, on which specific distinctions are sometimes based, vary both in relative size and position. The posterior one is usually situated midway between the toes and the heel, but sometimes more posteriorly or more anteriorly. The next one is placed between this and the third, and is usually nearer to this than to the first, it being sometimes opposite to the third. The third anterior tubercle occasionally has a minute supplemental one at its outer base. But the most variable character consists in the relative length and number of the caudal vertebræ. About one fifth of the Massachusetts specimens have the tail vertebræ equal to or longer than the head and body together; occasionally a specimen is found in which the tail vertebræ alone exceed this length by one fourth to one half an inch. At least four fifths, however, have the tail shorter than the head and body, and occasionally one occurs with the tail only equal to the body alone. In these latter the proportional length of the tail vertebræ to the length of the head and body is as 68 to 100; in the other extreme, or in those with long tails, as 118 to 100. The variation between these extremes is hence about fifty per cent of the mean, — a striking example of the unreliability of this character as a specific distinction already claimed in discussing the species of *Mustelidæ*. The number of the vertebræ varies from twenty-four or twenty-five to above thirty. In regard to absolute size, the length of the head and body together, in Massachusetts specimens, rarely exceeds four inches; the average is between three and a quarter and three and a half; perhaps nearer the latter. The variation in this respect is well illustrated in Professor Baird's table of measurements of a large number of Middleboro' and other specimens of this species, given in the Mammals of North America (p. 462).

Through the seasonal and other variations in color, as well as in size and proportions, it becomes extremely difficult to distinguish the different North American species of the restricted genus *Hesperomys*, if so many species are to be recognized as have been described, similar variations apparently occurring in all the species. That several exist in the eastern part of the United States seems unquestionable, but the validity of many that have been described from this region is at the same time highly doubtful. The *H. gossypinus*, as defined by Professor Baird, would at first seem readily distinguishable by its comparatively large size, coupled with a southern habitat and its short tail; in color and proportions it closely resembles *H. leucopus*. But since in *H. cognatus* we have a form intermediate between the two and intimately allied to both, the true standing and affinities of each of the three become questionable. Some specimens of *Hesperomys* before me from Florida * differ in no essential particular from examples of *H. leucopus* in summer pelage from Massachusetts and Maine. Well-marked examples of either of the two first mentioned of these so-called species seem sufficiently distinct, but a large series of specimens is constantly presenting intermediate stages, and a large amount of variation in each of the would-be distinctive characters. A single Florida specimen of *H. Nuttallii* (*Mus aureolus* Aud. and Bach.) differs much in color from the other Florida specimens of *Hesperomys*, and from *H. leucopus*.

* In addition to the specimens collected by myself in Florida the past winter, I am indebted to Mr. C. J. Maynard for the opportunity of examining others obtained there by himself the same season.

H. michiganensis, of which I have also had fresh specimens for examination, seems as well marked as any of the group, through its small size, very short tail, and dark plumbeous color at all seasons. Other specimens collected by myself in Western Iowa, supposed from their locality to be referable to *H. sonoriensis*, differ in no way appreciably, except in being a little lighter colored, from average specimens of Massachusetts *H. leucopus*.

H. myoides, described by Baird from Canada and Vermont specimens, is positively identical with *H. leucopus*, the cheek-pouches — the only character supposed to distinctively characterize it — being probably common to all the species of the genus, as well as to *Jaculus*.* I first became aware of the existence of cheek-pouches in *H. leucopus* by capturing the animal with the pouches distended with seeds and grain; a subsequent examination of many specimens in alcohol from Berlin, Middleboro',† Springfield, and other localities in Massachusetts, and from Waterville, Norway, Bethel, Upton, and other places in Maine, has fully confirmed this discovery, as I have yet to find the first specimen without the pouches. They almost uniformly exist as described by Gapper, — that is, extending upwards to the eye and posteriorly to the ear. They are equally well marked in specimens of *H. gossypinus* and *H.* "*cognatus*," from Florida. ‡

In the large proportion of equivocal species included among the thirteen recognized in the General Report, to which one since described from In-

* See *antea*, p. 226.

† The Middleboro' specimens were collected by Mr. J. W. P. Jenks, and presented by the Smithsonian Institution to the Museum of Comparative Zoölogy, labelled "*Hesperomys leucopus.*"

‡ In the Report on North American Mammals (p. 460) it is stated, "No traces of cheek-pouches can be detected" in *H. leucopus*. Under *H. myoïdes* the same author remarks (Ib., p. 472) that he found, much to his astonishment, decided indications of cheek-pouches in all the alcoholic specimens of that "species" he examined. "I then," he says, "investigated a considerable number of Middleboro' specimens, and in none could I detect the slightest indication of anything of the kind." "In another specimen," he says later (No. 2776), "from Watervile, New York, referable probably to the same species [*H. myoides*], I found the cheeks crammed with large seeds, and on cutting them open could see that the latter occupied a pouch of considerable size. It is possible that this specimen (immature) may not belong to *H. myoides*, if so, we must conclude that in the ability to distend the cheeks very much, even temporarily, the *H. leucopus* approaches very closely to the *H. myoides*, and this diminishes still more the propriety of placing the latter in a distinct genus. It is quite possible that others of our species may have the cheek-pouches more or less developed." It hence appears that the existence of cheek-pouches in the other species of *Hesperomys* was finally strongly suspected by the author in question. The oversight of their presence in *H. leucopus*, however, is somewhat surprising, since they are not difficult to discover in specimens preserved in alcohol, when search for them is properly made, though in specimens badly contracted by the alcohol they might quite readily escape observation.

diana by Prince Maximilian is added,* there are besides the several doubtful ones already mentioned, others equally questionable. Of those assigned to that part of the United States east of the Rocky Mountains, the *H. michiganensis*, *H. leucopus*, and *H. Nuttallii* (*aureolus* Aud. and Bach.), seem to be those best entitled to recognition, while possibly *H. gossypinus* may be also valid; but with my present knowledge of the subject, I fail to see why *H. texanus*, *H. indianus* (of Prince Maximilian), *H. sonoriensis*, *H. myoides*, and *H. cognatus*, should be thus regarded, all but the latter, and perhaps also both this and *H. gossypinus*, being apparently referable to *H. leucopus*. I do not hesitate to thus refer *H. sonoriensis*, and *H. myoides*, both of which I have examined in the fresh state, and numbers of the latter that were preserved in alcohol.

Of the Pacific Coast species, of which at least five have been described, several are intimately allied to the *H. leucopus* of the East, as well as to each other. Whether any of them are identical with *H. leucopus* is not at present, from want of sufficient material, easy to decide. Should they prove to be so, it would substantiate a more extended geographical range for *H.*

* 1. *Hesperomys leucopus* Baird, N. Am. Mam., 1857, 459; = *Musculus leucopus* Raff., Amer. Monthly Mag., III, 1823, 307.

2. *Hesperomys myoides* Baird, N. Am. Mam., 472; = *Cricetus myoides* Gapper, Zoöl. Journ., 1830, 204.

3. *Hesperomys indianus* Maximilian, Archiv für Naturgesch., XVIII, 1, 1862, 111.

4. *Hesperomys sonoriensis* LeConte, Proc. Phil. Acad. Nat. Sci., VI, 1853, 413; = *H. sonoriensis* Baird, N. Am. Mam., 474.

5. *Hesperomys texanus* Woodhouse, Proc. Phil. Acad. Nat. Sci., VI, 1853, 242; = *H. texanus* Baird, N. Am. Mam., 464.

6. *Hesperomys Nuttallii* Baird, N. Am. Mam., p. 467; =? *Arvicola Nuttallii* Harlan, Month. Amer. Journ., 1832, 446; = *Mus* (*Calomys*) *aureolus* Aud. and Bach., Jour. Phil. Acad. Nat. Sci., VIII, 1842, 302.

7. *Hesperomys cognatus* LeConte, Proc. Phil. Acad. Nat. Sci., VII, 1855, 442; = *H. cognatus* Baird, N. Am. Mam., 469.

8. *Hesperomys gossypinus* LeConte, Proc. Phil. Acad. Nat. Sci., VI, 1853, 411; = *H. gossypinus* Baird, N. Am. Mam., 469.

9. *Hesperomys Boylii* Baird, Proc. Phil. Acad., VII, 1855, 335; = Ibid., N. Am. Mam., 471.

10. *Hesperomys californicus* Baird, N. Am. Mam., 478; = *Mus californicus* Gambel, Proc. Phil. Acad. Nat. Sci., IV, 1848, 78.

11. *Hesperomys eremicus* Baird, N. Am. Mam., 479.

12. *Hesperomys austerus* Baird, Proc. Phil. Acad. Nat. Sci., VII, 1855, 336; = Ibid., N. Am. Mam., 466.

13. *Hesperomys Gambelii* Baird, N. Am. Mam., 464.

14. *Hesperomys michiganensis* Wagner, Archiv für Naturgesch., 1843, 2, 51; = *Mus michiganensis* Aud. and Bach., Journ. Phil. Acad. Nat. Sci., VIII, 304; = *H. michiganensis* Baird, N. Am. Mam., 476; = *Mus Bairdii* Hoy & Kennicott, Patent-Office Rep., Agr., 1856 (1857), 92.

leucopus than many of the rodents possess, particularly the smaller species, but no greater than seems to be admitted for *Jaculus hudsonius*, its somewhat near ally. The habitat of *Jaculus hudsonius*, as now commonly defined, extends from ocean to ocean, and from the Arctic regions southward through at least the Middle States and to Missouri. This, also, is a species remarkable for its variability in color, size, proportional length of the tail to the body, etc.; but in the General Report on the Mammals of North America these differences were allowed only their proper value, and several species of authors were reduced to synonymes in consequence. Had the same course been taken in respect to the genus *Hesperomys*, undoubtedly a large proportion of the nominal species now admitted would have been referred to their proper rank. There seems to be no reason why *Hesperomys leucopus* may not range as widely as *Jaculus hudsonius*, and but little to show that such is not the case.

62. **Arvicola Gapperi** Vigors. Red-backed Mouse. Apparently not very rare in some localities in the eastern part of the State. Professor Baird mentions seven specimens sent him by Mr. J. W. P. Jenks from Middleboro'.* There are also several specimens in the Museum of Comparative Zoölogy from localities near Cambridge. It has not yet been met with, however, in the vicinity of Springfield. It is apparently less southern in its distribution than the next following species.

63. **Arvicola riparius** Ord. Common Meadow Mouse. Abundant; periodically excessively so. At such times they often do great harm by destroying fruit and other trees. Apple-trees a foot in diameter are sometimes killed by being girdled by these destructive animals. They also occasionally destroy large numbers of those of smaller size, as well as of young pitch-pines (*Pinus rigida* Linn.) and other native trees. Their excessive increase is generally coincident with a series of winters during which the ground is covered with a heavy deposit of snow, which protects them from cold, and beneath which they burrow and commit their ravages. Their decrease generally occurs during a series of "open" winters, when in searching for their food they are wholly unprotected from severe cold, and the deep freezing of the ground obstructs their shallow burrows, within which they are doubtless often frozen. They frequent every variety of situa-

* N. Am. Mam., p. 521.

tion, from half-submerged meadows to the driest sandy plains. Dr. Godman, in his American Natural History,* under *Arvicola xanthognathus*, has very minutely described the habits of this species. While in meadows it forms roadways among the roots of the grass on the surface, in grain-fields it burrows beneath the surface, its habits varying with circumstances. In the latter situation the vegetation is not generally sufficiently dense to screen it, hence its more subterranean mode of life. Their nests are found containing newly born young from early in May till November. The number of litters produced by a single female in a year is probably generally not less than three, and may be more; the young of the early litters also themselves appear to have young the same season; hence the great rapidity of increase that obtains in this species.

Specimens, even from the same locality, vary considerably in size, color, the texture of the fur, and even in the shape of the skull, independently of considerable variations that result from age and season. On these variations have been erected numerous nominal species, some of which are already currently considered as synonymes of *A. riparius* Ord, and several more, doubtless, should be added to the list. Among those described from or attributed to Massachusetts which I refer to *A. riparius* are *A. hirsutus* and *A. albo-rufescens* Emmons,† *A. nasuta* Audubon and Bachman,‡ and *A. Breweri* and *A. rufidorsum* Baird; § also, *A. rufescens* De Kay, ‖ from New York.

On Muskeget Island (a small, uninhabited, low sandy island between Nantucket and Martha's Vineyard) I recently found the so-called *A. Breweri* excessively abundant. This is the only locality from which this supposed species has been reported. They are generally much paler in color than the *A. riparius* of the interior, and though not differing from them appreciably in any other respects, they form an interesting insular race. From the peculiar character of the locality, the scattered beach-grass growing upon it affording but slight protection to these animals from the sunlight, the intensity of which is greatly heightened by the almost bare, light-colored sands, the generally bleached appearance of the Muskeget *Arvicola* might have been anticipated. Specimens occasionally occur of nearly the ordinary color, or which are undistinguishable from the lighter-colored speci-

* Vol. II, p. 66.

† Report on Quad. of Mass., p. 60.

‡ Journ. Phil. Acad. Nat. Sci., Vol. VIII, p. 296; Quad. N. Am., Vol. III, p. 211, Pl. 144, Fig. 2.

§ N. Am. Mam., pp 525, 526.

‖ N. Y. Fauna, Vol. I, p. 85, pl. XXII, Fig. 1.

mens from the interior; but most of them seem to be quite like the ones described by Professor Baird. The mice living on the extensive sand-dunes at Ipswich, under circumstances similar to those of the Muskeget mice, often present, as I have recently ascertained, the half-white appearance of the *A.* "*Breweri.*"

The *A. albo-rufescens*, described by Dr. Emmons from two nearly white or cream-colored specimens procured at Williamstown, is, as first suggested by Audubon, undoubtedly but an albinic variety of *A. riparius.* Having obtained two specimens at Springfield that almost exactly accorded with Emmons's description of *A. albo-rufescens*, I was led at first to consider it a valid species. Subsequent experience convinced me that this is not its character. Two similarly colored specimens of the woodchuck (*Arctomys monax*), unquestionably albinic, have been since obtained at Springfield, which differ from the ordinary condition of that animal in the same way that these specimens of *Arvicola* do from the ordinary state of *A. riparius.* Aububon and Bachman mention similar examples that came under their notice; in one case different stages of albinism were observed in the different individuals of the same litter. A short time since I myself received an interesting albinic example of this species from Weathersfield, Vermont, from my friend Mr. J. P. Stoughton, of which the following is a description: Beneath, except the extreme posterior part of the body, pure white; mainly white above, with a wide, rather irregular band of dusky along the back; the anterior part of the head and the cheeks dusky; posterior part of the head white, with several dusky spots; ears, thighs, and a large spot on the left shoulder, dusky, with small axillary spots of the same color; all the feet and the terminal third of the tail, white. Irides a little lighter than the natural color, but not red. Ears conspicuous; much longer than the short, soft fur. A little smaller, and rather slenderer than ordinary specimens. Apparently a mature female, taken August 18, 1868. Albinos of this species appear to be not infrequent, the capture of a litter in which all the individuals greatly resembled the parti-colored one above described having come to my knowledge since the above was written.

The single specimen from Holmes's Hole, described as *A. rufidorsum*,* which is thus far the only recognized specimen of this supposed species extant, seems to be but an unusually highly colored example of *A. riparius.* At Springfield, where I have examined hundreds of specimens at different seasons of the year, the variation in color is very considerable, ranging from decidedly gray on the one extreme to as decidedly rufous chestnut-brown on the other. They are usually much grayer in March and April than they are late in the fall.

* See N. Am. Mam., p. 526, as previously cited.

The following is a partial list of the synonymes of

Arvicola riparius.

Arvicola riparius Ord, Journ. Phil. Acad. Nat. Sci., IV, 1825, 305.
" " DeKay, N. Y. Fauna, Pt. I, 1842, 84, Pl. XXII, Fig. 2. (Young.)
" " Aud. and Bach., Quad. N. Am., III, 1854, 302.
" " Kennicott, Pat. Off. Rep., 1856, Agr., 1857, 304.
" " Baird, N. Am. Mam., 1857, 522.
" *palustris* Harlan, Faun. Am., 1825, 126.
" *albo-rufescens* Emmons, Quad. Mass., 1840.
" " DeKay, N. Y. Fauna, 1842, I, 89.
" *hirsutus* Emmons, Quad. Mass., 1840, 60.
" " DeKay, N. Y. Fauna, I, 86.
" *oneida* Ibid., 88, Pl. XXIV, Fig. 1.
" *rufescens* Ibid., 85, Pl. XXII, Fig. 1.
" *nasuta* Aud. and Bach., Journ. Phil. Acad. Nat. Sc., VIII (2), 1842, 296.
" " Ibid., North Am. Quad., III, 1853, 211, Pl. CLXIV, Fig. 2.
" *pennsylvanica* Aud. and Bach., Quad. N. Am., I, 1849, Pl. XLV, 341.
" *rufidorsum* Baird, Mam. N. Am., 1857, 526.
" *Breweri* Ibid., 525.
" *xanthognathus* * Godman, Am. Nat. Hist., II, 1826, 65.
" " DeKay, N. Y. Fauna, I, 1842, 90.
" " Linsley, Am. Jour. Sc., XLIII, 1842, 350.

64. **Arvicola pinetorum** Aud. & Bach. (*A.* [*Pitymys*] *pinetorum* Baird.) The only specimens of this species I have seen from this State are one captured at Springfield in May, 1868, by my brother, Mr. E. Allen, and one taken by myself a few weeks later. Both were taken in the same field on the "pine plains" east of the city. Audubon and Bachman, I find, speak of having received it from near Boston, from Dr. Brewer. These authors also speak of it as occurring in Connecticut, and as abundant in certain portions of Rhode Island.† Professor Baird cites it from Long Island,‡ whence Audubon and Bachman derived their first specimens of *A.* "*scalopsoides*,"§ which they afterwards very properly considered as a synonyme of *A. pinetorum.* It

* Whatever the "*A. xanthognathus*" of Leach and Richardson (Faun. Bor. Am., I, 122) may have been, the *A. xanthognathus* of Godman, DeKay, and Linsley unquestionably refers to the *A. riparius* of Ord.

† Quad. N. Am., II, p. 216.

‡ Mam. N. Am., p. 544.

§ Journ. Phil. Acad. Nat. Sci., VIII, p. 299.

being a southern species, Massachusetts is probably its northern limit Its occurrence here is comparatively rare.

65. **Fiber zibethicus** Cuv. Muskrat. Abundant. Individ uals nearly black are taken occasionally.

HYSTRICIDÆ.

66. **Erethizon dorsatus** F. Cuv. (*E. dorsatus* and *E. epixanthus* Auct.) Porcupine. "Hedgehog." Occasional on the Hoosac ranges.

Professor Baird, in his description of this species,* thus observes: "Fur, dark brown; the long projecting bristly hairs dusky, with white tips; spines white, the points dusky. Nasal bones not more than one third the length of the upper surface of the skull." He adds: "I regret not to have a sufficiently perfect specimen of the common Eastern porcupine before me to furnish a satisfactory description. The differences, however, from *E. epixanthus*† are not very great, *consisting chiefly in the color of the tips of the long hairs*, and one description will answer very well for both, except where the peculiarities of each are specially indicated. The range of this species is much more limited than previously supposed, as it is replaced west of the Missouri by the *E. epixanthus*."

He thus describes *E. epixanthus*, from several good specimens: "General color dark brown, nearly black; the long hairs of the body tipped with greenish-yellow. Nasal bones nearly one half or two fifths the length of the upper surface of the skull"; which he says are not more than one third in *E. dorsatus*. Nine very fine specimens of *E. dorsatus* in the Museum of Comparative Zoölogy, from Central Maine, show that the color of the projecting bristly hairs is variable. In one they are *entirely black*, except a very few about the head, which are tipped with lighter; in another those of the back are black, while on the head, sides of the shoulders, etc., they are tipped with dull yellowish-white. Several have them of the greenish-yellow supposed to characterize exclusively *E. epixanthus;* in one or two only can they be called white, while in one these bristly hairs are almost entirely absent, being quite so on the back. The quills usually project considerably beyond the fur, but are sometimes quite concealed within it. Their color varies from white to dull yellow. Professor

* Mam. N. Am., p. 569.

† "*E. epixanthus* Brandt, Mém. Acad. de St. Petersbourg, 1835, 388, 416; Plate I (animal) and Plate IX. Figs. 1–4, skull."

Baird's detailed description of the exterior characters of *E. epixanthus* is in every respect applicable to fully one half the specimens from Maine referred to above, while none differ essentially from it. The differences referred to by him in the relative length of the nasals in the two supposed species are relatively very slight, especially as compared with the large amount of variability presented in a large series of the skulls of *Arctomys monax*, or of our common squirrels or rabbits; the difference in the proportional length of the nasals to the whole length of the skull, in five specimens of *E. epixanthus* and three of *E. dorsatus*, as given by Professor Baird, being but 4 per cent; the nasals in *E. dorsatus* being 37 per cent of the whole length of the skull, and in *E. epixanthus* 41. In No. 676 (*E.* "*dorsatus*") of Baird's table, the proportional length of the nasals to the entire skull is 39 per cent; in No. 3066, 32 per cent. In No. 822 (*E.* "*epixanthus*"), 39 per cent. In other words, the specimen in the series of *E. dorsatus* in which the nasals are longest differs less than one-third of one per cent in the proportional length of the nasals to the whole skull from the specimen with relatively the shortest nasals in the seies of the *E. epixanthus* specimens.

I am not able at this time to refer to M. Brandt's paper, but Waterhouse, in his Natural History of the Mammalia,* refers to it as follows: "Five specimens of an *Erethizon* from the West Coast of North America, in the Museum of St. Petersburg, having the exposed ends of the longest hairs of the fur of a brownish-yellow color instead of white, as the same hairs are stated to be in the *E. dorsatus*, M. Brandt is inclined to suppose there are two species of *Erethizon*, but not having specimens of the Canada animal for comparison, he is not able to satisfy himself upon this point. The specimens examined by M. Brandt are from California and Unalaska, and I may add that a similar specimen is found at Sitka, as I remember to have seen a specimen in the Leyden Museum from there agreeing with M. Brandt's description; its *spines* [not *hairs*] were most of them of a delicate yellow below the dark point." The following is Mr. Waterhouse's description of *E. epixanthus*, compiled from M. Brandt's memoir: "The longer and coarser hairs brownish-yellow at the point; spines white or yellowish at the base, and most of them brownish-black or dusky at the apex."

It hence appears that the three principal writers on the subject — Brandt, Waterhouse, and Baird — have neither of them had specimens of the two species for comparison at the time of writing; Brandt having only his five West Coast specimens, Waterhouse compiling from Brandt, and Baird's specimens coming, two from the Republican Fork, one from New Mexico, and one from California, with three or four skulls from the East.

* Vol. II, p. 442.

Dr. Brandt must have been much influenced by the difference in locality whence his specimens came, in supposing there might be two species of *Erethizon*, since the only difference he points out — that of the color of the tips of the long hairs — is one of a trivial, and, as all mammalogists must be aware, most inconstant character. The differences in the skulls discovered by Professor Baird, though so appreciable, have less weight since we know that skulls of individuals of the same species from the *same locality* not unfrequently vary as much, and in the same way. Again, according to the measurements he has given, and which are discussed above, one specimen of the one series of three is not appreciably different from a specimen of the other series of five. Hence, though having only Eastern specimens for examination, I quite confidently refer, for the reasons given above, the *E. epixanthus* Brandt to the *E. dorsatus* F. Cuvier. I am quite sure, also, that, had either Professor Baird or Dr. Brandt possessed a good series of *E. dorsatus* from Eastern North America, they could hardly have admitted the latter's doubtfully proposed species, even provisionally.

Prince Maximilian, in speaking of the porcupines of the Upper Missouri,* mentions them simply under the generic name *Erethizon*, stating that he was unable to decide whether the animal he observed should be referred to *E. dorsatus* or to *E. epixanthus*.

Dr. J. E. Gray, in the proceedings of the London Zoölogical Society,† has described a small specimen of *Erethizon* from Columbia as a new species, under the name of *E.* (*Echinoprocta*) *rufescens*, although there is nothing to indicate that it is in any way different from the young of the common *E. dorsatus*. The differences on which he has raised it to a distinct section or subgenus are only such as characterize the young or half-grown animal in *E. dorsatus*, with which also his corresponds in size.

LEPORIDÆ.

67. **Lepus americanus** Erxl. (Emmons's Rep., p. 56.) White Rabbit. Common, but generally less so than the next. Rare in the immediate vicinity of Springfield, though numerous at localities less than ten miles distant, in several directions.

68. **Sylvilagus nanus** Gray.‡ (*Lepus sylvaticus* Bach. *Lepus*

* Wiegmann's Archiv, XVIII, Theil I, p. 150.

† 1865, 121, Pl. XI; also in the Annals and Magazine of Natural History of the same year.

‡ In a recent paper entitled "Notes on the Skulls of Hares (*Leporidæ*) and Picas (*Lagomyidæ*) in the British Museum," Dr. J. E. Gray has given names to the sections of the old genus *Lepus*, first indicated by Professor Baird in his well-studied essay on this group (N. Am. Mam., pp. 572–620), and raised them to the rank of genera, thereby, of

virginianus Harlan, Emm. Rep., p. 58.) Gray Rabbit. Abundant in most parts of the State. Less common in the more elevated portions, and quite unknown in the higher ranges of the western counties.

General Synopsis and Remarks on the Geographical Distribution of the Species.

I. *Indigenous Species still existing in the State.*

1. Lynx canadensis *Raf.**
2. " rufus *Raf.**
3. Canis lupus *Linn.**
4. Vulpes vulgaris *Cuv.*
5. " virginianus *DeKay.**
6. Mustela Pennantii *Erxl.**
7. " martes *Linn.**
8. Putorius vulgaris *Linn.*
9. " ermineus *Linn.*
10. " lutreolus *Cuv.*
11. Gulo luscus *Sabine.**
12. Lutra canadensis *Sab.*
13. Mephitis mephitica *Baird.*
14. Procyon lotor *Storr.*
15. Ursus arctos *Linn.**
16. Phoca vitulina *Linn.*
17. Cystophora cristata *Nilsson.*
18. Cariacus virginianus *Gray.**
19. Balæna cisarctica *Cope.*
20 Agaphalus gibbosus *Cope.*
21. Megaptera osphyia *Cope.*
22. Eschrichtus robustus *Lilj.**
23. Sibbaldius tectirostris *Cope.*
24. " tuberosus *Cope.**
25. " borealis *Fisch.**
26. ? Balænoptera rostrata.
27. Physeter macrocephalus *Pander.**
28. Mesoplodon sowerbiensis.*
29. Orca gladiator *Sund.*
30. Globiocephalus melas *Traill.*
31. Hyperaodon bidens *Owen.**
32. Beluga canadensis *Erxl.**
33. Largenorhynchus sp.?
34. Delphinus erebennus *Cope.*
35. " clymene *Gray.**
36. Phocæna americana *Agass.*
37. Lasiurus noveboracensis *Tomes.*
38. " cinereus *H. Allen.**
39. Scotophilus fuscus *H. Allen.*
40. " noctivagans *H. Allen.*
41. " georgianus *H. Allen.*
42. Vespertilio subulatus *Say.*
43. Neosorex palustris *Verrill.**
44. Sorex platyrhinus *Linsley.*
45. Sorex Cooperi *Bach.**
46. " Forsteri *Rich.**
47. Blarina brevicauda *Baird.*
48. Scalops aquaticus *Fisch.*
49. " Breweri *Bach.**
50. Condylura cristata *Ill.*

course, introducing numerous changes in nomenclature. *Lepus* is restricted to the larger species, typically represented by *L. americanus* Erxl. and the European *L. timidus* Linn. Thirty species of the old genus *Lepus* are enumerated, but a considerable proportion appear to rest on highly questionable grounds. Dr. Gray enumerates in this paper thirty-nine species of *Leporidæ* alone, of which sixteen are North American and two South American. The characters of these groups, so far at least as they relate to the North American species, are those developed by Professor Baird in his excellent elaboration of this family.

* Species marked with the asterisk are very sparsely represented; among the Carnivora most of those thus distinguished have become nearly exterminated.

51. Sciurus cinereus *Linn.**
52. " carolinensis *Gmelin.*
53. " hudsonius *Pall.*
54. Pteromys volucella *Linn.*
55. Tamias striatus *Baird.*
56. Arctomys monax *Gmelin.*
57. Fiber zibethicus *F. Cuv.*
58. Jaculus hudsonius *Baird.*
59. Hesperomys leucopus *LeConte.*
60. Arvicola Gapperi *Vigors.*
61. " riparius *Ord.*
62. " pinetorum *LeConte.**
63. Erethizon dorsatus *F. Cuv.**
64. Lepus americanus *Erxl.*
65. Sylvilagus sylvaticus *Gray.*

II. *Extirpated Species.*

1. Felis concolor *Linn.*
2. Alce malchis *Ogl.*
3. Tarandus rangifer *Gray.*
4. Cervus canadensis *Linn.*
5. Castor fiber *Linn.*

III. *Adventitious Species.*

1. Mus decumanus *Linn.*
3. " rattus *Linn.*
3. " musculus *Linn.*

IV. *Northern Species.*

[Not occurring in this State south of the Canadian fauna (excepting *Lepus americanus*, which ranges through the Alleghanian), and hence represented only in portions of the western counties.]†

1. Mustela Pennantii.
2. " martes.
3. Gulo luscus.
4. Alce malchis.
5. Tarandus rangifer.
6. Arvicola Gapperi.
7. Erethizon dorsatus.
8. Lepus americanus.

V. *Southern Species.*

[Not occurring north of the Alleghanian Fauna, and hence unrepresented in the more elevated parts of the State, though more or less common in the other portions.]

† *Antea*, in a foot-note to page 147, *Cervus canadensis* is included among the species there mentioned as characteristic of the Canadian fauna, as formerly represented in Massachusetts. I have since found, from what is known of its earlier range, that it probably once extended over the greater part of the States lying east of the Mississippi, and undoubtedly extended along the Atlantic coast farther south even than Southern New England. There is unquestionable evidences of its existence within the last fifty years on both sides of the Ohio River near its mouth; a locality much more southern, faunally as well as geographically, than any part of New England. Hence it cannot be taken as a species the southern boundary of whose habitat marks the lower limit of the Canadian fauna, as there stated.

1. Vulpes virginianus.
2. Scalops aquaticus.
3. " Breweri.
4. Sciurus cinereus.
5. Sciurus carolinensis.
6. Arvicola pinetorum.
7. Sylvilagus sylvaticus.

VI. *Restricted to the Eastern Province.*

1. Cervus canadensis.
2. Cariacus virginianus.
3. ? Scotophilus georgianus.
4. Neosorex palustris.
5. Sorex Cooperi.
6. " Forsteri.
7. " platyrhinus.
8. Blarina brevicauda.
9. Scalops aquaticus.
10. " Breweri.
11. Condylura cristata.
12. Sciurus cinereus.
13. " carolinensis.
14. " hudsonius.
15. Tamias striatus.
16. ? Arctomys monax.
17. ? Hesperomys leucopus.
18. Arvicola Gapperi.
19. " riparius.
20. " pinetorum.
21. Lepus americanus.
22. Sylvilagus sylvaticus.

VII. *Species restricted to America, but which range over the greater portion of the Northern Continent.**

1. Felis concolor.
2. Lynx canadensis.
3. " rufus.
4. Vulpes virginianus.
5. Mustela Pennantii.
6. Mephitis mephitica.
7. Procyon lotor.
8. Vespertilio subulatus.
9. Scotophilus fuscus.
10. " noctivagans.
11. Lasiurus noveboracensis.
12. " cinereus.
13. Pteromys volucella.
14. Fiber zibethicus.
15. Jaculus hudsonius.
16. Erethizon dorsatus.

VIII. *Species that occur throughout the colder portion of the Northern Hemisphere.*

(Cetacea not included.)

1. Canis lupus.
2. Vulpes vulgaris.
3. Mustela martes.
4. Putorius erminea.
5. " vulgaris.
6. " lutreolus.
7. Gulo luscus.
8. Ursus arctos.
9. Phoca vitulina.
10. Cystophora cristata.
11. Alce malchis.
12. Tarandus rangifer.
13. Castor fiber.

* Probably *Sciurus hudsonius* and *Hesperomys leucopus* should be transferred from the preceding list to this.

IX. *Comparative Table.*

Showing what species of Dr. Emmons's Report on the Quadrupeds of Massachusetts, Dr. DeKay's on the Mammalia of the State of New York, and Mr. J. P. Linsley's Catalogue of the Mammals of Connecticut, are synonymous with those of the present list.

NOTE. — The numbers refer to the same species in each column. Domesticated and fossil species and the Cetacea are omitted.

Present List.	*Emmons's Report.*	*Linsley's Catalogue.*	*DeKay's Report.*
1. Felis concolor.	1. Felis concolor.	1. Felis concolor.	1. Felis concolor.
2. Lynx canadensis.	2. Lyncus borealis.	2. Lyncus borealis.	2. Lyncus borealis.
3. " rufus.	3. " rufus.	3. " rufus.	3. " rufus.
4. Canis lupus.	4. Canis lupus.	4. Canis lupus.	4. Lupus occidentalis.
5. Vulpes vulgaris.	5. Vulpes fulvus.	5. " fulvus " decussatus. " argentatus.	5. Vulpes fulvus.
6. " virginianus.	6. Vulpes virginianus.	6. " cinero-argentatus.	6. " virginianus.
7. Mustela Pennantii.	7. Mustela canadensis.	7. Mustela canadensis.	7. Mustela canadensis.
8. " martes.	8. " martes.	8. " martes.	8. " martes.
9. Putorius vulgaris.	9. Putorius vulgaris.	9. " pusilla.	9. " pusilla.
10. " ermineus.	10. " noveboracensis.	10. " fusca. Putorius noveboracensis.	10. " fusca. Putorius noveboracensis.
11. " lutreolus.	11. " vison.	11. " vison.	11. " vison.
12. Gulo luscus.	12. —— ——	12. —— ——	12. Gulo luscus.
13. Lutra canadensis.	13. Lutra canadensis.	13. Lutra canadensis.	13. Lutra canadensis.
14. Mephitis mephitica.	14. Mephitis americana.	14. Mephitis americana.	14. Mephitis americana.
15. Procyon lotor.	15. Procyon lotor.	15. Procyon lotor.	15. Procyon lotor.
16. Ursus arctos.	16. Ursus americanus.	16. Ursus americanus.	16. Ursus americanus.

Present List.	*Emmons's Report.*	*Linsley's Catalogue.*	*DeKay's Report.*
17. Alce malchis.	17. Cervus alces.	17. —— ——	17. Cervus alces.
18. Tarandus rangifer.	18. " tarandus.	18. —— ——	18. Rangifer tarandus.
19. Cervus canadensis.	19. —— ——	19. —— ——	19. Elaphus canadensis.
20. Cariacus virginianus.	20. " virginianus.	20. Cervus virginianus.	20. Cervus virginianus.
21. Phoca vitulina.	21. —— ——	21. { Phoca concolor. ? " grœnlandica. }	21. Phoca concolor.
22. Cystophora cristata.	22. —— ——	22. Stemmatopus cristatus.	22. Stemmatopus cristatus.
23. Lasiurus noveboracensis.	23. Vespertilio noveboracensis.	23. Vespertilio noveboracensis.	23. Vespertilio noveboracensis.
24. " cinereus.	24. " pruinosus.	24. " pruinosus.	24. " pruinosus.
25. Scotophilus fuscus.	25. " carolinensis.	25. " carolinensis.	25. " carolinensis.
26. " georgianus.	26. —— ——	26. —— ——	26. —— ——
27. " noctivagans.	27. —— ——	27. " noctivagans.	27. " noctivagans.
28. Vespertilio subulatus.	28. —— ——	28. " subulatus.	28. " subulatus.
29. Neosorex palustris.	29. —— ——	29. —— ——	29. —— ——
30. Sorex platyrhinus.	30. —— ——	30. Sorex platyrhinus.	30. Otisorex platyrhinus.
31. " Forsteri.	31. —— ——	31. —— ——	31. Sorex Forsteri.
32. " Cooperi.	32. —— ——	32. —— ——	32. —— ——
33. Blarina brevicauda.	33. —— ——	33. { Sorex brevicaudus. " parvus. " DeKayi. }	33. { Sorex brevicaudus. " parvus. " DeKayi. " carolinensis. }
34. Scalops aquaticus.	34. Scalops canadensis.	34. Scalops canadensis.	34. Scalops aquaticus.
35. " Breweri.	35. —— ——	35. —— ——	35. —— ——
36. Condylura cristata.	36. { Condylura longicaudata. " macroura. }	36. { Condylura longicaudata. " macroura. }	36. Condylura cristata.
37. Sciurus cinereus.	37. Sciurus vulpinus.	37. Sciurus vulpinus.	37. Sciurus vulpinus.

38. Sciurus carolinensis.	38. Sciurus leucotis. " niger.	38. Sciurus carolinensis. " niger.	38. Sciurus leucotis. " niger.
39. " hudsonius.	39. " hudsonius.	39. " hudsonius.	39. " hudsonius.
40. Pteromys volucella.	40. Pteromys volucella.	40. Pteromys volucella. " ——?	40. Pteromys volucella.
41. Tamias striatus.	41. Sciurus striatus.	41. Sciurus striatus.	41. Sciurus striatus.
42. Arctomys monax.	42. Arctomys monax.	42. Arctomys monax.	42. Arctomys monax.
43. Castor fiber.	43. Castor fiber.	43. Castor fiber.	43. Castor fiber.
44. Fiber zibethicus.	44. Fiber zibethicus.	44. Fiber zibethicus.	44. Fiber zibethicus.
45. Jaculus hudsonius.	45. Gerbillus canadensis.	45. Gerbillus canadensis.	45. Meriones americanus.
46. Mus decumanus.	46. Mus decumanus.	46. Mus decumanus.	46. Mus decumanus.
47. " rattus.	47. " rattus.	47. " rattus. Arvicola albo-rufescens.	47. Mus rattus. " americanus.
48. " musculus.	48. " musculus.	48. Mus musculus.	48. " musculus.
49. Hesperomys leucopus.	49. Arvicola Emmonsii.	49. " agrarius.	49. " leucopus.
50. Arvicola Gapperi.	50. —— ——	50. —— ——	50. —— ——
51. " riparius.	51. Arvicola hirsutus. " albo-rufescens.	51. Arvicola riparius. " xanthognathus.	51. Arvicola riparius. " rufescens. " hirsutus. " oneida. " albo-rufescens. ? " zanthognathus.
52. " pinetorum.	52. —— ——	52. —— ——	52. —— ——
53. Erethizon dorsatus.	53. Hystrix dorsata.	53. Hystrix dorsata.	53. Hystrix hudsonica.
54. Lepus americanus.	54. Lepus americanus.	54. Lepus americanus.	54. Lepus americanus.
55. Sylvilagus sylvaticu	55. " virginianus.	55. " virginianus.	55. " nanus.
— —— ——	— —— ——	— —— ——	— Didelphys virginiana.

X. *General Summary.*

Number of indigenous species still living in the State	*65
" species already extirpated	5
" adventitious species	3—
Whole number	73
Number of land species (including the seals)	52
" marine species (the cetaceans)	18
" northern species †	7
" southern species †	8
" species restricted to the region east of the great sterile plains	22
" " that range over the greater part of the continent	15
" " common to North America and the North Old World	13
" " that are numerously represented	28
" " that are sparsely represented	45
" " of Felidæ (including 1 extirpated)	3
" " Canidæ	3
" " Mustelidæ	8
" " Ursidæ	2
" " Phocidæ	2
" " Cervidæ (including 3 extirpated)	4
" " Balænidæ	8
" " Physeteridæ	2
" " Delphinidæ	8
" " Vespertilionidæ	6
" " Soricidæ	5
" " Talpidæ	3
" " Sciuridæ (including 1 extirpated)	7
" " Muridæ (including 3 adventitious)	9
" " Hystricidæ	1
" " Leporidæ	2
" " Carnivora (5 families)	18
" " Ruminantia (1 family)	4
" " Cetacea (3 families)	8
" " Insectivora (3 families)	14
" " Rodentia (4 families)	19
Number of families represented	16

Less than one half of the indigenous species existing in the State, as indicated above in Table I, are common, and more than a third are

* Emmons gave 41; Linsley, for Connecticut, 52; DeKay, for New York, 60.

† See notes to Tables IV and V, *antea*, p. 239.

rare. The common ones, with a few exceptions (*Putorius lutreolus*, *P. ermineus*, and *Mephitis mephitica* among the carnivores, *Vespertilio subulatus* and *Lasiurus noveboracensis* among the bats), belong to the three families of rodents, — the squirrels (*Sciuridæ*), the mice (*Muridæ*), and the hares (*Leporidæ*), — and to the *Balænidæ* and *Delphinidæ*, which latter are, of course, marine. In species and families, the carnivores and rodents are about equally represented, but in individuals any one of the more common rodents outnumbers all the carnivores together. Probably a single species of *Arvicola* (*A. riparius*) alone outnumbers, when it is most abundant, all the other mammals.

The list of Extirpated Species, forming Table II, five in number, is composed entirely of such animals as, from their large size and being special objects of the chase, would be expected to earliest disappear. Two of the four species of *Cervidæ* (*Alce malchis*, *Tarandus rangifer*) have not existed in the southern half of New England since the discovery of the continent by Europeans, except in the mountains of Western Massachusetts, and there probably only as occasional migrants from the contiguous region north. They may have existed in comparatively recent times in portions of the Alleghanies, but respecting such existence we have no certain record. At a remote period they must have lived much farther south than they do now, or than they have within the last three centuries, since bones of the Caribou have been found by Professor Wyman in the Kjoekkenmœddings of Southern Maine, and teeth that he believes, but does not positively assert, belong to this species in those of Cape Cod. A positive evidence of the former much greater southward extension of the habitat of this animal is indeed already at hand, a small antler and fragments of others of the Caribou being included in the very large collection of the remains of living and extinct species of mammalia recently brought by Professor N. S. Shaler to the Museum of Comparative Zoölogy from Big Bone Lick, Kentucky.* Remains of the elk and the moose having been found in the shell-mounds of the Atlantic coast as far south as New Jersey, we have evidence that these species existed thus far south in comparatively recent times.

To the list of the "extirpated species," nine † that are now ex-

* See Professor Shaler's remarks concerning these specimens in Proc. Bost. Soc. Nat. Hist., Vol. XIII, 1869.

† *Lynx canadensis*, *L. rufus*, *Canis lupus*, *Mustela Pennantii*, *M. martes*, *Gulo luscus*, *Ursus arctos*, *Cariacus virginianus*, *Erethizon dorsatus*.

tremely rare, some of them probably being but casual visitors from Vermont or New York, must soon be added. The fisher and the wolverine may be even now extinct, and the common deer exists in the wild state only by legal protection.

The three adventitious species (see Table III), which are the most noxious of our mammalia, are intruders that, like many of the common weeds, have accompanied civilized man in his voyages till they are almost cosmopolitan in their distribution.

Table IV, composed of northern species, consists, with one exception (*Arvicola Gapperi*), also of species of large size, and such as are special objects of the chase, either for their fur or for food. They hence early disappear before the advance of civilization, and it is now almost impossible to determine in respect to some of them where was formerly their natural southern limit of distribution. At present none of them (*Lepus americanus* excepted) range below the southern boundary of the Canadian fauna, though some may have formerly extended across the next fauna south. The occurrence of *Mustela martes* and *M. Pennantii* in the Alleghanies, the latter as far south as Buncomb County, North Carolina, is well established,* but they seem to be, or to have been, — they being now apparently nearly exterminated there, — confined to the mountains, and hence also to the Canadian fauna. Yet one or both of them have occurred in a few known instances at points rather more southern, faunally, than their usual range, but apparently only during casual migrations in winter.

The *Erethizon dorsatus*, however, seems to have formerly occurred at points clearly within the Alleghanian fauna, as in Western New York,† Northern Ohio,‡ Northern Indiana, Southern Michigan, and Southern Wisconsin; § but it has disappeared in all the more thickly settled parts of the United States; east of the Mississippi it does not now occur south of the Canadian fauna.

The *Lepus americanus*, also chiefly northern in its distribution, ranges, as before stated, a little farther south than the others, and finds its southern limit near the southern boundary of the Alleghanian fauna.

* Audubon and Bachman, Quad. N. Am., Vol. I, p. 314.

† Dr. J. E. DeKay, N. Y. Fauna, Vol. I, p. 79.

‡ Wm. Case, Esq., in Audubon and Bachman's Quad. N. Am., Vol. I, p. 285.

§ R. Kennicott, Pat. Off. Rep., Agr., 1857, p. 91; I. A. Lapham, Transact. Wisc. State Agr. Soc., 1852, p. 340.

Table V, comprising those species that do not occur north of the Alleghanian fauna, embraces but one of relatively large size, — *Vulpes virginianus,* — which is also the only carnivore; the others are two moles and four rodents. The presence of the species of this list, and the absence of those of the preceding, form the faunal differences that, among mammals, distinguish the Alleghanian from the Canadian fauna. The other thirty-three species of land mammals represented in the fauna of Massachusetts, and which are common to the other New England States, New York, the northern tier of the States westward to the Mississippi, and the greater portion of the Canadas, range widely both to the north and to the south, and some of them also to the westward, extending throughout the colder parts of the northern hemisphere, as is indicated by Tables VII and VIII.*

* In this connection a word in reference to the nature of faunæ may not be out of place, since naturalists of some eminence, but who cannot have thoroughly investigated the subject, appear to think that no faunal districts are recognizable unless there is an entire or almost an entire change in the species represented, while some altogether discard such distinctions. Such an extensive change more properly characterizes the larger divisions in geographical zoölogy, as the provinces and realms, rather than faunæ. It rarely happens that any species is restricted within the limits of a single fauna, and also rarely within those of two. There is not a single well-known species of mammal or bird but inhabits (taking the breeding range only of the latter) an area embracing two or more faunæ, and but few that do not range over more than two. The greater part extend over three, and a large proportion have a still wider distribution, as shown by Tables VII and VIII (see remarks respecting these beyond). But in going north or south from any point within the temperate zones, one observes at certain intervals (generally of about six or seven degrees of mean annual temperature) a marked change in the species, through the disappearance of some and the appearance of others; this change giving rise to well-marked differences in the general facies of the fauna at points not far distant. The habitats of species being in the main nearly coincident in their northern and southern boundaries with isothermal lines, and not with paralells of latitude; and since a number of species usually disappear at nearly the point at which a number of others first make their appearance, the limits of faunæ are thus readily defined, at least approximately. As isotherms necessarily vary with every inequality in the surface of the country, they rarely correspond, as is well known, with the parallels of latitude; and plants and animals sharing the same apparent irregularity in their distribution, some naturalists have been led to discredit the existence of recognizable zoölogical and botanical districts, or of any definite system in the distribution of animals and plants.

Faunæ, then (the term *fauna* in its restricted sense being usually and properly employed to designate the smallest zoölogico-geographical district), it may be added, are characterized by the peculiar association of species. Generally about twenty-five per cent of those embraced in either of two adjacent faunæ are absent from the other. Rarely do adjoining faunæ differ essentially in genera, though necessarily more or less occasionally. The absence or presence of genera, sub-families, families, and even sometimes orders, more properly characterizes the higher sub-divisions, as provinces and realms.

Each of the twenty-one species mentioned in the next table (Table VI) has a comparatively restricted range, the western limit of their habitats being in most cases the eastern border of the sterile plains of the middle province. This list is composed principally of shrews, moles, and rodents; none of the first two groups and but a few of the latter ranging across the continent. The absence of carnivores from this list is its most striking feature.

Table VII embraces fifteen species that, while restricted to America, range from the Atlantic to the Pacific, and possess a correspondingly wide distribution in latitude, most of them occurring nearly throughout the northern continent. This list is composed almost exclusively of carnivores and bats, all but one of the Massachusetts species of the latter having been found in California, and at various intermediate points.

Table VIII contains thirteen species that are regarded in this paper as common to the Old Word and the New; ten of these are carnivores, and include all the New England species of that group, except those embraced in the preceding list. The geographical distribution of these species, and of the groups to which they belong, affords further evidence in favor of the supposition of the specific identity of their representatives on the two continents above assumed; each species ranging as far north on both as it seems possible for mammalian life to exist. Each has also an extended distribution southward, on each continent, some of them ranging nearly or quite to the tropics; which shows them to be fitted to exist under widely varying physical conditions. These conditions in the northern portions of their respective habitats differ much more from those of the southern portions than those of localities on the two continents ordinarily do when situated under the same isotherm. The representatives of the species in question from the eastern and western continents differ less, as has been previously stated, when the specimens compared are taken from those portions nearly contiguous, as Northwestern America and Northeastern Asia, than when they come from such widely distant points as Eastern North America and Western Europe, the nearest affinity being between those from the localities first mentioned, and the widest differences between those from the latter. The eastern and western continents, moreover, approach each other so nearly at Behring's Straits, that several of the species in question are able to pass occasionally from one to the other. It hence seems unnecessary to suppose the former existence of an Atlantic continent to explain their present distribution. It is also a noteworthy fact that no cases of close affinity among the mammals inhabiting these two continents occur in species that do not range very far to the northward, as in the *Felidæ*, for example, where the only case at all suggestive of identity, or even of close relationship, occurs between the *Lynx canadensis* of Northern North America and the *Lynx lynx* of Northern Europe; both of which species range the farthest north of any of their family, and reach the Arctic regions.

All the circumpolar species, the beaver alone excepted, pertain to the most highly organized groups found in the colder portion of the northern hemisphere, and to which belong not only all the widely ranging species of the north temperate and boreal regions, but those of this character everywhere. With three exceptions, all are carnivores. Two of the others are ruminants, and one is a rodent.

The species most highly organized in their respective families, orders, or classes are almost universally those that possess the widest geographical distribution; partial exceptions occur only in groups where the means of locomotion is specialized, or unusually developed, as in the bats among mammals. The shrews, moles, and rodents, which comprise about three fifths of the species of the North American mammals, are groups of low structural rank, and abound in species of comparatively local distribution. In this great number there are but five or six, allowing the broadest latitude in respect to the limitation of the species, that at all approach to a continental distribution, and only three as the species are usually restricted.* This is about two one-hundredths of one per cent. Only one can be regarded as identical with any Old World species. In the canivores, on the other hand, excluding sub-tropical and nominal species, the number of those that range over most of the continent reaches nearly seventy-five per cent, while fifty per cent, or one half, are identical with Old World species. In the ruminants, which rank below the carnivores, but far above the rodents and insectivores, the species having a similarly wide range on this continent, number not far from thirty per cent. Several of them are identical with Old World species. The bats, though a low group, are,

* *Castor fiber*, *Fiber zibethicus*, and *Jaculus hudsonius*. Probably the following may be added to the list of those that range across the continent: *Erethizon dorsatus*, *Sciurus hudsonius*, *Pteromys volucella*, *Hesperomys leucopus*.

from their special means of locomotion, able to range widely; but to their allies, the moles and shrews, mountain chains and arid plains prove impassable barriers.

The same laws in respect to the character of the species that among mammals have a wide distribution are equally exemplified in birds, all the wide-ranging species being of high rank, or such members of lower groups as have the power of flight unusually developed. The modification of the anterior limbs into organs of flight specially characterizing the class of birds among vertebrates, it is evident that well-developed wings are one of the elements essential to a high grade of structure; and this renders necessary the coincidence in this class of high rank with a wide geographical range. The few land-birds that embrace a large portion of the two northern continents within their respective habitats belong principally to three families, — the finches, and the hawks and owls. The first is one of the highest, if not the highest, family of the class, and the others are by no means low. The other species which have a circumpolar distribution are among the highest members of their respective families, and are rarely of a low grade. The finches thus distributed all belong to the highest genera of their family. Among the birds having a wide distribution, but which are restricted to a single continent, are the typical thrushes, another of the higher groups. The species of the short-winged genera of the Fringillidæ and Turdidæ, on the other hand, are almost invariably the most circumscribed in their habitats.* This coincidence in respect to structure and distribution is also exemplified in every sub-family, as well as family, among the water-birds; but it is not necessary to trace it further here.

Hence the view above taken in reference to the species claimed to be common to the Old World and the New is supported, not only by the

* Compare the species of *Turdus* with those of *Harporhynchus* and *Mimus;* of *Poocætes* and *Passerculus* (see observations on some of the supposed species of *Passerculus* in Mem. Bost. Soc. Nat. Hist., Vol. I, p. 515) with those of *Melospiza*, *Coturniculus*, and *Ammodromus;* or those of the sub-family *Coccothraustinæ* with those of the sub-family *Spizellinæ*. Compare, also, in the *Sylvicolidæ*, the species of *Dendrœca* with those of *Geothlypis*. Also note the very high rank of the species of *Ægiothus*, *Pinicola*, and *Plectrophanes*, and the wide extent of their habitats. Compare further, in *Falconidæ*, the species of *Falconinæ*, with their long pointed wings and compact firmly knit muscular bodies, giving unequalled powers of flight, and their extensive habitats, in several instances embracing a whole hemisphere, with the comparatively short-winged, sluggish, and clumsy species of *Buteoninæ*, of a much lower type of structure and much narrower range.

evidence already given in the special discussion of each case, but by the fact of the near approximation of their habitats, and by general principles.

The thirteen species of land mammalia common to North America and the Old World embraced in the fauna of Massachusetts comprise all thus distributed now known, except two or three very boreal ones. The faunæ of the two continents are really quite different, — not totally so, as has been claimed, — though represented largely by genera and families common to the two. These and the circumpolar species show that a close relationship exists between them, the resemblance being, in fact, far greater than between the faunæ of Southern Mexico and Canada. The difference between the faunæ of the subtropical and cold temperate zones on either continent is many times greater than between the faunæ of the temperate and boreal regions of North America and the same regions of the Old World.*

But four species have been attributed to the States adjoining Massa-

* The distribution of vegetable life in zones, differing from each other in general character and corresponding in their limitation with climatic or isothermal zones, and their similar succession at different altitudes on mountain slopes and in different latitudes at the ordinary level of the land, was partially very early recognized, but first fully demonstrated only half a century ago, by Baron Alexander von Humboldt. It was somewhat later before it was clearly shown that the same law holds in respect to the distribution of terrestrial animal life, which was done in 1845 by Professor Louis Agassiz,[1] and somewhat later still Professor Dana disclosed its presence in the distribution of marine life, in his admirable essay on the geographical distribution of the crustacea.[2] Yet most recent writers who have given attention to the geographical distribution of animals appear to have overlooked this grand fact, and hence have been led to adopt a highly artificial division of the earth's surface in respect to its primary ontological regions. While geographical botanists have so generally recognized the influence of climate, and especially of temperature, in determining the limits of distribution of plants in latitude and in altitude, zoölogists, with only a few exceptions, have very imperfectly appreciated these important influences upon the distribution of animals. While the relation of the present distribution of life to the existing means of communication between the different bodies of land and to the earlier conditions in this respect are of the highest importance in investigations of this kind, if this is the only element taken into account, as is sometimes the case, climatic influences being for the time over-

[1] "Note sur la Distribution Géographique des Animaux et de l'Homme." Bulletin de la Societé des Sciences Naturelles de Neuchatel, Tom. I, 1845. See also, by the same author, a paper on the "Geographical Distribution of Animals," in the Edinburgh New Philosophical Journal, Vol. XLVI, 1850, pp. 1–25. Also his "Sketch of the Natural Provinces of the Animal World and their Relation to the different Types of Man," in Nott and Gliddon's Types of Mankind, 1854, p. lviii.

[2] U. S. Expl. Exped. Reports, Crustacea, Vol. II, 1852, pp. 1451–1500.

chusetts that have not been detected in the latter. Two of them — *Didelphys virginiana* Shaw, and *Lepus glacialis* Leach, the former occurring in Southern New York, and the other attributed to Northern Maine, and known to occur in Newfoundland * — are not likely to occur here. The other two, *Sorex Thompsonii* Baird † and *Blarina augusticeps* Baird, ‡ — the latter described from a specimen taken at Burlington, Vermont, and the other reported from the same locality, from Halifax, N. S., and Maine,§ — are of a highly questionable character. What has been called *Sorex Thompsonii* (the young probably of either *S. Forsteri* or *S. Cooperi*) doubtless occurs here.

looked, the argument is one-sided, only half the truth is reached, and the general view is a distorted one.[1]

As I have already remarked above, the mutual resemblance between the faunæ and floræ of the boreal portions of North America and those of the Europeo-Asiatic continent. is exceedingly great, amounting in the arctic portion, as was long since pointed out,[2] almost to identity. In the Arctic province, which occupies the woodless tracts in the extreme north of both continents, more than four fifths of the species found on the one continent occur on the other. While a few of the small number that inhabit this region are restricted to it, the larger part range much farther to the southward, the majority even over the colder part of the north temperate zone, and several throughout this zone. Besides the mutual floral and faunal resemblance between the two northern continents imparted by this wide distribution of the circumpolar species, this resemblance is increased by the large number of genera that are circumpolar, besides those that embrace the circumpolar species, and the occurrence of other forms, both specific and generic, that are closely allied. It is also true that among the forms restricted to each continent are a few family groups; yet the number of these, as of species and genera, that occur in the tropical and not in the colder temperate regions on either continent is far greater than that of those peculiar to either of the two northern continents. Consequently to apply as ontologico-geographic designations such terms as "Palæogean Creation" to the Eastern world and "Neogean Creation" to the Western, virtually implies the ignoring of the real close affinity of the life of the whole northern hemisphere at the northward, and the vast difference between that of the tropical and the cooler north temperate regions on the same continent. But a further discussion of this point is uncalled for now, and is, moreover, the more out of place here, since I shall, I trust, soon have an opportunity to treat it in detail in a more legitimate connection.

* Quad. N. Am., Vol. I, p. 248.
† N. Am. Mam., p. 34.
‡ Ibid., p. 47.
§ Proc. Bost. Soc. Nat. Hist., Vol. IX, p. 169.

1 See Murray's Geog. Distrib. of Mammals; Wallace's Malay Archipelago, etc.
2 See Agassiz's papers, cited above.

CAMBRIDGE, October, 1869.

No. 9. — *Preliminary Report on the Echini and Star-fishes dredged in deep water between Cuba and the Florida Reef, by* L. F. de Pourtales, Assist. U. S. Coast Survey; *prepared by* Alexander Agassiz.

(Communicated by Professor B. Peirce, Sup't U. S. Coast Survey.)

I. *Catalogue of the Echini.*

Cidaris annulata Gray, Proc. Zoöl. Soc., 1855.

Syn. Cidaris metularia Lütk. (non Lam.) Bid. til Kunds. om Echin.

Lütken has adopted for the common West India species the name of C. metularia Lam., which he compares carefully with Cidaris tribuloides. It is evident from his descriptions that his C. tribuloides is the Cidaris metularia Lam.; he says himself that he may not have had the true C. tribuloides Lam. From a direct comparison with original specimens of Lamarck of both these species, kindly sent the Museum by Professor Valenciennes, there is no doubt that both C. tribuloides Lam. and Cidaris metularia Lam. inhabit the Red Sea; the latter, however, has a much more extensive range, and occurs as far as the Sandwich Islands, being quite common in the East Indian archipelago. The Cidaris metularia Lam. is also identical with the species which I named Gymnocidaris minor in the Museum Bulletin (1863). Not having at the time had the opportunity of examining series of different ages, I find that the differences which had been considered as specific are simply different stages of growth. I have adopted for our West India species the name given by Gray, satisfied that he possessed, as far as I could judge from his description, specimens of the only littoral species thus far found in the West Indies.

Littoral to 116 fathoms.

Dorocidaris abyssicola A. Ag., nov. gen. et sp.

This species has the general facies of Cidaris hystrix. We find considerable variation in specimens collected in different localities, — valuable, from the number of specimens collected, in determining the nature of individual variation in this genus, and confirming the view to which I had been brought from the study of young Cidaridæ, that the spines, much as they may apparently vary in shape, especially round the mouth, yet present excellent characters not only to distinguish species, but are also useful as a guide in separating groups of species which are generally found closely allied. From the study of young specimens I have been led to modify the views I had taken of the nature of genera among Cidaridæ, and as the group requires a complete revision, I will not attempt at present to alter the genera proposed in the Bulletin, hoping to make the changes in the general revision of the order. With reference to Orthocidaris, to which this species is temporarily referred, I would mention that, whether valid or not, the name is preoccupied, having been employed by Cotteau a few months before the publication of the Bulletin.* (The same is the case with Temnocidaris.)

Test depressed; the spines are not as distinctly fluted and crenated as in C. hystrix; they are often worn perfectly smooth, and attain their greatest diameter at about one fifth the length of the spine from the base; the milled ring is finely striated, as well as the neck of the spine, which is sharply defined. The mamelon of the primary tubercles is small, deeply cut at its base, high, the mammillary boss not prominent, the scrobicule deeply sunk; the scrobicular circle and interambulacral miliaries being prominently raised, the secondary tubercles of the scrobicular circle are but slightly larger than the miliaries, diminishing regularly in size towards the sutures of the plates, which are clearly and sharply cut; the same is the case with the sutures of the ambulacral plates; each plate carries a larger exterior tubercle with a smaller one nearer the abactinal edge, and sometimes a third and fourth miliary between the two. The poriferous zone is narrow, but slightly undulating and occupying half the ambulacral plate. The sutures of the plates of the abactinal system are marked by distinctly cut lines, instead of the wavy double line characteristic of C. hystrix; the abactinal system is large, the ocular plates heart-shaped, the genital plates irregularly octagonal; the large sides of the plate adjoining the anal system are separated by five long wedge-shaped anal plates, forming the base of the smaller plates of the anal system.

From 40 to 270 fathoms.

Salenocidaris varispina A. Ag., nov. gen. et sp.

The composition of the plates of the anal system in young Echini, explains most unexpectedly the homology of the sub-anal plate of Salenia, and proves, from a different point of view, that the position of the anal opening can in no wise form a guide by which we can determine any geometrical axis of Echini, but that the only part of the abactinal system which has a constant structural relation to the axis is the madreporic body, which

* Dujardin and Hüpé refer its Mediterranean representative to Leiocidaris *Des.* (Phyllacanthus *Br.*), with which it has nothing in common, as the pores are not joined by furrows. I would substitute for Orthocidaris Ag., non Cott. the name Dorocidaris.

at once gives us the key to the position of an anterior and posterior side among Sea-urchins. The correctness of this view is fully maintained from the analysis of the abactinal system of a living Salenia here described, which shows that the sub-anal plate is the homologue of the first anal plate of young Echini, (which in many cases remains decidedly larger in older stages, — Toreumatica, Genocidaris, Trigonocidaris,) and shows that the abactinal system of Salenia is entirely homologous with the abactinal system of the Echinoids, the original plate only retaining a greater preponderance than has thus far been noticed in other genera. The remaining part of the anal system was, in the fossil species, undoubtedly covered by small plates, as in the living species; and that this was the structure of the anal system is shown by Wright, who has figured the abactinal system of Acrocidaris, and removed the genus to Salenidæ on account of the presence of a sub-anal plate. This feature, which seemed so characteristic of a small group of Echini, is one which alone has no systematic value, so that we must, I think, hereafter consider the Salenidæ simply as a sub-family of Cidaridæ, as the description of the species dredged in Florida by Mr. Pourtales will clearly show.

The general appearance of Salenocidaris is that of a young Dorocidaris abyssicola. The primary spines are enormous, — twice the diameter of the test in length, of a brilliant white color, and of all shapes. Some of them are uniformly tapering, others swelling at about one third the distance from the base, others flattened and curved, but all finely longitudinally serrated with sharp spines, irregularly arranged along the body of the spines. The secondary spines, as well as the greater number of the spines of the ambulacra, as far as the ambitus, are short, club-shaped, sometimes curved and flattened, longitudinally striated with slight serrations. These short spines give to the median interambulacral and ambulacral zone the aspect of the corresponding zones of Cidaris; but they are not, as in Cidaris, arranged in a circle round the base of the primary spines. These small spines, as well as the whole abactinal area, are covered with prominent dark violet pigment cells, standing in striking contrast to the white primary spines. The abactinal system has the structure of that of Salenia, but the position of the anal system is that of Hyposalenia. As we know nothing of the spines of either of these genera, it is better for the present to establish a new genus founded upon this peculiarity of the abactinal system, and the imbricated buccal membrane, which is covered thickly with plates arranged somewhat as they are in Echinocidaris; the ten buccal plates are sparingly covered by pedicellariæ. The primary tubercles of the interambulacral area are large, arranged in two vertical rows in the two areas; those of the ambulacral area are smaller, and diminish rapidly towards the abactinal pole; the median interambulacral space is occupied by two vertical rows of small secondary tubercles. The primary tubercles of both areas are imperforate, but distinctly crenulated. At the actinostome the ambulacra flare slightly, somewhat as in Hemicidaris. The pores are small, placed in pairs far apart, one above the other, so that there seems to be, as far as I could see, but a single pair of pores for each ambulacral plate, though near the mouth they are somewhat closer. As in Salenia, the indentations of the actinostome are very slight. The abactinal system covers nearly the whole of the abactinal part of the test; the anal system is eccentric. There is a marked difference in the size of the genital plates, the three posterior ones being much larger than the two anterior ones; the reverse is the case of the ocular plates. In the largest genital plate there is a trace of the madreporic body, corresponding to the position assigned to it by Forbes, Müller, and Wright, and which cuts the symmetrical axis of the sub-anal plate at an angle; this is the case also with the angle made by the axis of the madreporic body and the first anal plate of young Echini; the position of the axis passing through the anal plate has no definite relation to the madreporic body. The anal opening is covered by small plates, as in other Echini. The whole abactinal system is studded with embryonic spines, which are longest along the exterior edge of the abactinal system, thus separating it most distinctly from the test. The sutures between the plates are deeply cut with deep pits at the angles of junction of the genital and sub-anal plate and of the ocular and genital plates. The three larger genital plates have also pits in the middle of their line of junction with the sub-anal plate. The genital openings are large, placed in the middle of the plates.

Off Double Head Shot Key, 315 fathoms.

Diadema antillarum PHIL., Wieg. Archiv, 1845.

Syn. Diadema antillarum LÜTK., Bid. til Kunds. om Echin.

Littoral to 17 fathoms.

Cænopedina cubensis A. AG., nov. gen. et sp.

This species is a living representative of the genus Hemipedina of Wright (as emended by Desor, Wright having included in it species of other genera of Pseudodiadematidæ). It differs from its fossil representative by the peculiar arrangement of the pores, which have a tendency to arrange themselves in lateral arcs of three pairs. The general outline of the test is that of Cyphosoma. It has, like Orthopsis, Echinopsis, Hemipedina, perforate tubercles not crenulated. It reminds us of Pseudodiadema in having tubercles nearly of the same size, and has, like Phymosoma, only two rows of tubercles extending from pole to pole, while the flatness of the abactinal part of the test, and the great development of the abactinal system, remind us of some forms of Hemipedina, as, for instance, Hemipedina Guerangeri Cott. et Trig. The actinal opening is large, with sharp cuts for the passage of long, narrow gills. The spines are long, moderately stout, as long as the diameter of the test, longitudinally striated, resembling the spines of some species of Hemipedina figured by Wright. The pores are arranged in connected vertical arcs, of three to four pairs. There are two rows of perforate primary tubercles in the ambulacral area, decreasing rapidly in size towards apex, and placed close together. They are somewhat smaller than those of the interambulacral area. There are one or two small imperforate tubercles at the base of the larger ones. The poriferous zone is broad and well defined, spreading slightly at actinostome. The perforate interambulacral tubercles are arranged in two primary rows, separated from the poriferous zone by a row of small imperforate tubercles, with two or three similar irregular rows between the larger tubercles in the median interambulacral zone. The plates of the abactinal system are large, with straight sides, the genital are heptagonal, carrying five to six small tubercles, and as many still smaller ones. The ocular plates are pentagonal, with a large ocular pore surrounded by an arc of small tubercles. The plates covering the large anal system are very numerous and minute. The anus is situated in the very centre. The teeth resemble those of Echinocidaris. The buccal membrane is strengthened round the mouth, close to the teeth, by ten large plates (perforated for buccal tentacles), occupying nearly the whole membrane, with eight to ten very much smaller ones between the large plates and test. The color of the large spines is of a dull yellowish green, while the smaller spines, as well as test and abactinal plates, have a more yellowish tint.

From 138 to 270 fathoms.

Echinocidaris punctulata Desml., Étud. Echin.

Syn. Echinocidaris punctulata A. Ag., Bull. M. C. Z., No. 2.
" " Davisii A. Ag. " " "
" " punctulata Lütk., Bid. til Kunds. om Echin.
" " " " Holmes, P. F. Pl. 2, fig. 5.
Anapesus carolinus Holmes, P. P. F. Pl. 2, fig. 2.

The specimens collected by Mr. Pourtales seem to show conclusively that the species distinguished as E. Davisii in the second number of this Bulletin is only a local variety. All Echinocidaridæ are difficult to distinguish, as there is great variation in the same species, in the number and arrangement of the tubercles; and the characters by which E. Davisii was separated from E. punctulata are found in the large series of young specimens collected by Mr. Pourtales at Cape Fear, North Carolina, to have no permanence. Lütken considers the Echinocidaris pustulosa LAM. as a nominal species; quite a number of specimens of it were brought home by the Thayer Expedition from Brazil. It may be that a larger series than we possess will prove its identity with E. punctulata, but from the material at hand I should consider it a good species, closely allied to E. æquituberculata. I am inclined to think that the various West Coast species of this genus will be limited to two, or at the utmost three, species; namely, E. stellata and E. nigra, perhaps E. spatuligera.

Littoral to 125 fathoms.

Podocidaris sculpta A. AG., nov. gen. et sp.

This genus has the general facies of young Echinocidaris, with a depressed abactinal surface as in Astropyga, the ambulacra rising in ridges above the surface. The large spines are confined to the lower surface, the primary tubercles scarcely extending beyond the ambitus. These tubercles alone carry a large, smooth mamelon, while the rest of the test is covered with rudimentary spines, arranged, however, in regular, vertical rows, four of which form a distinct, raised band in the median interambulacral zone, flanked by three more, less well defined, while in the narrow ambulacral zone there are but two such rows, close to the poriferous zone, which is very narrow, the pores being arranged in a single vertical row. The rudimentary, knob-shaped spines, strongly serrate, are not carried upon a mamelon, but rise directly from the test, as in very young Sea-urchins, and are connected at their base by a ridge, leaving thus a more or less quadrangular pit in the space between four tubercles. This ridge is particularly prominent between the spines of the median interambulacral rows, while in the more irregular rows the ridges are less marked, forming simply depressions in the test, running irregularly. The pits in the ambulacral zone are very marked, and are connected into an irregular groove extending along the whole ambulacral zone, the ridges, starting from the base of the tubercles, extending only part way across the ambulacral area, like spurs and rounded knobs. The whole surface of the test is covered with long-stemmed, articulated pedicellariæ, which have a distinct mamelon for their support, surrounded by a sort of scrobicular circle, the base of the pedicellariæ forming a ball-and-socket joint with the tubercle, while there is a thin muscular membrane holding them in place, as in true spines, — an additional proof that pedicellariæ are only modified spines, as was made probable by their identical mode of development with spines, observed in the Star-fishes and Spatangoids. The abactinal system, placed in a depression of the abactinal part of the test, resembles that of Echinocidaris, having only four anal plates, with large genital and ocular plates, which, however, are not bare as in that genus, but carry small, rudimentary, knob-shaped spines. The genital openings are near the anal system. The buccal membrane carries ten large quadrangular plates, with rounded edges placed near the test, the whole space between them and the mouth being covered by small plates; the rest of the membrane is bare. The actinal opening is large, the cuts slight, and the pores are not arranged in arcs near the mouth as in Echinocidaris. The spines are sharp, flat spindle-shaped, with a prominent ridge running along the middle of the upper surface, the section is triangular, the longest side being the under side, which is convex, the shorter upper sides being concave. The spines are finely granulated longitudinally with a slightly serrate edge. The large spines, as well as the knobs of the rudimentary spines, are sometimes beautifully colored by dark violet pigment cells, following the arrangement of the granulation. The pedicellariæ have the same coloration. The tentacles, to judge from alcoholic specimens, must have been very large, though not possessed of a powerful disk; the test, when prepared to show the structure, was of a delicate cream color, upon which the brilliant coloration of the knob-shaped spines stood out in bold relief.

From 138 to 315 fathoms.

Echinometra Michelini Dés., Agass. Cat. Rais.

Syn. Echinometra Michelini A. Ag. (non. Lütk.) Bull. Mus. C. Z., No. 2.
Echinometra lucunter Lütk., Bid. (non. Lam.)
" lobata Blain., Article Oursin.
Heliocidaris mexicana Auct. (non. Ag.)
Heliocidaris Castelnaudi Hupé in Casteln.

From an examination of typical specimens of Echinometra lucunter Lam. it became evident that Lamarck's species was the common Echinometra, having such an extensive range in the Pacific and Indian Oceans; extending from the Sandwich Islands to the Red Sea. It is with some doubt, however, that the above name has been adopted for our common West India species, the varieties of which have served as the type of many species; the large, somewhat oblong, swollen-sided adult, with short stout spines, has been the Echinometra lobata Blain., the flatter, more circular variety, with long slender spines, has even been referred to a different genus Heliocidaris by Hupé. Authors generally have referred the young flat stage to Heliocidaris mexicana Ag. It is somewhat remarkable that with the extensive geographical distribution of this species (the whole coast of Brazil, the Gulf of Mexico, Caribbean Sea, West India Islands, Bahamas, and Bermudas) it should be so limited in bathymetrical range.

Littoral, to 6 to 7 fathoms.

NOTE.—Verrill has insisted, in his notes on Radiata, on referring Heliocidaris mexicana AG. to Anthocidaris LÜTK., while he places Toxocidaris mexicana A. AG. in Toxopneustes; I do not see upon what grounds. The specimens in the Natural History Society of Boston to which he refers are only one of the younger stages of the long-spined variety of Echinometra Michelini DES. (A. AG.), and have nothing in common with Heliocidaris. In the second place, Anthocidaris LÜTK. is synonymous with Toxocidaris A. AG.; so that it is perfectly natural that the two species he quotes should belong to different genera, one being a young Echinometra, the other a true Toxocidaris A. AG., Anthocidaris LÜTK. I cannot see the propriety of the changes made by Verrill in the limitation of Toxopneustes, by substituting Euryechinus for a group of Echini, which are perfectly well known by all writers on Echinoderms as Toxopneustes. For the following reasons it seems to me, even granting all his premises, that the changes he proposes are not warranted. The type of a genus at the time the Monog. d. Echinides was written was never used in the restricted sense now common, but was coextensive with a group of species. When Toxopneustes was first proposed, it was applied to a so-called typical species which future investigations showed did not belong to the genus. The author took the earliest opportunity possible to point out his mistake by substituting for it another type, and giving a description which *applies not only to Toxocidaris as Mr. Verrill would have it, but also to all the species since removed as Sphærechinus by Desor.* Desor, who had edited the Catalogue Raisonné, and probably knew accurately what group of Echini was defined as Toxopneustes, was the first, in his Synopsis, to limit Toxopneustes by removing from it certain species as Sphærechinus, and restrict Toxopneustes to such forms as (T. neglectus) T. drobachiensis AG., but still including the species which I have since, in the Bulletin of the Museum, separated as Toxocidaris. All these limitations, even were they not accepted, have the priority over a similar limitation which Verrill makes twelve years after a proper limitation of the genus has been recognized, and eighteen years after a mistake (upon which Mr. Verrill bases the whole of his proposed changes) has been corrected by the author himself; nothing, moreover, is gained in accuracy by the change proposed by Verrill, T. tuberculatus being probably only a nominal species, and one concerning which we have, at any rate, no authentic information sufficient to form the basis of a sweeping reform. At the present rate of retrospective application of the laws of priority, we are fast drifting into the most absurd anachronism by applying the present condition of our knowledge of any group to works written twenty or thirty years ago in an entirely different spirit, when the idea of type, genera, etc. had a totally distinct signification from what it has at the present day.

Echinometra viridis A. Ag., Bull. M. C. Z., No. 2.

Syn. Echinometra Michelini Lütk. (non. A. Ag., nec Des.) Bidrag.
" " plana A. Ag., Bull. M. C. Z., No. 2.

As in Echinometra Michelini Des. there is a flat long-spined variety of Echinometra viridis, distinguished formerly as Echinometra plana, but which the full series now in the Museum collection shows decidedly to hold the same relation to E. viridis which Heliocidaris mexicana Auct. holds to E. Michelini.

Same range as former species, much less common.

Echinus gracilis A. Ag., nov. sp.

This species holds an intermediate position between E. Flemingii Ball and E. melo Lam., to both of which it is allied. Like the former, it is subject to great variations in the ratio of the longitudinal and vertical diameter of the test. The primary tubercles are larger than those of E. melo, but smaller than those of E. Flemingii. The spines in the proportion they bear to test are similar to those of E. melo, as well as the general pattern of coloration, consisting of bands of green made up of irregularly shaped lozenges running in vertical rows, diminishing in intensity towards actinostome, the intermediate spaces forming brilliant white or straw-colored bands. In one of these white bands is placed the poriferous zone, and each primary row of tubercles is placed in a similar band. Thus the test is divided into twenty bands alternately green and white; the poriferous zones and two principal rows of tubercles being separated by these dark-green lozenges, giving the test a most graceful pattern of coloration. The shape of the genital plates of the abactinal system, which is compact and circular, is a pointed pentagon somewhat as in E. melo, while in Flemingii they are heptagonal. The anal system is made up of a large number of small plates. The ten large plates of the buccal membrane are quadrangular with rounded corners, carrying stout pedicellariæ similar to those of E. melo. The position and general arrangement of the tubercles is similar to E. melo; the large tubercle is placed in the centre of the interambulacral plate, which carries in addition short horizontal rows of two or three minute tubercles, the row near the horizontal suture being the most prominent. In the ambulacral zone the main tubercle has a similar position; the small tubercles are placed close to the median suture, and form irregular vertical rows. This species attains a considerable size; specimens are in our collection measuring 2.60 inches in diameter, and another 2.75 inches in height, exceeding somewhat the transverse diameter.

From 93 to 200 fathoms.

Echinus Flemingii Ball, Forbes Brit. Starf.

Among the Echini dredged by Mr. Pourtales is a single small specimen which I am unable to distinguish from specimens of the same size of E. Flemingii. It may be that, when more extensive series of the young of E. melo, E. Flemingii, and E. gracilis, described above, have been compared, that we shall find these species to be only local varieties, though I am not inclined, from the material at my command, which is quite ample, to adopt this view, but rather suppose that we have here, side by side, two allied species, one of which has an extensive range. Grube already considers E. melo and E. Flemingii as identical; I suspect he has only found the two species side by side, as they are both known to inhabit the Mediterranean.

In 195 fathoms.

Genocidaris maculata A. Ag., nov. gen. et sp.

This genus is established for a small Sea-urchin, the living representative of Opechinus, which Desor separated from Temnopleurus. The spines resemble in their structure those of Temnopleurus, but are short; the Sea-urchin with its spines resembling a Psammechinus, and having, like it, a large number of tubercles, of nearly uniform size, closely crowded together, but of a peculiar chiselled structure (so that it may be said that this genus is a Psammechinus among Temnopleuridæ), there is one principal row in the ambulacral and interambulacral area larger than the others. The poriferous zone is narrow; the pores are arranged in an unbroken vertical row separated by an arched ridge. The mamelon of the primary tubercles is smooth, imperforate. Near the base of the tubercle the test is ornamented by cuts specially marked near the suture of the plates, and the small tubercles are frequently connected by a ridge with the main tubercles, the ridge forming spokes radiating from a hub, similar to the structure of Glyphocyphus radiatus, and some species of Echinocyphus. The genera Opechinus, Temnotrema, Trigonocidaris, and Genocidaris form a transition between Psammechinus and Temnopleurus. The actinal membrane is bare, with the exception of the ten small circular buccal plates. The actinal opening is not large, with slight indentations; the test is irregularly covered with pedicellariæ, having a blunt head surmounting a long, slender stem, articulating upon a shorter, stout rod. The abactinal system is peculiar, as we find, in the largest specimens even, which appear fully developed, but a single circular plate, slightly conical, occupying nearly the whole anal system, with the exception of a small crescent-shaped slit, covered by four very small plates. The genital plates are large pentagonal, with a deep groove, in which is situated the genital opening, having on the anal edge a cluster of three or four small tubercles; the ocular plates are also pentagonal, elongated horizontally. The color of the test is greenish (in alcohol), mottled with dark violet patches; the spines are of the same greenish tinge, banded irregularly with reddish, transverse bands. In other specimens we have the same pattern of coloration, in different shades of green, with white spots irregularly scattered over the surface.

From 30 to 160 fathoms.

Trigonocidaris albida A. Ag., nov. gen. et sp.

This genus is allied to Genocidaris. The principal tubercles have the same structure; but, in addition, the whole test is covered by a reticulation of ridges, similar to those of Podocidaris, extending from the base of the different tubercles, both primary and secondary, and uniting them all in a complicated, raised system of network, with irregularly shaped cells, the ridges leaving more or less deep pits, giving the test the appearance of having been gouged out in spots. The spines are long, slender, somewhat transparent, longitudinally striated, with slight, transverse striation. The abactinal system resembles that of Cænopedina, but the anal system is covered by only four triangular plates, one of which is much larger than the others. From the fact that in the youngest specimens examined we find them already, I am tempted to suppose they never increase in number, and remain as they are, as in Echinocidaris. The actinal membrane is, as in Lytechinus, entirely covered by a number of rather large plates irregularly arranged, the ten buccal plates being but slightly larger than the others. The actinal opening is of moderate size, slightly indented; the auricles are exceedingly slender, and disconnected at the extremity. There are but two principal rows of primary tubercles, both in the ambulacral and interambulacral zone, with from five to six minute tubercles seated upon the connecting ridges in the latter zone, and two to three upon each plate in the former. The poriferous zone is narrow; the pores are placed obliquely in an unbroken vertical zone, three to each ambulacral plate, and separated by ridges running from the ambulacral tubercles to the interambulacral zone, similar to those joining the tubercles. The test, as well as the spines, are almost white, the latter having only a slight tinge of yellow when largest. The whole test is covered with pedicellariæ, having a sharp-pointed head articulated upon a long, slender thread, seeming scarcely capable of supporting the head.

From 40 to 270 fathoms.

Lytechinus variegatus A. Ag., Bull. M. C. Z., No. 2.

Syn. Lytechinus carolinus Ag., Bull. M. C. Z., No. 2.
" " atlanticus A. Ag. " " "
Echinus variegatus Rav., Cat. Echin. S. C.; P. P. Foss. Pl. 2, fig. 1.
" " variegatus Lam., An. s. V.
Psilechinus variegatus Lütk., Bidrag.
Psammechinus exoletus McCr., Pl. Foss. S. C., Pl. 2, fig. 6.

Soon after the publication of the second number of the Museum Bulletin, Dr. Lütken called my attention to the identity of L. carolinus and L. atlanticus with E. variegatus. The extensive series of this species collected by Professor Agassiz in Brazil, the West India Islands, and dredged by Mr. Pourtales, have satisfied me of the correctness of his view, the variations due to age or locality being astonishing. It has, like the common Echinometra, a great geographical range identical with it, but at the same time has a somewhat more extensive bathymetrical distribution.

Littoral, to 34 fathoms.

Tripneustes ventricosus Ag., Agas. Cat. Rais.

Young specimens of Tripneustes show the correctness of the analysis of the arrangement of the pores made by Dr. Lütken. Each ambulacral plate has only three pairs. The original Heliechinus Gouldii Gir., Proc. Bost. Soc. N. H. 1850, is nothing but a young Tripneustes.

Littoral, to 10 fathoms.

Clypeaster rosaceus Lam., An. s. Vert.

It is quite remarkable that of a species so common as this no young small enough to show any very striking difference from the adult should have been collected, while of nearly all the more common species complete series of all sizes were obtained.

Littoral, to 5 fathoms.

Stolonoclypus prostratus Ag., Bull. M. C. Z., No. 2.

Syn. Clypeaster prostratus Lütk., Bidrag.

This genus is distinguished from the true Clypeaster by the character of the internal pillars connecting the actinal and abactinal part of the test, which is totally different, in all the flat Clypeastroids allied to Clypeaster placunarius Lam., from that of Clypeaster rosaceus Lam., being slender, often needle-shaped points, instead of heavy, solid columns, as in true Clypeaster. Rhaphidoclypus cannot be maintained as an independent genus; it is only the young type of Stolonoclypus which presents some striking peculiarities, and the species upon which the genus was based will probably turn out to be young specimens of a species of true Stolonoclypus, to judge by analogy with the young of this Florida species, which undergo very great changes during their growth, resembling to such an extent Echinocyamus pusillus LESKE of Europe, that for some time I considered the young as identical with that species.

Littoral to 325 fathoms.

Stolonoclypus Ravenelii A. AG., nov. sp.

The presence of a true Laganum in the West Indies has been often mentioned by various writers on Echinoderms, but it has invariably been presumed to be founded upon mistaken localities (Rumphia Lesueuri) or a confusion with young specimens of Stolonoclypus prostratus. Mr. Pourtales has dredged, from a depth of thirty-four fathoms, a small Clypeastroid of about two inches in length, which has the facies of a Laganum to such an extent that it would pass for one without an examination of the internal structure. The outline is pentagonal, with rounded corners; the pentagon is equilateral, and more regular than in any species of Laganum, the central part of the test rising abruptly from the extremity of the ambulacral rosette. The test has a thick, rounded edge, and it may be that specimens of this species have been collected by those who have referred to the presence of a Laganum in the West India Islands. Hupé speaks of Laganum latissimum as found on the coast of Brazil; it certainly cannot be the Clypeaster latissimus LAM., which Agassiz distinctly says is allied to C. scutiformis, although by mistake it was subsequently referred to Laganum in the Catalogue Raisonné, and which is found in the East Indies. The specimen collected by Mr. Pourtales is evidently the young of a large Stolonoclypus collected by Mr. Ravenel off Charleston Harbor, which, from want of additional material, remained undescribed in the Museum collection. It does not differ in outline (although measuring five and a half inches in length) from the smaller specimen; has the same thick, rounded edge, with abruptly rising test near the extremity of the ambulacral rosette. The rosette is not raised as in other species of Stolonoclypus, but is flush with the rest of the test; the whole lower part of the test is flat, as in Laganum. In the smaller specimen the rosette is harp-shaped, well opened at the extremity, as in Echinarachnius, while in the adult this is the case only in the anterior ambulacrum; the others are brought close together at the extremity. The ambulacral rosette extends to within one third the distance of the apex from the edge. The poriferous zone is much broader than in S. prostratus. The furrows are more numerous and more closely crowded together than in any other species of Stolonoclypus. In the younger specimen the lower surface is covered with spines only upon the interambulacral area. This is narrow, leaving the broad, bare bands of the ambulacral areas colored light yellow, giving this species a striking appearance. The tubercles of the upper part of the test are quite small, closely crowded together; they increase in size in the interambulacral spaces of the lower surface. The color of the spines is greenish yellow in the smaller, and in the larger specimen the color was duller.

Off Charleston bar; Florida in 34 fathoms.

Mellita testudinata Klein, Nat. Disp. Echin.

Syn. Mellita pentapora Lütk., Bid.
Mellita quinquefora Ag., Agass. Cat. Rais.
" ampla Holmes, Rav. Cat.

The large series collected by the Thayer Expedition along the whole coast of Brazil show that this species has a wide geographical range, and is liable to great variations, indicating that the characters which are described as separating M. quinquefora and M. testudinata have no permanent value.

Littoral, to 7 fathoms.

Mellita hexapora Ag., Agass. Cat. Rais.

Syn. Mellita hexapora Lütken, Bid.
" caroliniana Rav., Cat.; Pl. Foss. S. C., Pl. 1, fig. 4.

Littoral, to 270 fathoms.

Encope Michelini Ag., Agass. Cat. Rais.

Syn. Encope Michelini Ag., Bull. M. C. Z., No. 2.
" aberrans Martens, Wieg. Archiv. XXXIII. I. p. 112.

The extensive suite of Encopidæ brought home by the Thayer Expedition from different points of Brazil, and more particularly the series of all sizes of Encope emarginata which the Museum owes to the kindness of Dr. Fritz Müller, of Desterro, has satisfied me that Lütken is correct in uniting under one name, that of E. emarginata, most of the nominal species he mentions (E. Valenciennesii, subclausa, oblonga, E. quinqueloba Esh. and Grube), to which we would add the name given by Béval, E. Griesbachii. E. tetrapora Gmel. must remain doubtful, as the original cannot be found in any Museum. Yet I cannot agree with him in referring to the same species Encope Michelini Ag., in which the position of the apex is totally different from that of any of the other species referred to E. emarginata, as is readily seen by the excellent profile given in Agassiz Mon. d. Scut., Pl. 6[a], fig. 10. Nor can I agree with him in referring to Encope emarginata E. grandis Ag., a species found in the Gulf of California, and Encope

Agassizii MICH., identical with it. There is a second species also found on the West Coast, which Verrill has described as E. occidentalis, and which is identical with Encope tetrapora AG. non GMEL. From a careful comparison of specimens of E. cyclopora, micropora, and perspectiva, there is no doubt that these are only nominal species, all identical with Verrill's E. occidentalis; and as the name micropora seems to be the most appropriate, it would be the best name to retain.

Littoral to 11 fathoms.

Encope emarginata AG., Agass. Cat Rais.

Syn. Encope Valenciennesii AG., Agass. Cat. Rais.
" subclausa " " "
" oblonga " " "
" quinqueloba " " "
" Griesbachii BÉVAL., Acad. de Brux.
" emarginata LÜTK., p. p. Bidrag.
Moulinsia cassidulina AG., Agass. Cat. Rais. (young!)
" " LÜTK., Bidrag.

Dr. Lütken, in his discussion of Encope emarginata, has given figures of young Encope after the appearance of the posterior interambulacral lunule. Younger specimens in our collection, before the appearance of this posterior lunule, show that Moulinsia is only a young Encope emarginata. As in my account of young Echini I have given a full description of the changes Encope undergoes during its growth, I will only recall them here to justify the synonymy adopted.

Littoral to 7 fathoms.

Echinoneus semilunaris LAM., An. s. v.

Syn. Echinoneus semilunaris LÜTK., Bid.
" elegans A. AG., Bull. M. C. Z., No. 2.

Lütken, like myself, has only been able to recognize one species in the West India Islands. As is well known, the difficulty of distinguishing the species in this genus is very great; the more so, as thus far only tests without spines have been used in the determination of species. Mr. Pourtales has collected one specimen at Carysfort Reef with its spines and tentacles, which gives us the first opportunity of making a direct comparison with specimens from the Sandwich Islands (the true E. cyclostomus) still retaining the anal and buccal membranes. As far as I am able to discriminate between the test of these two species, the Pacific species is remarkable for the narrowness of its poriferous zone, the pores being placed in close contact, separated by a ridge carrying small tubercles, while in the specimens of E. semilunaris the poriferous zone is much broader. It has also (taking the same point of the test in specimens of the same size) larger tubercles, and a greater number of large, glassy tubercles, while the miliaries are closely crowded together. In E. cyclostomus, on the contrary, the primary tubercles, as well as the glassy tubercles, are, proportionally, much smaller and farther apart, the miliaries being more numerous. From the examination of the alcoholic specimen from Florida, I could not come to any satisfactory conclusion concerning the function of the glassy tubercles; they are not primary tubercles in the course of growth, as they are fully as large, and the primary tubercles, when young, always appear at first as opaque tubercles. They carry no special spines. On living specimens their function will probably be ascertained. Similar glassy tubercles often appear on the edge of very young Clypeastroids (Stolonoclypus prostratus), which disappear in older stages. Desor has given figures of the spines; but in addition to these, the test is thickly covered with stout pedicellariæ carried upon moderate peduncles. The tentacles do not differ (as far as could be judged from this alcoholic specimen, where they still were tolerably expanded) from the tentacles of our ordinary Echini, having prominent suckers. The tentacles retain the same structure from the mouth to the apical system. On the lower surface, especially round the mouth and anal system, the spines are longer and more slender than on the remaining portions of test. The anal system will, I think, furnish good characters for the determination of species, if we can judge from the striking differences the arrangement of the plates of the anal system presents in the two thus far examined. In the Pacific species the anal opening is more pear-shaped; the anus is placed near the blunt end, surrounded by a number of small plates arranged concentrically round it, and extending as a narrow band of small, slender, elongated plates between the single rows of large plates, extending on each side along the other extremity of the anal system. This row of large plates consists of five large plates, diminishing in size from the centre of the row towards either extremity, and carry a few large tubercles bearing spines. In the West India species, on the contrary, the anal system is more elliptical, the anus being placed almost in the centre, surrounded by a smaller number of small plates radiating from it irregularly. The single rows are made up of four plates, leaving a triangular space covered by small plates between them and the anus. The rest of the anal system is covered by much larger polygonal plates than in the Pacific species. The buccal membrane is covered by small quadrangular plates, arranged in rows radiating from the mouth, diminishing in size towards the opening of the mouth placed in the centre of the membrane. The absence of teeth is fully confirmed by an examination of this specimen. The close structural resemblance between the young of Echinolampadæ and Echinoneus shows that Echinoneus has no affinity whatever with the Galeritidæ, with which the genus has always been associated, but that it is a true embryonic Cassidulus allied to Echinolampadæ and Caratomus, already suggested by Desor to be a true Cassidulus, and not a Galerites. This affinity the examination of young Echinolampadæ proves undoubtedly. The removal of Echinoneus, Caratomus, and all the allied edentate forms of Galerites now reduces the family to one of great homogeneity, and suggests again the question of their affinity to true, regular Echinoids in a more forcible manner than before. We must, however, wait till we find a living representative of Galerites, to have the question fully decided. I am inclined, in the mean while, to associate the Galeritidæ having teeth with the true Echinoids, and consider them as forming among Echinoids a prophetic type of the Clypeastroids, with which they have many points of resemblance.

Littoral.

Echinolampas caratomoides A. Ag., nov. sp.

Fragments of an Echinolampas were dredged in the first expedition, indicating the presence of a species which must attain a length of at least two inches. In the second expedition an entire specimen, measuring a little over an inch, was dredged from a depth of thirty-five fathoms. It resembles in outline E. Richardii Desml. found in Senegal, but differs from it by the peculiar structure of the ambulacral rosette, which is not strictly petaloid (the large fragments have the same structure), the two lines of pores of each ambulacrum having a different development. In the posterior pair, the anterior zone is fully developed, forming one side of the petal, while the other zone is not quite half as long. It is the same with the anterior pair of ambulacra, but the anterior zone is the shorter. In the odd ambulacrum the left poriferous zone is the shortest. In the continuation of the ambulacra from the rosette to the mouth it is always the exterior pore which is continued from each zone, and not pairs of pores, as is uniformly represented in all drawings of fossil Echinolampadæ. The floscelle round the mouth is most distinct, but in this specimen the bourrelets were not yet developed, formed as yet only by simple accumulations of small tubercles closely crowded together. In still younger specimens the resemblance of the opening of the actinal system to that of Clypeastroids is much greater, showing plainly that the distinction of a suborder, founded upon the presence of the bourrelets and phyllodes, as separating the Echinolampadæ from the Spatangoids cannot be maintained, and is simply an embryonic feature which may be more or less developed. The peculiar bare space of the actinal part of the test, so characteristic of Pygorhynchus, and upon which Desor lays so much stress, is well developed, though in older specimens of

Echinolampadæ it can be traced only as a faint, indistinct narrow band. The young of this Echinolampas resemble Caratomus to such an extent (see the description of the young stages) that the larger specimens were considered as living representatives of Caratomus. The series collected by Mr. Pourtales in his second expedition shows conclusively that Echinolampas passes at first through a stage strikingly similar to Echinoneus and subsequently most closely allied to Caratomus.

NOTE. — Desmoulins has called attention to the fact that the Senegal species should be named E. Laurillardi DESML., the name Richardii having been applied by him to a fossil species from the tertiaries of Bordeaux, from which it is different.

From 35 to 160 fathoms.

Rhyncholampas caribbæarum A. AG., nov. gen.

Syn. Cassidulus caribbæarum LAM., An. s. Vert.
Cassidulus caribbæarum LÜTK., Bid.
Nucleolites Richardii DUCH., Antill. (non DESML.)

Lamarck's genus Cassidulus, as established in 1801, contains in it two distinct types: Cassidulus lapis cancri and the species from the West Indies; Cassidulus Marmimi has very justly been separated as a distinct genus, Rhynchopygus by Desor, but this still leaves Cassidulus of Lamarck composed of two types, for either of which the name Cassidulus might properly be retained, but as Cassidulus is preoccupied among Mollusca, I would propose to retain temporarily Cassidulus for the fossil species allied to C. lapis cancri, and leave to some palæontologist the task of properly limiting that genus, and separate from Cassidulus under the name of Rhyncholampas a genus including Cassidulus caribbæarum and its West Coast representative, which was originally named Pygorhynchus pacificus in the Museum Bull. No. 2. This view is the one Lütken adopted at first, but afterwards he has referred these two species to Rhynchopygus, a change which does not seem judicious, and which his own excellent analysis and comparison of Cassidulus and Rhynchopygus does not justify. Mr. Pourtales brought home fragments of this species, showing that it must equal in size its pacific representative. As it has been figured frequently, and described so well by Lütken, I will only call attention to a few points of difference between the East and West Coast species. The bare actinal band of the West India species is deeply pitted with longitudinal round and elliptical pores, the edges surmounted by minute tubercles, carrying extremely delicate spines, resembling in every respect the structure of the microscopic spines of the fascioles of the true Spatangoids. The spines in fascioles cannot be called pedicellariæ, although it is the universal practice: they are true spines, having all the structure of embryonic spines, — in fact, true pedunculated pedicellariæ among Spatangoids are not found in fascioles at all; they are found round the mouth principally, and also on the surface of the test. The plates of the anal system, arranged in three rows, are broader and longer than in the Pacific species, where they are arranged in two rows only, the outer row being the largest. In the pacific species the pits of the smooth band are reduced to a few indistinct impressions, the whole band being thickly covered by minute silk-like spines. The floscelle is most distinct also, while, owing to the sculpture of the bare band round the mouth in the West India species, its outline cannot be traced.

Fragments in 106 fathoms.

Neolampas rostellatus A. Ag., nov. gen. et sp.

Outline from above resembling Echinolampas more elongated, three large genital openings; the left anterior one atrophied, placed closely together, madreporic body restricted to a narrow ridge separating them. Seen in profile, the test rises gradually from the anterior extremity towards the apical system, attaining its greatest height between it and the posterior extremity; this is sharply truncated anteriorly, as in some species of Catopygus. The lower extremity is concave, undulating; the anal system is large, elliptical, occupying the whole of the posterior truncated end, somewhat as in Botriopygus, the test being turned in like the finger of a glove, while the anus opens at the end of a long slender tube, extending well beyond the outline of the test, starting from the upper part of the anal membrane, which is covered by small plates, gradually diminishing in size and eventually firmly soldered together to form the base of the anal tube. Test thin, mouth placed near anterior extremity, having a well-developed floscelle and prominent bourrelets. The test is covered by minute tubercles of different sizes, not separated into primaries and miliaries, as in Echinolampas. The tubercles are not sunk, but stand out prominently from the test. The spines are straight, very fine, resembling those of the Scutellidæ. There is no ambulacral rosette so prominent in all Echinolampadæ. From an external examination alone it would be difficult to trace the course of the ambulacra, but from the interior we easily see one pore for each ambulacral plate extending from the floscelle to the apical system, and appearing as most minute pores when seen from outside. In fact, the structure of all the ambulacra is here identical with the structure of the ambulacra between the rosette and the mouth in other Echinolampadæ. The color of this Sea-urchin is a yellowish green, and I am convinced it is not the young of any other Echinolamp, in spite of its size ($\frac{7}{12}$ of an in.), owing to the great development of the bourrelets, which in other Echinolampadæ appear only after the specific characters are fully formed and the main features of the adult attained.

From 100 to 125 fathoms.

Pourtalesia miranda A. Ag., nov. gen. et sp.

A single specimen of this interesting genus was dredged at a depth of 349 fathoms. It is a living representative of Infulaster of the cretaceous period, holding the same relation to it which Rhynchopygus, with its projection covering the anus, holds to Echinolampas, if the posterior part of the test of the former were drawn out into a long spout. The outline of this genus, and of Infulaster, is very peculiar, and at first sight no one would take for a Sea-urchin the elongated, bottle-shaped body with its thin and transparent test. It is more like a Holothurian; the anus is nearly at one extremity, while the mouth is placed at the other. The short, vertical diameter, as compared to its length; the absence of any feature which would indicate the presence of a petaloid ambulacral rosette; the long, slender, curved spines, far apart, supported upon peculiar tubercles, mark this genus as one of the most interesting which have been brought to light by Mr. Pourtales. It forms a valuable link in our appreciation of the affinities of Spatangoids proper with Spatangoids in which the mouth is not labiate. Seen from above, the outline is bottle-shaped, the neck being the posterior extremity. At the base of the neck the test carries a deep pit, surmounted at its anterior extremity by a rostrum projecting from the test, and under this, at the bottom of the pit, is placed the anus. Seen in profile, the anterior extremity is almost vertically cut off, the test arching regularly from the apical system to the rostrum, where it is abruptly cut off, forming a regular curve to the posterior extremity, which extends beyond the anal system like a snout thickened at the end, surmounted at its extremity by an accumulation of minute deep violet-colored tubercles, which carry no spines. The lower surface is convex, regularly arched from the posterior to the anterior extremity. The posterior pair of ambulacra extend on both sides of an elongated plastron to the base of the snout-like prolongation, where they curve sharply upwards, and follow close to the abactinal part of the test, along a marked wedge-shaped ridge, extending from the apical system into the rostrum, protecting the anus, to the apical system, situated almost at the summit of the nearly vertical anterior extremity. The pair of anterior ambulacra take a similar course, but curve more regularly, and do not extend beyond the median line towards the posterior end. The odd ambulacrum is made up of two lines of pores far apart, situated in the deep anterior groove. The abactinal system consisting of four large genital openings, placed close together, with the madreporic body tolerably well defined in the centre, is situated at the origin of the anterior groove, this is flanked by prominent ridges extending from the apical system, gradually disappearing towards the mouth, placed at the other extremity of the anterior groove, which increases in depth on the lower surface, resembling, in fact, the anal groove of Echinobrissus, and allied genera with inverted position. The actinal system is elliptical in the trend of the groove, very large, with sharply defined edges covered by very minute plates. There are no indications of a floscelle. The odd ambulacrum carries large, thick tentacles, with a slightly lobed disk, while the tentacles of the other ambulacra are peculiar. They are placed, one for each plate, far apart, branching at the extremity, strengthened by a rod separating in the three branches, each terminating by a well-marked disk. There is no petaloid portion in the ambulacra; they are all simple pores from the mouth to the apical system. The spines are long, curved at the base, as in Spatangoids, but the tubercles to which they are attached have not a sunken, scrobicular area. The mamelon is small, crenulated, perforate, surrounded by a large granulated, scrobicular area, and raised above the surface of the test, to which the milled ring is attached by a very flexible muscular membrane. There are smaller spines of a similar structure scattered irregularly over the test, but quite distant. The whole appearance of the test is bare, and it is only on the ridges along the anterior groove, round the mouth and anus, that the small spines are closely packed together. Radiating from the apex towards the mouth, and extending along the abactinal plastron, there are masses of pigment cells forming lines of dark violet spots, also a similar series of spots round the extremity of the anal prolongation of the test, particularly marked on the edge of the pit leading to the anal opening. From the above description it is evident that Infulaster and the Ananchytidæ must have had a structure allied to that of Pourtalesia, and are embryonic Spatangoids, still retaining some features of Clypeastroids, while the features characteristic of young Spatangoids are prominently developed.

Off the Tortugas in 349 fathoms.

Lissonotus fragilis A. Ag., nov. gen. et sp.

This genus has the general outline of Maretia, but is somewhat more elongate. It must, from the description of Grube, be closely allied to Platybrissus, but the presence of a subanal fasciole, as well as a slight anterior groove, readily distinguish the two genera, in addition to the presence of a rudimentary rosette in Platybrissus, wanting in this genus. The mouth is not labiate, but pentagonal, with a well-developed floscelle, while the remaining portion of the ambulacra, extending to the apical system, are simple pores, one for each ambulacral plate, so that the ambulacral areas, seen from above, are scarcely perceptible, marked only by the somewhat more closely packed minute tubercles covering the ambulacral plates. Seen in profile, the test is regularly arched anteriorly, from the lower side to the apex, running then almost horizontally, and abruptly bevelled at the posterior extremity. The central plastron is small, triangular, surmounted by an elliptical subanal fasciole. The spines of the lower surface are large and few in number, confined entirely to the edge of the test, leaving broad, bare bands in the ambulacral areas and adjoining parts, while on the rest of the test the tubercles are minute, carrying small, fine spines, with the exception of three large, curved spines (Lovenia-like) near the circumference, placed in the anterior extremity of the test. The tubercles are also somewhat larger on the edge of the anterior groove, and more closely packed in the posterior interambulacral space, from the apex to the anal system, than in remaining parts of the test. The plates of the two posterior ambulacra are broad, while all the other ambulacra are made up of smaller plates. There are three large genital openings; the right anterior one is obliterated. The anal system is transversely elliptical, its membrane covered by minute granulation; an indistinct branch of the subanal fasciole extends along the lower side of the opening; the anus itself opens in a short, delicate tube, similar to that of Neolampas, but shorter. The whole test is mottled with dark spots; the ground color is grayish, with a purplish tinge.

From 320 to 368 fathoms.

Brissus columbaris Ag., Cat. Rais.

Littoral.

Meoma ventricosa Lütk., Bidrag.

Syn. Brissus ventricosus Ag., Cat. Rais.
" panis Grube, Neue Echin.
" spatiosus McCr., P. Pl. Foss. S. C., Pl. 3, fig. 1.

Lütken first referred this species to the genus Meoma of Gray, established for a presumed Australian species, M. grandis. Lütken also, in 1863, called my attention to the generic identity of Kleinia nigra A. Ag., with Meoma, which I had with doubt referred to Kleinia. This mistake I was led into by the fact that Gray himself did not refer Brissus ventricosus to Meoma, but still retained it in a section of Brissus. This shows how little reliance can be placed upon the subdivisions which Gray so frequently introduces in his genera (often copied without any attempt at a more accurate discrimination of the species from similar headings in the Catalogue Raisonné), when two species as closely allied as Meoma ventricosa and Meoma grandis are placed in two genera, or when in the subdivisions of Echinocardium, as another instance, Echinocardium ovatum is placed in the subdivision of the genus with "*deep, odd, ambulacral groove,*" instead of being placed in the same subdivision as E. gibbosum. The genus Kleinia I am unable from Gray's figures and descriptions to distinguish from Brissopsis. Meoma grandis

GRAY, I am also inclined, from a careful comparison of the figures of Gray, to consider as identical with Meoma nigra (Kleinia nigra A. AG.), as the locality quoted by Gray is undoubtedly erroneous, Captain Belcher, as Lütken mentions in his "Bidrag," having visited Central America; and the fact that we have in the British Museum, brought back by Belcher, an Agassizia subrotunda GRAY, and a Meoma grandis GRAY, marked "Australia," neither of which can be distinguished from Agassizia ovulum and Meoma nigra, found upon the West Coast of Central America, seem to indicate without much doubt an error in the localities of the specimens of Gray's Catalogue.

Littoral, to 85 fathoms.

Plagionotus pectoralis AG., Agass. Cat. Rais.

Syn. Plagionotus pectoralis LÜTK., Bidrag.
" " GRAY, Cat.
" Desorii GRAY "
" Holmesii, Ravenellianus McCR., Pl. Foss. S. C., Pl. 3, figs. 2, 3.

I am unable to appreciate the grounds upon which Gray distinguishes P. Desorii GR. from P. pectoralis AG. The figure he quotes as basis for his species is taken from the original Spatangus pectoralis LAM., which came from Bahia.

The identity of the pliocene and post-pliocene species here cited, as well as in the synonymes of the preceding and following species, is of course problematical; yet the differences indicated by McCrady do not indicate as great a range of variation as we find in living species. I have quoted the figures for the sake of calling attention to them. There are, in addition, other tertiary species described by Michelin and by Guppy, coming from the Gulf and the West India Islands; but as those represented in our collections are not accompanied by figures, I have not attempted to point out their affinities.

Littoral and fragments from 115 fathoms.

Brissopsis lyrifera AG., Agass. Cat. Rais.

The only difference to be traced, after a careful comparison, between Florida and European specimens is the existence of a distinct branch of the subanal fasciole extending round the anal system to the peripetalous fasciole. In European specimens there are traces of this branch, but it is not distinctly and sharply defined as in the Florida specimens. The subanal fasciole seems, from all I can gather after an examination of Spatangoids in various stages of growth, the only one subject to changes, and it is not remarkable that we should have in Brissopsis similar variations, in the sub-anal fasciole, to these upon which Troschel has founded his genera Abatus Hamaxitus and Atrapus, — changes which, in Brissopsis at least, are due to different stages of growth. The character of continuity of the adjoining pairs of ambulacra, which Desor assigns to Toxobrissus as a distinguishing feature, does not constitute a sufficient basis for its separation from Brissopsis. This character is more and more apparent according to the size of the specimens; so much so, that we should place Brissopsis lyrifera, when young, in Brissopsis, but when full grown it would most decidedly pass for a Toxobrissus. If the subanal fasciole is really absent in Toxobrissus, it cannot, as Lütken considers it, be identical with Kleinia. It may be that other characters will yet be traced to separate it from Brissopsis; if not, then Kleinia and Toxobrissus will both become synonymous with Brissopsis.

From 55 to 156 fathoms.

Agassizia excentrica A. Ag., nov. sp.

Syn. Agassizia porifera McCr., Pl. Foss. S. C., Pl. 1, fig. 5.

I am somewhat inclined to consider this species as the Agassizia porifera; but not having any original specimens for comparison, and the drawings of Ravenel and McCrady showing rather striking differences, I will not take their identity for granted, and compare it only with the West Coast representative, from which it can at once be recognized by the position of the apical system, which is much more eccentric posteriorly; on this account the disparity between the odd anterior pair of ambulacra and the posterior pair is greater than in that species. The interambulacral plastron is elliptical, and with this exception the arrangement and proportion of the tubercles is that of A. ovulum Lütk. The peripetalous fasciole does not pass below the ambitus, and the posterior fasciole makes a sharp angle under the anal opening.

I am unable to distinguish Agassizia scrobiculata, of which authentic specimens are in the Museum collection, from A. ovulum. I must say, however, that Valenciennes's drawings in the Venus are not very faithful, and, from an identification based upon his figures alone, specific differences would readily become apparent.

From 36 to 115 fathoms.

Echinocardium ovatum Gray, Cat. Brit. M.

Syn. Amphidetus ovatus Ag., Agass. Cat. Rais.
E. orthonotus McCr., P. Foss. S. C., Pl. 2, fig. 1.

An examination of young specimens of Echinocardium cordatum shows that the generic distinction which I attempted to make between Amphidetus and Echinocardium, based upon the isolation of the anal from the subanal fasciole, and thus separating the group with a deep anterior groove from these with a slight anterior groove is untenable. The presence of three species of Echinocardium on both sides of the Atlantic is certainly remarkable, but I am unable to distinguish the fragments of specimens unmistakably identical with a fine specimen of Echinocardium ovatum collected at Charleston, S. C., in the Museum collection, from European specimens of this species.

Off Charleston bar; Florida in 128 fathoms.

Echinocardium lævigaster A. Ag., nov. sp.

The existence of several species of Echinocardium having the outline of Echinocardium cordatum, but the slight odd ambulacral groove of Echinocardium ovatum, is an additional proof of the identity of Echinocardium and Amphidetus, as they had been limited in the Museum Bulletin, No. 2. The present species, of which but a single specimen was collected, is closely allied to the Mediterranean E. gibbosum. Not having sufficient material to make a thorough comparison, which may prove their identity, I give the points of difference observed in the specimens compared. The abactinal ridge between the posterior ambulacra is quite prominent, extending as a well-marked rostrum over the anal opening; this is pear-shaped. The arrangement of the anal plates is similar to that of E. ovatum; the apical portion of the odd ambulacrum is narrow, the fasciole being elongated, elliptical; the sides of the test slope up very gradually from the ambitus; the apex is anterior to the centre; the whole upper surface of the test is covered by minute tubercles, with the exception of a few large ones along the edge of the ambulacral groove. The bare spaces of the ambulacra on the lower surface are very broad, the subanal plastron projects beak-like from the posterior extremity, which is nearly vertically truncated, but the beak is not as prominent as in E. gibbosum, where it becomes a striking feature.

From 79 to 121 fathoms.

Echinocardium Kurtzii Gir., Proc. Bost. Soc., 1852.

Syn. Echinocardium ampliflorum McCr., P. Foss. S. C., Pl. 2, fig. 2.
" " gothicum McCr. " " " Pl. 2, fig. 3.
" ? " cordatum Gray, Cat. B. M.

Girard has described as Echinocardium Kurtzii a species from Charleston (it occurs also in N. C.) closely allied to the European E. cordatum. Fragments of it were collected by Mr. Pourtales, and it may be interesting to compare our American species, of which the Museum possesses excellent series, with E. cordatum, with which future investigations may yet prove it identical, as the differences are confined almost entirely to a portion of the test, subject to the greatest variation in Spatangoids. These consist in the greater prominence of the posterior abactinal interambulacral ridge; the anal opening is almost circular, and covered by a larger number of plates than in the European species, where they are larger and few in number. The extremity of the subanal plastron also projects beak-like, and is more prominent, though not as much as in E. lævigaster.

Littoral, to 85 fathoms.

Schizaster cubensis D'Orb., Agass. Cat. Rais.

Fragments of a true Schizaster, allied to S. gibberulus, were collected. These are referred with some doubt to the above species; especially if the determination of Dujardin is correct, who refers it to Periaster, and must have had access to the original specimen. The fragments have, however, the distinctive mark, given in the Catalogue Raisonné, of having the anterior ambulacrum much less sunken than in S. canaliferus, — a character which has nothing to do with Periaster.

Fragments from 80 fathoms.

Mœra atropos Mich., Rev. Mag. de Zool.

Syn. Schizaster atropos Ag., Agass. Cat. Rais.
Schizaster lachesis Gir., Proc. B. S., 1850.
Mœra lachesis Des., Synops.
Mœra atropos Lütk., Bidrag.

Fragments of this species were dredged from a depth of 80 fathoms. Girard has attempted to separate specimens from Texas, of slightly more elongated outline, as a distinct species. The color of M. atropos when alive is yellowish. The spines, where more thickly clustered, are brownish; they are short except where they cover the sunken ambulacra, which are entirely hidden by the spines meeting from both sides. On the lower surface, the interambulacral plastron is covered by long spines, which as they wear out at the extremity become spatula-shaped. On the side of the ambitus, and the upper lateral part of the posterior ambulacra, the spines attain a great length, especially towards the mouth, where they are most closely crowded together. Gray is particularly unfortunate in his subdivision of this genus; he has, like Michelin, divided Schizaster, but into three genera (following exactly the three types of the Cat. Rais.). "Nina" having for its type S. canaliferus, while S. gibberulus, which is most closely allied to it and cannot be separated generically, figures as Brisaster, and the most abnormal of the Schizasteridæ is retained as Schizaster. Michelin's subdivisions, made at the same time, have been adopted here.

The attempts made thus far to restore old generic names, in vogue before

Lamarck, and limit them to genera, as we understand them now, have been most confusing. Not that I would ignore writers who, like Breynius, Leske, Klein, Linck, were often far in advance of many modern publications, but when the so-called restoration amounts to sweeping out of existence genera which are well understood, and properly defined, and have been current in literature for more than half a century, and replacing them by generic names of doubtful limitation, I can consider such radical changes as anything but progress and justice. It seems to me that unless these changes are made with as much discretion and judgment as they have been made by Desor in his Synopsis, applying the old name to a subdivision, and retaining at the same time the current name for a portion of the genus thus subdivided, they are not calculated to advance our knowledge of Echinoderms. For instance, the attempt to substitute Echinanthus (which includes genera as widely different as Echinolampas, Conoclypus and Clypeaster) for Clypeaster, while D'Orbigny considered Echinolampas as identical with Echinanthus; the adoption of either view involves endless confusion, and Desor's solution is so natural that we must, as a general rule, take his definitions, in spite of the priority of this and many other restorations proposed by Gray, which are liable to similar objections.

Littoral, to 80 fathoms.

II. *On the Young Stages of Echini.*

From the large number of small-sized Echini collected by Mr. Pourtales it became necessary, in order to study them intelligently, to examine the young of as many species as possible, and obtain some criterion by which to determine this collection accurately. As the results to which this examination has led me form the basis of the preceding descriptions, it is not out of place to give the proofs, as far as they can be given by a short *résumé* and without figures, of the conclusions to which I have been led by the study of these young, leaving for a more elaborate paper a detailed description, as well as figures, of the changes here mentioned, which these young undergo. Some of the specimens collected by Mr. Pourtales are so small that they must have absorbed their Pluteus very recently before their capture. This collection, taken in connection with the Museum materials, gave the means of studying the changes due to growth of the following species: —

Cidaris annulata GRAY.

Dorocidaris abyssicola A. AG.

Diadema antillarum PHIL.
Garelia cincta A. AG.
Echinocidaris punctulata DESML.
" æquituberculata AG.
Echinometra VanBrunti A. AG.
Toxopneustes drobachiensis AG.
Echinus Flemingii BALL.
" melo LAM.
" gracilis A. AG.
Sphærechinus brevispinosus DES
Temnotrema sculptum A. AG.
Toreumatica concava GRAY.
Genocidaris maculata A. AG.
Trigonocidaris albida A. AG.
Lytechinus variegatus A. AG.
Tripneustes ventricosus AG.
Boletia granulata A. AG.
Echinocyamus angulosus LESKE.
Clypeaster rosaceus LAM.
Stolonoclypus prostratus A. AG.
Echinarachnius parma GRAY.
Encope emarginata AG.
Mellita testudinata KL.
" hexapora AG.
" longifissa MICH.
Fibularia volva AG.
Echinolampas caratomoides A. AG.
Echinocardium cordatum GRAY.
Brissopsis lyrifera AG.
Agassizia excentrica A. AG.

I doubt if without the aid of the information gained by the study of these young Echini a satisfactory report of this collection could have been made. The changes some species undergo are so great that nothing would have been more natural than to place the two extremes of the series not only in different species, but often in different genera, and even in different families. As a necessary consequence, the study of these young, showing what we may consider differences due only to growth, will lead to the elimination of numerous species and genera, and give us hereafter a much more accurate basis in our limitation of genera, species, and the higher subdivisions. But it would be out of place here to do more than hint at this reform, especially as I trust soon to publish, in our Illustrated Catalogue, a Revision of the Echini, which has been undertaken, with the collections in the Museum and of the Smithsonian as a basis. I shall always consider myself fortunate to have had the opportunity — thanks to the liberality of the Superintendent of the Coast Survey — of examining this collection, forming the most valuable addition to our knowledge of recent Echinoids since the collections of the same order made by Stimpson in the Pacific.

In Toxopneustes drobachiensis Ag. soon after resorption of the Pluteus the young Sea-urchin has few large tubercles with mamelon, limited to the ambitus (Podocidaris and Podophora-like). The next stage has two principal rows of large tubercles occupying the whole test (Cidaris-like, no miliaries), increasing in number as they grow older, the spines gradually passing from a condition similar to those of Rhabdocidaris, Cidaris, Echinocidaris, and finally to Toxopneustes-like spines, as fast as the primary tubercles are formed, retaining their embryonic features most strongly while the spines are directly connected to the test, as in Podocidaris. In the earlier stages the actinal opening is large (Echinocidaris-like), without indentations (Cidaris-like), occupying nearly the whole of the actinal surface. As the test increases this opening becomes proportionally smaller, and slight cuts are formed (Psammechinus-like). The anal system is at first closed by a single subanal plate, appearing before the formation of the genital and ocular plates; it remains for a considerable period more prominent than the other plates, which are added to cover the enlarged anal system. The symmetrical axis of the subanal plate does not hold a fixed relation to the madreporic body, being opposite different genital plates in various stages of growth. This corresponds to the oblique position of the subanal plate in Salenidæ, when we take as starting-point the madreporic body. The abactinal system subsequently passes through a stage reminding us of Echinocidaris and Trigonocidaris, only there are five instead of four anal plates. The poriferous zone is at first narrow, the pores arranged in vertical rows; subsequently they are slightly arched vertically; they next separate into horizontal arcs of a smaller number of pores, increasing rapidly in number with age, and in small specimens we can trace their mode of formation, as the arcs near the ambitus are similar to those of the adult, while those next the abactinal system are similar to the younger stages. The plates of the poriferous zone increase independently of the inter-ambulacral plates. The different stages of growth represent in the younger stages Cidaris, next Hemicidaris, then Pseudodiadema, Echinocidaris, Heliocidaris. The same general changes take place in Toxopneustes lividus, but the turban shape (Cidaris state) of the young test is more striking than in T. drobachiensis.

In Cidaris the difference between old and young stages is almost entirely limited to the proportionally larger size of the spines, and the more prominent serrations (recalling Salenocidaris). The abactinal system early assumes the character of the adult; in fact, with the exception of the smaller number of coronal plates, the above differences in the spines are the only important changes undergone in this genus. The same holds good for Diadema and Garelia, in both of which the spines are proportionally larger, and being so much less numerous gives to young Diadematidæ a peculiar facies (D. calamaria-like). We find also in young Diadema characters in the actinal membrane differing from the adult; the peculiar grouping, in five separate clusters, of the buccal ambulacral plates which appear first, is soon lost by the encroachment of the smaller interambulacral plates, and in older specimens the plates become deeply imbedded in the buccal membrane. The pores at first are placed in a vertical row in very young specimens; they then become arranged in arcs of three or four pairs; with increasing age the median rows of interambulacral tubercles assume the arrangement found in the adult. Owing to the rapid growth of the spines in the young, the extremity, and frequently the greater part of the spine almost to the base, is hollow; but as the young increase in age they become more solid at the base, and further up in proportion to their age.* Garelia is a good genus, as has been acknowledged by

* The genus Echinodiadema of Verrill is founded upon structural peculiarities of young Diadema mexicanum. Complete series of the young Diadema antillarum, from one tenth of an inch in diameter upwards, show that: the slight cuts, the shape of the abactinal system, the presence of small scales covering the anal system (few in number in very small specimens), the trigeminate arrangement of the pores, the hollowness (generally upper extremity only) of the spines, due to the mode of growth and subsequent solidification from the base upwards in Diadematidæ, the arrangement of the tubercles, the peculiar grouping of the plates of the buccal membrane, — features upon which the genus has been characterized, — are found in young Diadematidæ. I have carefully examined the type of Mr. Verrill's species, as well as young of Diadema mexicanum,

Bölsche, in letters subsequently to the "Nachtrag" to his Diadematidæ, in Wiegman's Archiv. The spines are solid, already longitudinally striated in the youngest specimens examined, differing totally in their structure from those of Echinothrix or Diadema. This shows plainly that in these embryonic Echini (Cidaridæ, Diadematidæ) the structure of the spines forms a good basis for the discrimination of groups notwithstanding their apparent great changes of form. These do not extend to the nature of the ornamentation, which remains very constant, and will prove of great value in fossil Echini.

Nowhere among the young regular Echini have I found such great changes in the shape and proportions of the test and spines as in Echinometra. We frequently find specimens of the same size, where in one case the outline is almost circular, the test flattened, covered with long slender spines, while in the other the test is lobed, swollen, high, surmounted by numerous short stout spines. These and all intermediate stages, complicated by the greater or smaller number of primary tubercles, the arrangement of the arcs of the poriferous zone undergoing changes exactly similar to those described in Toxopneustes, are found retained in specimens of very different size. This has given rise in a great measure to the confused synonymy attached to our most common species, and renders their identification, if based upon meagre material, almost hopeless.

In young Echinocidaridæ we have already in the youngest stages four anal plates. The abactinal system of very young specimens is remarkably prominent, occupying more than one half the abactinal part of the test. The whole test is deeply pitted (Trigonocidaris-like); the rudimentary tubercles, covering the greater part of the abactinal part of the test, are connected by ridges, which are gradually resorbed and reduced to the granulation found upon the coronal plates of the genus. The primary tubercles are at first limited to the ambitus, surmounted by short stout spines (Podophora-like), gradually becoming more slender and proportionally longer with increasing age (the opposite of what takes place in Toxopneustes, Cidaris, and most young Echini). The rudimentary spines are not seated upon tubercles; they are club-shaped (identical

of D. antillarum, and additional specimens of the so-called Echinodiadema coronatum, which has convinced me that Verrill's species is only a young Diadema mexicanum, the structural differences noticed being found in all young Diadematidæ I have had occasion to examine (D. antillarum, D. paucispinum, and D. mexicanum).

in structure to those of Podocidaris). The poriferous zone has in the earliest stages the structure found in the adult, only it does not widen at the actinostome. The ratio of the actinostome to test does not vary greatly in different stages of youth; the edge of the actinal system forming the groove of the gills is turned back but slightly in young, the lips taking the place of cuts becoming more prominent (Boletia-like) with increasing age. The separation of Echinocidaris and Arbacia to represent the groups with bare or crowded interambulacra is not natural, depending upon the greater or less resorption of the rudimentary tubercles formed in the earlier stages. It is very common to find young of Echinocidaris punctulata which would pass for young of Arbacia, and young Arbacia æquituberculata which would pass for young Echinocidaris. Owing to the independent growth of the plates of the poriferous zone, we have either three or four pairs of pores for each ambulacral plate; the same is the case with other Oligoporidæ, as limited by Desor, showing that the division he has made, convenient though it is as a key for the easier grouping of genera, is yet not strictly reliable, the mode of growth of many Polyporidæ showing in their young stages that they have but a small number of pores (Tripneustes, Mespilia) for each ambulacral plate which places them among the Oligoporidæ; but, owing to the independent growth of the plates of the poriferous zone in older stages, they seem to belong to the Polyporidæ.

In Echinus, Sphærechinus, Lytechinus, we find in the younger stages the same unbroken vertical arrangement of the pores, taking next a vertically arched form, still connected, and then assuming the arrangement of the adult. In these genera the anal system is at first covered by one plate, and undergoes changes similar to those of Toxopneustes, by the addition of four smaller plates, and so on, the original subanal plate retaining long a greater prominence. The miliaries are formed in these genera as well as Toxopneustes by radiating ridges arising from the base of the primary tubercles, forming a sort of star, then they swell at the distal extremity, forming a set of club-shaped spokes round the main tubercle; these are little by little separated from it, and become independent elliptical tubercles at first, and then miliaries or secondary tubercles. The ten large buccal plates of the actinal membrane are the first to appear. Small plates (in genera in which they are found in the adult) are next formed between them and the teeth (Echinus-like), while afterwards they cover the whole membrane, as in Lytechinus, Psammechinus, Trigonocidaris, appearing between the ten plates and the test. This mode of growth is totally unlike the growth of the buccal plates of the Cidaridæ, where these plates perform the part of ambulacral and interambulacral plates, and appear near the test at first, forming in full-grown specimens rows made up of more than two plates, as in the Palæchinidæ, suggesting that the test of Palæchinidæ must have been made up of plates homologous to the buccal plates of Cidaris. The test of course would then have been capable of considerable compression and change of outline, as is the case in Astropyga and Asterosoma. This similarity is very striking in young Cidaridæ, where the number of coronal plates is small, and the young Sea-urchin seems to consist almost entirely of an abactinal and an actinal system, separated by a narrow band of coronal plates. Let this narrow band of coronal plates disappear entirely, and the buccal plates take a correspondingly great development, and we have a Palæchinus made up of small ambulacral and interambulacral plates consisting of several rows, and continuous from the teeth to the abactinal system, similar to that discovered by Meek and Worthen, the whole test surmounted by short spines, articulating upon a more or less distinct mamelon. The structural features of the buccal membrane of Cidaridæ entitle them to a higher rank than that of a family, in the suborder of Echinoids, intermediate between the Palæchinidæ and Echinidæ proper.

In the Temnopleuridæ (Toreumatica) the subanal plate remains very prominent in adult specimens; the anal system in the young is covered by one large elliptical plate; as the anal system enlarges, numerous minute plates surround the larger plate, which always retains its peculiar ornamentation, and is readily distinguished from the other by its size and shape. In Temnotrema, on the contrary, the anal system undergoes changes identical with those of Toxopneustes, Echinus, and the like. In Toreumatica, the pits at the angles of the plates appear at first like rectangular openings, which, as the specimens grow older, become little by little connected by grooves, growing deeper and more prominent with advancing age. The same is the case in Temnotrema; the pits, however, are never so marked in the adult, becoming simply comma-shaped. The miliaries in both these genera are formed as in other genera by ridges appearing at first connected with the base of the primary tubercles. In Trigonocidaris the young differ from the old in having larger pits, less numerous and lower ridges, and but few secondary tubercles, the principal rows of ambulacral and interambulacral tubercles being very prominent. The buccal membrane and abactinal system present no striking differences, the anal plates being only four in number in all the specimens collected. In Genocidaris, of which an extensive series was collected, we find in the smallest specimens a few large spines, resembling the spines of young Dorocidaris abyssicola, equalling in length the diameter of the test. As the specimens increase, the spines lose their spindle-shaped form and their serrate edge; they become more pointed and elongate, diminishing rapidly in proportion to the size of the test, and soon take the proportions they have in the adult. The actinal opening is very large at first, the test in young specimens being a narrow ring when seen from the actinal side. The primary tubercles are few in number, with remarkably prominent ridges radiating from them, leaving deep pits between the ridges. With increasing size these ridges become miliaries and secondary tubercles, the pits, however, remaining round the boss of the primary tubercles in both the areas; so that the test passes through stages in which it resembles at first young Psammechinus, then a Psammechinus with deep grooves radiating from the tubercles, and finally with deep pits round their base. The subanal plate retains always its preponderance, and the embryonic character of the anal system (retained in the generic name) is a marked feature of this interesting Sea-urchin. The actinal opening rapidly becomes smaller, and resembles that of Psammechinus. In fact, Genocidaris might be called a Psammechinus among Temnopleuridæ, while Toreumatica is the Lytechinus of the family.

The changes taking place in the arrangement of the pores in Tripneustes and Boletia are similar to those observed in Echinus; at first a simple vertical row, then arcs laterally curved, then three pairs of pores for each ambulacral plate, in oblique open curves, and finally almost horizontal curves, the pores appearing to be placed in independent vertical rows. Hipponöe of Gray cannot be retained, the name being preoccupied by Audouin, and as Hipponöe and Tripneustes are identical, the name Tripneustes can be retained to include the species of both these genera.

Among the Clypeastroids we find in the young during their growth great changes of form and structure taking place. In young Echinarachnius the outline is elliptical, the test is arched, high, the anus is placed in a slight depression of the test, and, seen in profile, we are reminded of the general aspect of Pygorhynchus. There are but two principal rows of large tubercles in each area, extending from apex to mouth, so that, seen from above, the young Echinarachnius has much the facies of an Echinometra. The mouth is large, pentagonal, its radius being half the radius of the test. The ambulacral rosette is reduced to two pairs of pores, — simple perforations of the test, one in each poriferous zone for each ambulacrum. This extraordinary shape and structure the young do not retain long; they soon become pyriform; the blunt extremity being the posterior, the test becomes greatly flattened and the anus approaches the edge. The rosette is now composed of three and two pairs of simple pores in each poriferous zone for each ambulacrum; the anterior ambulacrum having only two pairs in each zone. The tubercles are proportionally smaller, though there are still but two rows in each area, but further apart. In the next stage we find the rudimentary rosette composed of four and five pairs of pores close together and two or three distant pairs of pores, in the following ambulacral plates, one pair in each plate, which in subsequent stages increase in number and extend almost to the edge of the test. The test has become quite flattened, the lower side is concave, undulating, the ambulacral zones are now much narrower than the interambulacral ones. Each plate still has only one tubercle; the lines of separation between the two zones run straight from the edge of the test to the apex. It is only in somewhat older stages, when the rosette loses its radiating outline, and assumes a slightly petaloid shape, that we find the angle formed at the base of the petal in the ambulacral zone, from which point the ambulacral plates widen rapidly; each plate now carries from two to six smaller tubercles. The outline is quite pentagonal, the lower surface concave, but little undulating, the anus placed near the edge, and covered, as in all preceding stages, by one plate; the anal system in older specimens has five plates, the plate first formed remaining somewhat the largest. As the young Echinarachnius increases in size its outline becomes more circular, and in specimens measuring one fifth of an inch in diameter has the general appearance of the adult. The furrows joining the ambulacral pores appear soon after the first traces of a true rosette are seen; they become deeper and the pores separate in proportion with the petaloid structure of the abactinal part of the ambulacrum. The tubercles are proportionally much smaller and more numerous, and soon after the ambulacra have a well-developed rosette, bear nearly the ratio to the plates which they have in the adult.

Young specimens of Mellita hexapora, measuring $\frac{3}{32}$ of an inch in diameter, are almost circular, with a thickened raised edge, as in Laganum, and as yet have no lunules. The rosette is simply a series of radiating pores, three and two in each poriferous zone, for each ambulacrum, extending but a short distance from the apex. The ambulacral and interambulacral plates are of the same size, hexagonal, forming twenty equal zones, carrying but a single large tubercle in the centre of each plate; seen from below the surface is deeply concave, the mouth much larger in proportion to the test than in adult specimens, and we see forming from this side the posterior interambulacral lunule as a deep pit, at one extremity of which is placed the anus near the mouth, about one third the distance from the edge of the test. We find also rudimentary phyllodes made up of a few of the small pores, which eventually extend in the ambulacral furrows to the edge of the test, but are now restricted to a small number clustered round the mouth. The outline in a subsequent stage becomes slightly pentagonal, the plates elongate; the lunule pierces through to the abactinal side; the rosette is also radiating, made up of five to six pairs of pores for each poriferous zone. The ambulacral area is now slightly narrower than the interambulacral zones. When the posterior lunule has become a small round opening, encroaching upon the plates of the posterior interambulacral area, extending as a lobe beyond the outline of the test, the rosette is slightly petaloid. There are from two to five tubercles on each plate; they are quite elongate, having lost their hexagonal outline; the lower surface is flat, and on the lower side the ambulacra have broadened very rapidly, the interambulacra forming narrow bands carrying larger tubercles between the ambulacral zones. The edge of the test is still quite thickened, and it is only when the young Mellita has attained somewhat less than half an inch in diameter that the ambulacral lunules appear as pits, seen at first from the lower side only, and gradually forcing their way through the test. The posterior interambulacral lunule increases rapidly in size; the test and the groove in which the anus is placed become somewhat separated from it, being simply a depression in the continuation of the lunule. After the appearance of the lunules as slight pits, which develop unequally, not appearing simultaneously, the changes are limited to the increase in size of the lunules and of the poriferous ambulacral zone on the lower side; the outline and general facies, with the exception of the larger size of the tubercles, being that of the adult.

The general character of the changes undergone by Echinarachnius and Mellita hexapora, as far as they relate to the transformations of the ambulacral rosette, the growth of the tubercles, the changes in the proportions of the relative breadth of the ambulacral and interambulacral zones, are identical in Mellita testudinata and Encope emarginata. What is remarkable in Mellita testudinata is that the mode of formation of the ambulacral lunules is not identical with that of M. hexapora. The interambulacral lunule alone is developed from a depression formed on the lower surface pushing its way through the test, while the ambulacral lunules are the result of the closing in of notches appearing on the edge of the test, which remain open until the Mellita has attained a considerable size, — three quarters of an inch and sometimes more; long after the arrangement of the plates, the shape of the rosette, the size of the tubercles, and the extent of the poriferous zone on the lower surface have the character of the adult. In fact, the mode of development of Encope and of Mellita testudinata (also M. longifissa) are far more closely allied than that of the two species of Mellita of the types of hexapora and testudinata.

In Encope emarginata we have, as in Mellita, an early stage in which no posterior interambulacral lunule exists. The outline of these young Encopidæ is not Laganum-like, as in Mellita, but is elliptical, as in very young Echinarachnius; the ambulacral zones extending uniformly from edge to apex, are narrower than the interambulacral. The plates of both areas carry one to two large tubercles and a couple of very small ones. The ambulacral pores extend from the apex to the mouth. One pair of pores, not connected by grooves, is situated in the suture of each ambulacral plate. The outline seen from above is deeply scalloped — in fact, it is a Moulinsia, — and the figure given by Agassiz in the Monographie des Scutelles is only a young Encope emarginata. The posterior interambulacral lunule commences as a pit from the lower side, and by the time the young Encope has attained a diameter of three quarters of an inch, the lunule is seen from above, also as a small elliptical opening. The edge of the test is deeply scalloped, especially at the median ambulacral sutures, where notches soon appear, and the young Encope gradually takes a deeply lobed outline. These cuts may or may not close, and thus we have the basis of the great number of species established upon the depth of lobes, the presence or absence of certain lunules, which are nothing but features of the young either retained in the adult or greatly exaggerated. The ambulacral rosette is formed as in Mellita and Echinarachnius by the independent growth of the upper part of the ambulacral area, which in Clypeastroids grows more rapidly than the rest of the test, from the moment the pores are joined by grooves, the plates crowding upon one another, and pushing them or part of them towards the edge of the test. In the Scutellæ the pairs of pores of the rosette are placed in the sutures of the ambulacral plates, while in the Clypeastroids, besides the pair of pores in the sutures an additional pair pierces the middle of each ambulacral plate.

The development of Stolonoclypus prostratus and flat Clypeastroids of the type of Clyp. placunarius is most instructive, tending to show that in connection with the development of the Scutellidæ above described, we must probably introduce a complete reform among the genera recognized as Lenita, Scutellina, Runa, Echinocyamus, and other minute Echinoids, which may eventually prove to be nothing but the young of other Clypeastroids, as Mellita, Scutella, Laganum, Stolonoclypus, Clypeaster, Encope, and the like; but want of sufficient material prevents me from entering into this comparison more in detail. Though we know now, from what has been said above, that the Scutellidæ pass through phases which cannot be distinguished from Moulinsia, Fibularia, Runa, Scutellina, and the Clypeastroids proper pass, as I shall show below, through a stage of growth identical with Echinocyamus. For similar reasons I am inclined to consider Fibularia as the early stage of some Clypeastroid. The absence of partitions in some species, I think, can easily be accounted for, as they are developed only later. We have a species of Fibularia from the Sandwich Islands, in which there are no partitions when very small, while in the adult these partitions are most rudimentary. Greater material than I possess is necessary to elucidate the affinity of the genus, which certainly has all the features of immature Clypeastroids.

Among the Echini, collected in great numbers by Mr. Pourtales, was a small species showing, on careful examination, the facies of Echinocyamus, and which, after a minute comparison with Echinocyamus pusillus, I could only distinguish from it, by its more circular outline, larger tubercles, less crowded and thinner interior partitions; observing, however, in the horizontal sutures of the ambulacral plates, rows of minute pores, extending from the imperfect rosette to the mouth, I at once saw that it must be a young Clypeaster, and on comparing them with young Stolonoclypus prostratus, measuring half an inch in length, recognized a similar arrangement in the ambulacral zone, below the rosette. It was now plain that our Florida Echinocyamus was only a young Stolonoclypus prostratus, which in the earlier stages is identical in every structural feature with Echinocyamus; for European specimens of Echinocyamus show the presence of similar horizontal rows of pores, as in our young Stolonoclypus from Florida. I am well aware that no Clypeaster has been found in European seas, yet we have evidently such an incomplete knowledge of the marine Fauna, existing at great depths, to judge from the collections made by Mr. Pourtales, that negative evidence can no longer be admitted in opposition to such positive proof as we find in Florida. The larvæ referred by Müller to Echinocyamus were not raised by artificial fecundation; they do not resemble Spatangoid or Clypeastroid larvæ, but seem closely allied to true Echinidæ larvæ. Can they not be larvæ of Cidaris hystrix and of Cidaris papillata — which would account for the presence of such forms in the North Sea and Mediterranean — rather than be referred to Echinocyamus? Very small specimens varied in the number of the tubercles on each plate, the number of pores of the imperfect rosette, the changes being similar in kind to those observed in the Scutellidæ. From the Echinocyamus stage they become more pentagonal; the concavity of the lower side increases, the partitions increase by the addition of needle-shaped processes, and they soon attain the shape and structure given by Lütken in his figures of young Stolonoclypus prostratus. The tubercles increase more rapidly near the edge of the test, and a remarkable feature of these stages is the presence of minute glassy tubercles similar to those of Echinoneus, developing side by side with young tubercles, the function of which is as obscure as it is in Echinoneus, and which are not found in older specimens.

The development of Echinolampas has thrown unexpected light upon the affinities of the toothless Galerites and of the Cassidulidæ. It shows conclusively that Echinoneus is only a permanent embryonic stage of Echinolampas, thus becoming allied to the Cassidulidæ, and that it has nothing in common with the Galerites as I would limit them, confining them entirely to the group provided with teeth. This reduces the type to a most natural division, and from what we now know of the simple nature of the ambulacra of all Echini in their early stages, I would not give to this feature the significance which it has received, but would be inclined to unite the toothed Galerites with Echinidæ proper in the same suborder, as a prophetic family, approaching the Clypeastroids by the separation of the anus from the apical system, and retaining the teeth and general symmetrical structure of the regular Echini. Though I am aware that the great development of Galerites in former geological periods, and the relation of the anus and test, may, on further acquaintance with living representatives, entitle them to rank as a suborder intermediate between the Echini proper and Clypeastroids. Young Echinolampadæ, measuring a trifle over one eighth of an inch, are elliptical, resembling Echinoneus, with a large transverse elliptical mouth, the anus placed in the truncated posterior extremity above the ambitus. The outline in profile is almost globular, each plate of the narrow ambulacral zone carries a single principal tubercle, surrounded by a circle of miliaries. The pores are arranged in a vertical row of a single line of pores, three or four for each plate, extending from mouth to apex. The interambulacral plates are elongated horizontally, and carry from one to three principal tubercles, with numerous small miliaries arranged in circles round the primaries, or irregularly scattered. In specimens twice the size of the above, the test is less elliptical, more flattened, and the first trace of a rudimentary rosette appears as a short row of double pores extending from the apex, consisting of from eight to nine pairs, only in one of the poriferous zones of each of the pairs of ambulacra — in the anterior zone of the posterior pair and the posterior zone of the anterior pair of ambulacra — the odd ambulacrum remains simple. In specimens measuring above half an inch this rudimentary one-sided rosette has increased in length, and traces of the second row of double pores are seen in the simple zones near the apex. In specimens measuring an inch these rows have grown to be half as long as the arc of the rosette first formed; the same structure has also extended to the abactinal part of the odd ambulacrum. The elliptical outline is entirely lost in these specimens, the shape having gradually become more circular, pentagonal, and ovoid. At the same time the miliary tubercles increase rapidly in number, forming clusters of small tubercles, embossing the plates of both areas. The anal system is covered by three large triangular plates, the anus opening near the edge of the system, in a narrow slit covered by very minute plates. The mouth, as the young increase in size, becomes more and more sunken. The buccal membrane is covered with minute plates, the mouth opening in the centre. There are as yet no signs of phyllodes or of bourrelets, which appear only later, the bourrelets being at first accumulations of small tubercles between the phyllodes. When measuring about half an inch in length, the young Echinolampas resembles Caratomus to such an extent that this stage was considered for a time a living representative of Caratomus. The larger series collected by Mr. Pourtales, in his second expedition, showed conclusively the relationship to Echinolampas, and proves the correctness of the step taken by Desor in removing Caratomus and allied genera from the Galeritidæ, and placing them among the Cassidulidæ, on account of the semipetaloid nature of the apical portion of the ambulacra. Pedicellariæ with a short stem are irregularly scattered over the test; the spines resemble those of Clypeastroids, being short, slender, straight, the secondary spines silk-like. The tentacles, as far as could be ascertained from alcoholic specimens, are provided with a powerful sucking disk, as long as they retain the aspect of Caratomus.

Among Spatangoids proper, the examination of young specimens shows that they undergo great changes in outline during their growth, that the posterior part of the test is especially subject to variation, that the position of the anus is exceedingly variable in one and the same species, that the mouth is not labiate in the young as in the adult, that the peripetalous fascioles and lateral fascioles do not change in their limits, but that the subanal and anal fascioles are liable to great modifications during their growth, and cannot be used as distinguishing features of generic value, while the permanence of the peripetalous and lateral fascioles is of great systematic value. The ambulacral petaloids also are greatly modified with age, generally becoming confluent, while in the young they are remarkably distinct and the pores not conjugated. The semitæ are not covered by regular pedicellariæ, as is universally stated to be the case. We find on the fascioles minute tubercles carrying embryonic spines. Troschel was the first to call attention to this, and Müller has subsequently, in his Embryology of the Echinoderms, given accurate figures of the spines of the fascioles of S. canaliferus, in his sixth Memoir, Plate VII. figs. 7 – 9. Yet these observations, dating back to 1852, seem to have escaped the attention of recent writers, who persist in stating that the fascioles carry true pedicellariæ. These are found irregularly scattered over the test, generally more abundantly round the mouth. From the examination of the pedicellariæ made in some of the genera of this collection (Podocidaris), there can now be no doubt that pedicellariæ are nothing but modified spines; the existence of pedicellariæ surmounting a tubercle and moved by the same mechanism as spines, as well as the mode of formation of the pedicellariæ, as observed in Asteracanthion and Spatangoids, by Müller and myself, proves conclusively that they are only more sensitive spines, performing the functions of scavengers or of providers, according to their position.

The Cassiduloid-shaped mouth of young Spatangoids, as well as the existence of several Spatangoids, both fossil and recent, in which the mouth has a similar structure, is as convincing a proof as necessary of the correctness of uniting Cassiduloids and Spatangoids in the same suborder, though the name given by Albin Gras, of "Irregular," is hardly what could be desired.

Young Brissopsis lyrifera, less than a quarter of an inch in length, are cylindrical, the mouth having a flat, crescent-shaped edge, the test truncated vertically at the posterior edge, surrounded by a prominent elliptical sub-anal fasciole; the peripetalous fasciole is elliptical, undulating; the anus is placed near the posterior extremity of the fasciole. The odd ambulacrum carries four or five large tentacles with lobed disk; the pores of the odd ambulacrum are single, not in pairs; the other ambulacra are short, straight, well defined, consisting of three and four pairs of pores not yet conjugated. In older specimens the posterior edge of the mouth becomes labiate, the anus approaches the subanal fasciole, which sends out a rudimentary anal branch, eventually uniting with the peripetalous fasciole, the outline of which becomes more pentagonal, undulating, and elongated with the increasing size of the petaloid ambulacra. The posterior edge becomes more bevelled with age, the subanal plastron more prominent, the lateral pairs of ambulacra gradually tend to unite, passing from a strictly Brissopsis outline to one considered hitherto characteristic of Toxobrissus. The spines in all young Spatangoids are strikingly larger in proportion to their size than in the adult.

In Echinocardium cordatum the changes of the mouth, of the outlines of the internal ambulacral fasciole, and the gradual confluence of the lateral ambulacra are similar to those of Brissopsis; the posterior extremity undergoes the greatest change in outline; the subanal plastron is very prominent; in fact, the outline of young E. cordatum recalls E. gibbosum. The subanal fasciole and anal branch are at first united, but as the specimens increase in size, the anal branch separates from it. The odd ambulacral pores are at first two single rows of pores, which by closer crowding eventually alternate, but are not arranged in pairs.

The young Agassizia, a quarter of an inch in length, is a flat elliptical Spatangoid resembling Gualteria. The peripetalous and lateral fascioles have the same general limits as in the adult, but the arrangement of the pores in all the ambulacra is identical; there is but a single pore for each ambulacral plate, as it exists in the anterior pair and odd ambulacra of the adult; the ambulacral grooves are not yet formed, the anterior groove alone being slightly indicated; the mouth is not labiate.

The great number of Spatangoïd genera established upon differences in the subanal fasciole, the existence or absence of the anal branch, the depth of the ambulacral grooves, the confluence or distinctness of the lateral ambulacra, all based upon characters subject to great variation during growth, show the necessity of a careful revision of the whole group of Spatangoids with the data here furnished; and such closely allied genera as Maretia, Spatangus, Hemipatagus, and Macropneustes; Eupatagus, Plagionotus, and Metalia; Meoma and Linthia; Agassizia, Prenaster, and Periaster; Gualteria and Brissopsis; Tripylus, Desoria, Abatus, and many others, must be re-examined and critically revised before we can attempt an arrangement of Spatangoids into natural families.

The subordinal divisions usually adopted since their introduction by Albin Gras do not seem satisfactory, if tested by our present information. In the first place, the whole classification is based upon the separation of the anus from the abactinal system. From what the Embryology of Echini has taught us, the position of the anus has not the physiological importance attributed to it by authors who have so generally received this classification. The unstable position it occupies in the same animal at different stages of growth — at one stage opening next to the mouth, then on the margin, and finally opening in the central part of the apical system in the adult — should make us hesitate to adopt a single anatomical feature as our sole guide. In the first place the order of Perischœchinidæ, a most natural one, is founded upon characters derived from the structure of the interambulacral and ambulacral systems. The other two suborders, regular and irregular, usually recognized, can scarcely be called natural. The suborder of regular Echini is more satisfactory than the other, though, from what I have said of the Galerites with teeth, I should be inclined to add them to the suborder as one of its three subdivisions, which, as here limited, are the Cidaridæ, the Echinidæ proper, and the Galerites. The suborder of "irregular" Echini, after the withdrawal of the Galerites, still contains the Clypeastroids. From the structure of the ambulacral system, they have some affinity with the Spatangoids; yet the presence of partitions and teeth, combined with petaloid ambulacra, seem to constitute good subordinal characters for the Clypeastroids as contrasted with the Spatangoids proper, which include all edentate forms, taking in also the edentate genera formerly placed among Galerites as well as the Cassidulidæ, sometimes regarded as independent suborders.

III. *Bathymetrical and Geographical Distribution.*

The accompanying table (pp. 298 and 299) shows at a glance the principal features of distribution of the different zones of depth. We can distinguish a strictly littoral fauna, extending from tide-mark to generally less than 10 fathoms, though a few of the species characteristic of this zone extend to a depth of 34 and 40 fathoms. This fauna consists of

Diadema antillarum.
Echinometra Michelini.
" viridis.
Lytechinus variegatus.
Tripneustes ventricosus.
Clypeaster rosaceus.
Stolonoclypus Ravenellii.
Mellita testudinata.
Encope Michelini.
" emarginata.
Echinoneus semilunaris.
Brissus columbaris.

A second set of species, less numerous, extends from the shore to a much greater depth, — from 80 to about 120 fathoms. They are

Cidaris annulata.
Echinocidaris punctulata.
Meoma ventricosa.
Plagionotus pectoralis.
Mœra atropos.

At a depth of 30 to 40 fathoms commences a third set of species, the majority ranging to about 160 fathoms, though two species range to 270 fathoms, marked *, and a few species commence at a greater depth, 80 to 90 fathoms. These species are

* Dorocidaris abyssicola.
Echinus gracilis.
Genocidaris maculata.
* Trigonocidaris albida.
Rhyncholampas caribbæarum.
Echinolampas caratomoides.
Neolampas rostellatus.
Brissopsis lyrifera.
Agassizia excentrica.
Echinocardium ovatum.
" lævigaster.
" Kurtzii.
Schizaster cubensis.

At a depth of about 140 fathoms, extending to over 310 fathoms, are found most interesting species:

Cænopedina cubensis.
Podocidaris sculpta.
Echinus Flemingii.

While near the lowest depth reached by the above species we strike upon a peculiar fauna recalling types of the cretaceous period, extending from 315 fathoms to the greatest depth attained in the straits between Florida and Cuba. These are

Salenocidaris varispina.
Pourtalesia miranda.
Lissonotus fragilis.

Two species — Stolonoclypus prostratus and Mellita hexapora — have the greatest bathymetrical range, extending from the shore, the one to 270 fathoms and the other to 325 fathoms. I would state, however, that it is only the young which have this great range; the adult specimens are limited to a quite shallow zone, — about 40 fathoms. In the young of our common northern Cuvieria the reverse takes place, the young being quite common at low-water-mark, while young Echinarachnius and T. drobachiensis are found at a much greater depth than the adult. I

NOTE. — Figures denote depth in fathoms; range of a species is indicated by the horizontal lines; thus, 138——270 in Cænopedina shows its range from 138 to 270 fathoms. Figures at head of column to be taken, where no others are given.

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Cidaris annulata GRAY	—	—	—	—	—	—	—	116													
Dorocidaris abyssicola A. AG.					—	—	—	—	—	—	—	—	—	—	—	270					
Salenocidaris varispina A. AG.																		315			
Diadema antillarum PHIL.	—	—	17																		
Cænopedina cubensis A. AG.									138	—	—	—	—	—	—	270					
Echinocidaris punctulata DESML.	—	—	—	—	—	—	—	—	125												
Podocidaris sculpta A. AG.									138	—	—	—	—	—	—	—	—	315			
Echinometra Michelini DES.	—7																				
" viridis A. AG.	—7																				
Echinus gracilis A. AG.							93	—	—	—	—	—									
" Flemingii BALL												195									
Genocidaris maculata A. AG.			30	—	—	—	—	—	—	—											
Trigonocidaris albida A. AG.					—	—	—	—	—	—	—	—	—	—	—	270					
Lytechinus variegatus A. AG.	—	—	—	34																	
Tripneustes ventricosus AG.	—																				
Clypeaster rosaceus LAM.	—5																				
Stolonoclypus prostratus AG.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	325		
" Ravenellii A. AG.	—	—	—	34																	

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380
Mellita testudinata KL.	—7																				
" hexapora AG.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	270					
Encope Michelini AG.		11																			
" emarginata AG.	—7																				
Echinoneus semilunaris LAM.	—																				
Echinolampas caratomoides A. AG.				35	—	—	—	—	—	160											
Rhyncholamaps caribbæarum A. A.						106															
Neolampas rostellatus A. AG.							—	—	125												
Pourtalesia miranda A. AG.																				349	
Lissonotus fragilis A. AG.																		—	—	—	368
Brissus columbaris AG.	—																				
Meoma ventricosa LÜTK.	—	—	—	—	—	—	85	115													
Plagionotus pectoralis AG.	—	—	—	—	—	—	—	—	—	156											
Brissopsis lyrifera AG.				55	—	—	—	115													
Agassizia excentrica A. AG.			36	—	—	—	—	—	128												
Echinocardium ovatum GRAY.						79	—	—	121												
" lævigaster A. AG.						79	—														
" Kurtzii GIR.	—	—	—	—	—	—	85														
Schizaster cubensis D'ORB.							—														
Mœra atropos MICH.	—	—	—	—	—																

have given the greatest depth of living young, as the dead tests may have been dropped by fishes or carried by currents. The character of the Echinian fauna, on the three belts developed by the soundings of Mr. Pourtales, are tolerably well defined; the first zone being littoral, and extending to 90 fathoms, is characterized by species, the majority of which do not range beyond 40 fathoms, with a few species ranging somewhat beyond, to about 120 fathoms.

The second zone (from 90 to 250 fathoms) is characterized by species extending into the first somewhat and attaining a range of about 270 fathoms, with an admixture of a few species extending from 140 to 310 fathoms.

The third zone contains the typical deep-sea species of Florida, extending from 315 to 500 fathoms.

Although we have not a sufficient number of soundings to establish homogeneous zones of geographical and bathymetrical range, an analysis of the above grouping of species shows us something analogous to the distribution of animal and vegetable life in latitude and height; the oceanic distribution being of course an identity for northern latitudes and southern depth, or a representation by species closely allied.

For instance, we find littoral, as far north as North Carolina, Mœra atropos, Echinocardium Kurtzii, and as far as the southern part of Cape Cod Echinocidaris punctulata, species which in Florida have a range in depth to 125 fathoms. Of their range further north we know nothing.

The following North-European species — Cidaris papillata, Schizaster fragilis, Echinus Flemingii, Echinocardium ovatum, E. cordatum, Echinocyamus? pusillus, Brissopsis lyrifera — are represented by their allies or by the identical species: viz. Dorocidaris abyssicola, Schizaster cubensis, Echinus gracilis, E. Flemingii, Echinocardium ovatum, E. Kurtzii, Stolonoclypus prostratus, Brissopsis lyrifera, which have a range somewhat more extensive than the previous species. These same species, with the addition of Brissus columbaris, Echinocardium lævigaster, Diadema antillarum, and Echinocidaris punctulata, are again the representatives of a Mediterranean fauna strikingly similar, consisting of Cidaris hystrix, Schizaster canaliferus, Echinus melo, Echinocardium cordatum, Echinocyamus? pusillus, Brissopsis pulvinata, Brissus Scillæ, Echinocardium gibbosum, Diadema europæum, Echinocidaris æquituberculata. The specific representation on both sides of the Isthmus of Panama is becoming every day, as far as Echinoderms are concerned, more strikingly identical. Since the list given by Mr. Verrill, several species have come to light, and the following comparative list of species on both sides of the Isthmus, extending from Peru to the Gulf of California on the Pacific, and including on the Eastern side the Gulf of Mexico, Florida, the northern coast of South America, the West Indies and Bahamas, may not be out of place. (I have examined all the species here named.) This list would undoubtedly be greatly increased by additional dredging.

Eastern Fauna. (*Caribbean.*)	Western Fauna. (*Panamic.*)
Cidaris annulata Gray	Cidaris Thouarsii Val.
Dorocidaris abyssicola A. Ag.	
Salenocidaris varispina A. Ag.	
Diadema antillarum Phil.	Diadema mexicanum A. Ag.
	Astropyga venusta Ver.
Cænopedina cubensis A. Ag.	
Echinocidaris punctulata Desml.	Echinocidaris stellata Ag.
Podocidaris sculpta A. Ag.	
Echinometra Michelini Des.	Echinometra Van Brunti A. Ag.
" viridis A. Ag.	" rupicola A. Ag.
Echinus gracilis A. Ag.	
" Flemingii Ball.	
Genocidaris maculata A. Ag.	
Trigonocidaris albida A. Ag.	
	Toxocidaris mexicana A. Ag.
Lytechinus variegatus A. Ag.	Lytechinus semituberculatus A. Ag.
	Psammechinus pictus Ver. is the young.
	Boletia rosea A. Ag.
Tripneustes ventricosus Ag.	Tripneustes depressus A. Ag.
Clypeaster rosaceus Lam.	
Stolonoclypus prostratus Ag.	
" Ravenellii A. Ag.	Stolonoclypus rotundus A. Ag.
Mellita testudinata Kl.	Mellita longifissa Mich.
" hexapora Ag.	" pacifica Ver.
Encope Michelini Ag.	Encope grandis Ag.
" emarginata Ag.	" micropora Ag.
	Echinoglycus Stokesi Gray.
Echinoneus semilunaris Lam.	
Echinolampas caratomoides A. Ag.	

Eastern Fauna.	Western Fauna.
Rhyncholampas caribbæarum A. Ag.	Rhyncholampas pacificus A. Ag.
Neolampas rostellatus A. Ag.	
Pourtalesia miranda A. Ag.	
Lissonotus fragilis A. Ag.	
	Lovenia sp.
Brissus columbaris Ag.	Brissus obesus Ver.
Meoma ventricosa Lütk.	Meoma grandis Gray.
Plagionotus pectoralis Ag.	Plagionotus nobilis A. Ag.
Agassizia excentrica A. Ag.	Agassizia scrobiculata Val.
Brissopsis lyrifera Ag.	
Echinocardium ovatum Gray.	
" lævigaster A. Ag.	
" Kurtzii Gir.	
Schizaster cubensis D'Orb.	
Mœra atropos Mich.	Mœra clotho Mich.*

With the exception of three Panama species, all the West Coast species have representatives on the Eastern Coast. The Eastern species which have not as yet been found represented on the West Coast are the deep-water species of Mr. Pourtales's collection, and, what is very peculiar, a few species, like Clypeaster rosaceus, Echinoneus semilunaris, Echinocardium Kurtzii, and Echinolampas, belonging to genera which have a most extensive range,—in fact, an almost cosmopolitan one,—are found everywhere in the great Indo-Pacific belt, and its continuation on the West Coast of Africa, extending also to the temperate zones, on both sides of this equatorial belt.

The relation of the Caribbean Fauna with the existing geographical distribution of Echini is shown by the accompanying faunal table (p. 303), including only strictly representative species.

We have in Genocidaris maculata and Trigonocidaris albida representatives of the Temnopleuridæ, thus far limited almost entirely to the Indian and China seas. The littoral species having the most limited bathymetrical range are those which have the widest geographical distribution. They are Tripneustes ventricosus, Diadema antillarum, Cidaris annulata, Echinometra Michelini, Lytechinus variegatus, Mellita testudinata, Encope emarginata. Some of these species extend from the southern part of Brazil to the Bermudas. They all belong to

* Astriclypeus Manni Verrill is found in Japan. Mr. Verrill did not know the exact origin of his specimen.

Caribbean.	Panamic.	Europ. Boreal.	Mediterranean.	Senegal.	Indo-Pacific.	Chinese.	Japanese.	Patagonian.
Cidaris annulata GRAY	*			*i.*	*			
Dorocidaris abyssicola A. AG.		*	*		*			*
Salenocidaris varispina A. AG.								
Diadema antillarum PHIL.	*		*	*	*	*	*	
Cænopedina cubensis A. AG.								
Echinocidaris punctulata DESML	*		*	*				
Podocidaris sculpta A. AG.								
Echinometra Michelini DES.	*			*	*		*	
" viridis A. AG.	*				*			
Echinus gracilis A. AG.		*	*					
" Flemingii BALL		*i.*	*i.*					
Genocidaris maculata A. AG.							*	
Trigonocidaris albida A. AG.						*		
Lytechinus variegatus A. AG.	*				*			
Tripneustes ventricosus AG.	*				*		*	
Clypeaster rosaceus LAM.				*				
Stolonoclypus prostratus AG.		*	*		*		*	
" Ravenellii A. AG.	*							
Mellita testudinata KL.	*							
" hexapora AG.	*							
Encope Michelini AG.	*							
" emarginata AG.	*							
Echinoneus semilunaris LAM.					*		*	
Echinolampas caratomoides A. AG.				*	*			
Rhyncholampas caribbæarum A. AG.	*							
Neolampas rostellatus A. AG.								
Pourtalesia miranda A. AG.								
Lissonotus fragilis A. AG.								
Brissus columbaris AG.	*		*		*			
Meoma ventricosa LÜTK	*							
Plagionotus pectoralis AG.	*							
Brissopsis lyrifera AG.		*i.*	*		*			*
Agassizia excentrica A. AG.	*							
Echinocardium ovatum GRAY		*i.*	*i.*					
" lævigaster A. AG.			*					
" Kurtzii GIR.		*	*				*	
Schizaster cubensis D'ORB.		*	*		*			
Mœra atropos MICH.	*							

NOTE. — *i* denotes identity of species; * denotes representative species.

genera having representatives in the great tropical belt surrounding the globe, formed by the Indo-Pacific, Mediterranean, Senegalian, West Indian, Panamic, and Polynesian faunæ, — such as Cidaris, Diadema, Echinometra, Tripneustes, Clypeaster, Stolonoclypus, Echinolampas, Echinoneus, Brissus, the species of which have a great geographical range, and are represented by the following species: —

Cidaris metularia, Tripneustes sardicus, Echinometra lucunter, Diadema Savignyi, Clypeaster Rangianus, Stolonoclypus placunarius, Echinolampas oviformis, Echinoneus cyclostomus, Brissus carinatus, all of which have an immense geographical distribution.

The effect which currents play in shaping the geographical distribution of marine animals is very great; we have an example in the Gulf Stream and the northern branch of the Amazonian current flowing into the Gulf of Mexico, which account fully for the great range of the more common littoral species. The Japanese current makes itself felt as far as San Diego, two species of Echini extending in the Northern Pacific from the northern part of Japan along Kamtchatka, the Aleutian Islands, Sitka, Vancouver's Island, the one as far as Cape Mendocino (T. drobachiensis), the other (Dendraster excentricus) to San Diego. The Indo-Pacific equatorial current has undoubtedly been the main agent of the extensive geographical range of such species as Cidaris metularia, Echinoneus cyclostomus, Heterocentrotus mammillatus, Diadema Savignyi, Tripneustes sardicus, Echinolampas oviformis, Brissus carinatus, Stolonoclypus placunarius.

The effect of currents in thus extending the distribution of marine animals would act very differently upon the several classes of the animal kingdom, and its efficiency depends to a great extent upon the nature of their earlier stages, and upon their habits during that period. The time during which the Pluteus of Echini remains helpless at the mercy of the currents is considerable: from early spring till late in the summer is the usual time required for the full growth of the Pluteus in many species of Sea-urchins, and the distance which the young could thus be transported, even by a sluggish current, during a single season, must be considerable, even under the most unfavorable circumstances.

Various writers have attempted to retrace, in former geological periods, the probable course of the currents and their effect upon the geographical distribution of marine animals; they all agree in representing up to the cretaceous period an unbroken equatorial current, passing through Central Asia, Arabia, the northern part of Africa, and connecting with the Pacific by a narrow strait through the Isthmus of Panama. The existence of this connection in the cretaceous period is placed beyond doubt by the presence of an Ananchytes, which I am unable to distinguish from Ananchytes radiata, collected on the Isthmus of Panama, and now in the Museum of Yale College, kindly loaned me for examination by Professor Verrill. From the small number of identical species, either of Mollusca, Crustacea, or Fishes, recorded on both sides of the Isthmus, this connection must have been very imperfect at a comparatively recent geological period, — since the existence of the present Faunæ.

The question naturally arises, Have we not in the different Faunæ of both sides of the Isthmus a standard by which to measure the changes which these species have undergone since the raising of the Isthmus of Panama and the isolation of the two Faunæ? If the upheaval of the isthmus has been gradual, it must, of course, have cut off the deep-water species on both sides of the isthmus, and gradually have isolated the more shallow, till the littoral species also became separated. As a natural consequence, the deeper we go, the farther back in time we must expect to find the representation, — a result which is strikingly confirmed by the nature of the deep-water Fauna of the West Indies. Unfortunately we have not, as in the case of the littoral Faunæ, a standard of comparison. At the same time, with the gradual closing of the Isthmus of Panama, the greater part of Central Asia, of the Arabian Peninsula, and of Northern Africa was emerging from the sea, reducing the range of the equatorial current, and thus confining the course of the currents much as they are at the present time. This would thus cause a limitation in the range of the species formerly having the greatest distribution, and extend that of those which were more local.

If migration on land when continents were joined together, and subsequent variations after their isolation through submergence, has been the main agent in the distribution of the existing terrestrial Faunæ, we must acknowledge a similar agency to currents in the distribution of marine Faunæ; and by the submergence or rise of various portions of the continents, we shall be able, if we can trace these changes, to reconstruct within certain limits the altered courses of the main oceanic currents, and get some idea of the probable geographical distribution at different geological epochs. The greater the bathymetrical range of littoral species, the longer will such species remain unaffected, while deep-sea species may early become isolated and remain as outliers as it were, — mementos of a former condition of currents, or even of a previous geological period. The careful analysis of the Fauna of a given point, its comparison with other Faunæ, and accurate bathymetrical data, would go far towards reconstructing the Natural History of the sea in former ages, and showing its relation to the present and past times.

The representative species of Echini, Echinocardium, Psammechinus, Schizaster, in the Arctic and Antarctic boreal zones would be considered as the living representatives of a cosmopolitan Fauna existing at the time when the great equatorial current flowed unbroken round the globe, sending branches north and south along Eastern North and South America, along Eastern Japan and Australia, and the eastern coast of Africa; while the tropical species of the genera Diadema, Clypeaster, Echinoneus, Echinolampas, &c., existing at that time, had a more limited equatorial geographical distribution. The subsequent period of isolation of Atlantic and Pacific currents is shown by the existence of truly Atlantic and Pacific species; while as we go down in depth we go back also in time, and find at first representatives of the genera found in our Tertiaries, while at greater depth the species are representatives of genera found in the Cretaceous. A more detailed comparison than can be given here of the Caribbean Fauna, with the fossils of the tertiary and cretaceous deposits of our coasts, would be most interesting; but unfortunately the materials thus far collected are too fragmentary, and we must await a careful geological survey, accompanied by deep dredgings of a considerable extent of coast, before we shall have the data needed to follow up the important results to be gained in this way for palæontology and geography, of which our present incomplete materials give us such an interesting glimpse.

IV. *List of the Star-fishes.*

Asterina minuta Gray, Synopsis; Ann. Mag. Vol. VI, 1841

Syn. Asteriscus brasiliensis Lütk., Vidensk. Medd. 1859.
" stellifer Möb., Neue Seesterne.
Littoral, to 7 fathoms.

Pteraster militaris M. T., Syst. d. Asteriden.

From 120 to 125 fathoms.

Pentaceros gigas Ag.

Syn. Pentaceros grandis, reticulatus, gibbus Gray, Synops.
Oreaster reticulatus, O. aculeatus, M. T., Syst.
Oreaster gigas Lütk.
Littoral, to 128 fathoms.

Astropecten antillensis Lütk.

Littoral, to 147 fathoms.

Astropecten articulatus Lütk., Vidensk Med. 1864.

Syn. Asterias articulata Say., Journ. Acad. Nat. Sciences, Phila. 1825.
Littoral, to 5 to 6 fathoms.

Astropecten variabilis Lütk.

Littoral, to 7 fathoms.

I have thus far only met with three species of Astropecten from Florida and the West Indies, though as many as six or seven nominal species are known. The names of Lütken are given for want of authentic specimens of the others.

Luidia clathrata Lütk.

Littoral, to 101 fathoms.

Luidia alternata Lütk.

40 fathoms.

Ophidiaster (Linckia Lütk.) **ornithopus** Val.

Syn. O. ornithopus M. T., Syst. d. Ast.
" " Lütk.
Littoral, to 26 fathoms.

Ophidiaster flaccidus Lütk.

Littoral, to 123 fathoms.

Othilia spinosa Gray, Synops.

Syn. Echinaster spinosus M. T., Syst.
Littoral, to 6 fathoms.

Othilia braziliensis Ag.

Syn. Echinaster braziliensis M. T., Syst.
Littoral, to 5 or 6 fathoms.

Asteracanthion mexicanum Lütk.

From 80 to 120 fathoms.

Asteracanthion tenuispinum Lütk.

Syn. Asterias tenuispina Lam.
Asterias atlantica Ver., Trans. Con. Ac.
From 120 to 174 fathoms.

With the exception of the Pteraster and Asteracanthion tenuispinum, the bathymetrical and geographical distribution of the Star-fishes does not show any striking features. The presence of a northern and of a Mediterranean species in Florida is fully in accordance with the results derived from other classes; as with Echini and Ophiurans, we find the young in much deeper water than the adults. This is particularly well shown in a series of Pentaceros gigas; the smallest specimens (Pteraster-like in shape) are from 128 fathoms, more advanced stages (Goniodiscus-like) are from 68 fathoms, a still more advanced stage from 42 fathoms. The same is the case with Luidia clathrata and Astropecten antillensis.

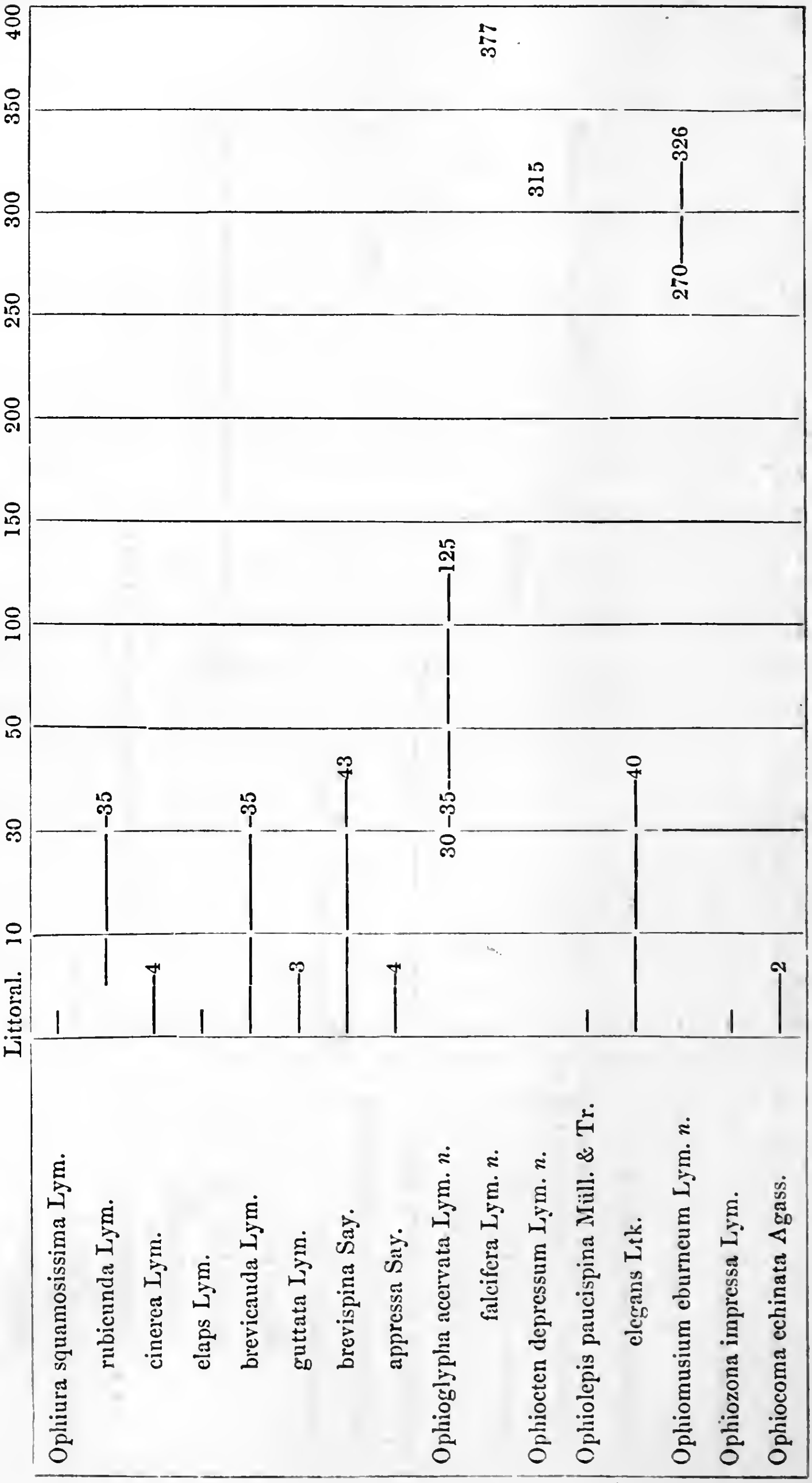
Cambridge, October, 1869.

No. 10. — *Preliminary Report on the Ophiuridæ and Astrophytidæ dredged in deep water between Cuba and the Florida Reef, by* L. F. DE POURTALES, Assist. U. S. Coast Survey. Prepared by THEODORE LYMAN.

(COMMUNICATED BY PROFESSOR B. PEIRCE, SUP'T U. S. COAST SURVEY.)

I. *General Remarks.*

FROM the small circle of the Caribbean waters there are now known sixty-three species of Ophiurans and Astrophytons, nearly all of which are critically determined. The standard work of Müller and Troschel, published in 1842, did not contain a greater number of well-defined species from the whole world! Considering their number and their bathymetric range (which goes nearly to 400 fathoms) we are justified in looking upon their faunal data as of real importance. First, then, considered within their own peculiar sea dominion, to what depths do these species descend, and to what shallows do they rise? A glance at the following table will reply. Those species with which naturalists have been most familiar as "West Indian" are pretty much *littoral.* The abundant forms of *Ophiocoma echinata*, *Ophiura cinerea*, *Ophiactis Mülleri*, &c., swarm among the sponges and madrepores of the warm shallows. A few descend to 35 or 40 fathoms, as if to reach a hand to their deep-sea relations; such are *Ophiura brevispina* and *Ophiolepis elegans;* there are even two, *Ophiostigma isacanthum* and *Amphiura tenera*, that have been found respectively at 75 and 128 fathoms. But these are exceptions, for if the dredge sometimes brings up a littoral brittle-star, it is a straggler and not an inhabitant. Between 15 and 75 fathoms there is a mixed region where dwell the more venturesome of the littoral species and certain new-comers, that either recall the European fauna (*Ophioglypha acervata*) or seem a continuation of the littoral types (*Ophiactis plana*, *Ophiocnida olivacea*). It is below 100 and even 200 fathoms that the really *new* types are found. The seven new genera herein described have all a maximum depth of more than 100 fathoms, and only one, *Ophiothamnus*, runs into less than 75 fathoms. All the species below 250 fathoms are either of new genera, or are singular forms of old genera (*Ophioglypha falcifera*, The *horizontal* lines show the range of the species in depth.



	Littoral.	10	30	50	100	150	200	250	300	350	400
Ophiocoma Riisei Ltk.	–										
pumila Ltk.	–										
Ophioblenna antillensis Ltk.	–										
Ophiacantha { meridionalis Lym. *n.* = (O. pentacrinus Ltk. ?) }							237—	———	——327		
Ophiomitra valida Lym. *n.*					120–130						
sertata Lym. *n.*									315		
Ophiostigma isacanthum Lym.	———	———	—36—	——75							
Ophiochondrus convolutus Lym. *n.*								270			
Ophiactis Krebsii Ltk.	———	-12——	—35								
Mülleri Ltk.	–										
humilis Lym. *n.*					125—	———	———	———	——324		
loricata Lym. *n.*					110						
plana Lym. *n.*		-13–17—	———	———	-117–140						
Amphiura Riisei Ltk.	——4										
gracillima Ltk.	–										
Stimpsonii Ltk.	———	-13									

	Littoral.	10	30	50	100	150	200	250	300	350	400
Amphiura tenera Ltk.	-4——	——	——	——	-117-128						
grandisquama Lym. *n.*						174					
semiermis Lym. *n.*										377	
pulchella Lym. *n.*			39								
Ophiophragmus septus Lym.	-										
Wurdemani Lym.	-										
Ophiocnida scabriuscula Lym.	-										
olivacea Lym. *n.*			40——	——79——	-117						
Ophionephthys limicola Ltk.	-2										
Ophionema intricata Ltk.	-2										
Ophiothamnus vicarius Lym. *n.*		15——	——	——	-117-135						
Ophionereis reticulata* Ltk.	-3——	——	—35								
Ophiopsila Riisei Ltk.	——	—15									
Ophiomyces mirabilis Lym. *n.*							237—	——	—320		
frutectosus Lym. *n.*				77——	——	—160					
Ophiothrix violacea Müll. & Tr.	——	——	——45								

* Prof. Verrill has shown (Proceed. Boston Soc. Nat. Hist. XII, 381, 1869) that *O. porrecta* is from the Pacific islands. I am therefore inclined to think that this species, with *O. crassispina* Ljn. and *O. squamata* Ljn., may all be synonymes of *O. dubia* Lym. (Savigni, Descr. de l'Egypte, 1809, Pl. I, Figs. 3^1 to 3^{10}).

	Littoral.	10	30	50	100	150	200	250	300	350	400
Ophiothrix Örstedii Ltk.	–										
Suensonii Ltk.	———	–12									
lineata Lym.	–										
Ophiomyxa flaccida Ltk.	———	———	––36								
Ophiocreas lumbricus Lym. *n.*					125—130						
Astrophyton costosum Seba.	———	–12									
arborescens Müll. & Tr.*	(Range ?)										
cœcilia Ltk.	–										
Krebsii Ltk.				50							
mucronatum Lym. *n.*					120–125						
Astrogomphus vallatus Lym. *n.*				94–	––119						
Astroporpa annulata Örst. & Ltk. †				50							
affinis Ltk.	–										
Astroschema oligactes Ltk.		20									
Hemieuryale pustulata Martens.	[Locality ?]										

* At the Jardin des Plantes are two Astrophytons, brought the one from the Antilles by Maugé, 1799; the other from Guadaloupe, by Beaupertuis, 1837. They are of the same species; and I could detect no difference between them and a specimen of *A. arborescens* from the Mediterranean.

† Dujardin and Hupé (Hist. Nat. des Zoophytes, 1862) speak of *Astroporpa dasycladia*, in the Jardin des Plantes, as a new species. I saw these specimens in 1861, and they are nothing but *A. annulata*; also their *Astroschema affinis* is too dubious to be admitted.

Ophiactis humilis, &c.). If, therefore, these zones of sea bottom were to-morrow turned to stone, we should find a certain separation of species, but there would be *overlapping* species that would connect the fossils, as of one formation. Such are the *vertical* relations. The horizontal relations can only partially be known, except in the direction of the European coast, because there have been no considerable dredgings on the American side, either to the north or the south, and comparisons must be made only with the littoral forms. It is well known that a few of the Florida Ophiurans (*Ophiactis Krebsii*, *Ophiolepis elegans*, &c.) have been found as far as Charleston, S. C., while in the direction of Brazil many species are found (*Ophiomyxa flaccida*, *Ophiactis Krebsii*, *Ophionereis reticulata*, *Ophiothrix violacea*, *Ophiolepis paucispina*, *Ophiura cinerea*, *O. appressa*, *Amphiura Riisei*, *Ophiopsila Riisei*). One species, *Hemipholis cordifera*, has been collected in Charleston and in Rio, but not yet between those points.

Naturalists seem to overlook the fact, that, although the edges of the Caribbean fauna spread thus wide, they encounter two other faunæ, north and south. At Charleston, *Ophiothrix angulata* and *Amphiura atra* are forms not seen on the Florida coast, while at Rio the *Ophiura Januarii*, *Ophioceramis Januarii*, and several species of *Amphiura* attest a region of new marine life. It is already well known that the littoral Ophiuran faunæ of North and Middle Europe and the Gulf of Mexico are not comparable with each other, even the genera being often different. How is it with the deep-sea forms? One species is *identical*,—*Ophiomyces frutectosus*,—and this, strangely enough, was never seen by human eye until within a few months. Two other species *may* be identical, — *Astrophyton arborescens* and *Amphiura tenera* (= *elegans?*). One species is, in the true sense, *representative*, — *Ophioglypha acervata* (comp. *O. albida*). The remaining fifty-nine species are, so far as we now know, Caribbean. As to the Panama fauna, the similarity between the opposite sides of the Isthmus has already been shown by Lütken, Verrill, and myself. The correspondence of the twelve twin species shown in the following table is something more than casual: —

Caribbean Fauna.	Panama Fauna.
Ophiura cinerea Lym.	Ophiura teres Lym.
Ophiolepis elegans Ltk.	Ophiolepis variegata Ltk.

Caribbean Fauna.	Panama Fauna.
Ophiozona impressa Lym.	Ophiozona pacifica Lym.
Ophiocoma pumila Ltk.	Ophiocoma Alexandri Lym.
Ophiactis Krebsii Ltk.	Ophiactis virescens Örst. and Ltk.
Amphiura tenera Ltk.	Amphiura violacea Ltk. " puntarenæ Ltk. " microdiscus Ltk.
Amphiura Riisei Ltk.	Amphiura grisea Ljn.
Ophiophragmus septus Lym.	Ophiophragmus marginatus Lym.
Ophiocnida scabriuscula Lym.	Ophiocnida hispida Lym.
Hemipholis cordifera Lym.	Hemipholis affinis Ljn.
Ophionereis reticulata Ltk.	Ophionereis annulata Lym.
Ophiothrix violacea M. and T.	Ophiothrix spiculata LeC.

How is it that the vast Pacific fauna, common to the waters between Zanzibar and the Sandwich Islands and between Loo Choo and the Kingsmill group, changes its character near Panama, and takes on a *partial* Caribbean form? We might think that the mingling of the two oceans, before the upheaval of the isthmus, was the origin, and that the differences between these species was the measure of their variation since the cretaceous period. But then the Caribbean forms appear on the Pacific side, while the Pacific forms seem not to come over; and no matter whether there is or is not a difference of level between the oceans, it would scarcely have availed to prevent a mixture in *both* directions by storms, or by currents. It is also perfectly credible that water-birds should mix the faunæ across an isthmus which has a minimum width of twenty-eight miles, just as they convey fish eggs to distant and isolated ponds. But again there is the same objection as before. I must therefore content myself with saying that of these twelve pairs of species there are several that would probably be considered only as *varieties*, if they lived in the same waters. Speculation is, after all, of small value, because the facts are insufficient, and because there is a prospect of getting many more facts. For example, all the diligent dredging on the European coasts had failed to show a species of brittle-star identical with the Caribbean; but, almost at the same time, two expeditions bring up, from a depth of only 75 fathoms, a species new to science and common to the two sides of the warm Atlantic. Such is the value of negative evidence!

II. *Descriptions of New Genera and Species, with Critical Remarks.*

Here follow descriptions of seven new genera and twenty-one new species. There were, besides, two specimens of *Ophiothrix*, brought up from 110 and 206 fathoms. The one had the disk completely hidden by little thorny stumps, showing only the points of the radial shields; the arm-spines were long, slim, and very jagged; the other specimen had a small, compact disk, with naked radial shields spotted with green, and green cross lines on the arms; in the centre of the disk, spines; arm-spines short and very jagged. Both were young, and I did not choose to add to the present complication of this difficult genus by describing them. The *Ophiothrix violacea* displays certain variations at a depth that are not seen in shallows, but I believe the species is the same. There also were two species of *Amphiura*, probably new, but too imperfect to describe; and one soft-bodied little thing that may be the young of *Ophïomitra*, or may be new.

OPHIURIDÆ.

Ophioglypha acervata Lyman, sp. nov.

Special Marks. — Three arm-spines of unequal lengths; the middle one commonly shortest; towards the tip of the arm the spines are longer as compared with the side arm-plates. Under arm-plates with a peak or point without. Those papillæ of the "arm-comb," which are beneath the disk, are flat and square, so as to form an even close-set row.

Description of a Specimen. — Diameter of disk 9 mm. Length of arm (broken) about 40 mm.* Mouth papillæ seven to each angle, of which the innermost is central, lying just below the teeth, and of similar form, so that it might as properly be considered a true tooth; the mouth-papilla on each side is of the same shape, but the two outer ones are flattened, angular, much wider than long, with a cutting edge re-enteringly curved, or notched. Teeth three, four, or even five, shaped like a blunt spear-head, swelling in the middle, and rounded. Mouth-shields as long as broad; broader without than within; outer side cleanly curved, inner side making an angle; length to breadth 1.8 : 1.8. Side mouth-shields narrow, and of equal width, meeting within, and thence running along the inner angle of the mouth-shield to the head of the genital slit. First under arm-plate as

* The arm is doubtless much longer than this, usually. In some smaller specimens it ran out in a thread-like way, something after the manner of *O. robusta*.

large as any; broader than long; of a rounded diamond-shape, with a distinct, rounded peak without; length to breadth .6 : .9. Second plate touching the first; third plate barely separated from the second by the juncture of the under arm-plates; fourth plate well separated from its successor, as are all those beyond. Fifth plate bounded within by two re-entering curves, which come to a point on the median line; without, it has a little peak in the centre which gives it a faintly *tri-lobed* appearance; the laterals are short and straight; length to breadth .5 : .8. The plates beyond this one have a similar form, but continually grow smaller by the increased encroachment of the side arm-plates. Side arm-plates meet below at the third under arm-plate; and, above, at the ninth upper arm-plate: their upper edges are re-enteringly curved, which gives a peculiar shape to the upper arm-plates. These last are, near the disk, broader without than within, with a strongly curved and thickened outer side; and their laterals are curved by reason of the peculiar form of the side-plates; further out, where they do not touch each other, they come to a point, within; length to breadth (sixth plate) .8 : .7. Disk, above, covered with crowded, irregular, flattened scales, none of which are much swelled, so that the surface is nearly smooth. The primary plates are not conspicuous either by size or thickness, except the central one, which is very distinct, nearly round, and .6 mm. in diameter. Radial shields large, thick, and conspicuous; irregular pear-seed shape, and strongly diverging; length to breadth 2 : 1.4; they are entirely separated by a very irregular wedge of scales, which sometimes consists of a double row; sometimes of a mixture of a single and double row, respectively of larger and smaller scales. The large, thick radial-scales carry all the papillæ of the arm-comb, which are about twenty in number on each side and of two sorts; those seen from above are sharp and diverge from each other; those seen from below are flat and square, so as to form an even, close-set row; there are about ten of each kind, and those at the ends of the row differ most. The arm-comb is continued, along the edge of the genital slit, by a row of about seventeen very fine papillæ. On the upper arm-plates within the notch is a row of fine papillæ corresponding to those of the arm-comb. The scales of the interbrachial spaces below are thin and crowded. Arm-spines cylindrical, blunt, scarcely tapering; lengths to that of the under arm-plate (eighth joint) .4, .2, .3 : .5. Further out on the arm they are proportionately much longer, and towards the last third of the length the lowest spine is nearly or quite as long as the side arm-plate; there, also, they are more slender, and taper to a fine point. Twelve tentacle scales on the first pore, seven being on the side next the interbrachial space; six scales on the second pore; five on the third; four on the fourth; three on the fifth; two on the sixth; and one scale on the joints beyond that.

Color, in alcohol, light gray.

Variations. — A specimen with a disk of 6 mm. had the arm-spines nearly equal (the lowest rather shortest), and three fourths as long as the side arm-plate. In general the middle spine is shortest, but in a considerable series examined numerous variations were to be seen; rarely, the spines on some part of the arm were equal; yet, even then, they would be of unequal lengths on other parts. A specimen with a disk of 3 mm., had the under arm-plates comparatively smaller, but still exhibiting in one way or another the characteristic peak or lobe on the outer side; the fourth plate was broad, regular, heart-shape, but with a little point within where the outer sides of the side arm-plates joined on the median line; the tenth plate was similar, but the outer side being wavy gave greater distinctness to the little lobe; on the upper surface of the disk, a greater proportionate space was occupied by the primary plates, though none of them touched each other; the radial shields were quite separated by two large rounded plates; the notch of the disk only included a part of one upper arm-plate, and the side arm-plates met above, at the third joint from the disk. In a very young specimen, having a disk only 1 mm. in diameter, nearly all the surface of the upper disk was covered by six large, round primary plates, one in the centre and one opposite each arm; immediately round the centre plate were five small ones, situated opposite the interbrachial spaces; over each arm were two very small radial shields like scales, and, in the interbrachial space, on the edge of the disk, a large plate; finally, there was one more small plate in each interbrachial space, making a total of thirty-one pieces. The notch of the disc was scarcely indicated, and there was no arm-comb. Below, the interbrachial spaces were almost filled by the mouth-shields. The side arm-plates bore three short spines about one third the length of the joint resembling those of *O. albida*, and met both above and below, on all the joints; although the upper and lower arm-plates were well defined and had nearly their true shapes.

This species, brought up in numbers from 30 to 125 fathoms, is of high interest; first, because it seems not to live in company of any species of the same genus; and secondly, because it much resembles *Ophioglypha albida*, so widely distributed in the North European seas and in the Mediterranean. It is, however, distinguished by the different form of the arm-spines, arm-comb, and under arm-plates. *Ophioglypha Grubei* has very similar under arm-plates (if Heller's drawing is accurate),* but differs in the arm-spines and in the curious swelling of the upper arm-plates. Mr. Ljungman kindly examined the specimens and decided that they did not agree with any of the numerous varieties of *O. albida*, with which he is familiar. He also

* Sitzungsb. der Kais. Akad. der Wissens. XLVI, p. 415, pl. II, figs. 13–16.

stated that *O. Grubei* was only a variety. I examined specimens of *O. albida* dredged by the "Josephine" at the Azores, and they were as different from *O. acervata* as those of Scandinavia.

Several localities, in from 30 to 125 fathoms.

Ophioglypha falcifera Lyman, sp. nov.

Special Marks. — Three arm-spines, the middle one is a strong hook, turned upwards. Arm-comb single, running along the genital plate and along the outer edge of radial shield, above the arm.

Description of Specimen. — Disk 4.5 mm. Arm 10 mm. Width of arm, 1 mm. Mouth-papillæ very short and broad and so closely soldered as to appear like a plain line; usually, however, there may be distinguished four on each side, of which the two outer are longest; besides these, there is a central, inner one, not soldered with the rest, having a blunt diamond shape, somewhat like the teeth, under which it lies.

Mouth-shields rounded heart-shape, with a wide curve without, and a decided obtuse angle within; length to breadth 1.1 : .8. Side mouth-shields rather narrow, meeting within, and extending outwards to the lateral corner of the mouth-shield. Under arm-plates, near base of arm, as long as, or longer than, broad; much wider without than within; bounded without by a curve, within by a small angle whose sides are re-entering curves, and on the sides by re-entering curves; a little further out the curves of the inner angle and of the side of the plate are blended in one, and the plate then resembles a broad wedge with curved outlines. This wedge widens and shortens as it is found further out on the arm, so that, near the end, it consists of a very obtuse angle without, and of a wavy border within, having a little central peak; length to breadth (4th joint) .4 : .4. Side arm-plates meeting everywhere below, and also above, beyond the first joint from the disk. Their line of juncture at the fourth joint is equal to half the length of the under arm-plate; the total length of the joint being .6 mm. This proportion rapidly increases, and, near end of arm, this line is double or treble the length of the under arm-plate. Upper arm-plates fan-shape, bounded without by a curve and within by two re-entering curves, which meet on the median line; length to breadth .4 : .5. Disk covered above by numerous rounded scales in concentric rows, each row standing higher than that outside; the central primary plate is highest of all, and has a diameter of .8 mm. Among these are a few smaller, irregular scales. There are three of these concentric circles, whereof the outermost includes the radial shields, which are of a rude pear-seed form, touching near their outer third, so that they diverge widely within, and less widely without, forming a notch in the disk which includes part of an upper arm-plate; length to breadth .8 : .8. They are separated within by part of a large scale, which has a rude diamond form. Below, the disk is covered by half a dozen plates, in each interbrachial space, arranged in two concentric rows; besides which a wide genital plate runs along the slit, bearing on its edge a row of short, stout, rounded papillæ, which run from the second under arm-plate upwards along the outer edge of the radial shield to a point about opposite the lateral corner of the upper arm-plate. Arm-spines three, very short and small; lengths to that of under arm-plate (3d joint) .2, .2, .2 : .4. At, and beyond the first joint outside the disk, the middle spine takes on the form of a broad, strong hook, having two curved teeth on the upper edge. At the tip of the arm there are but two spines, of which the upper is the hook. Tentacle scales of the mouth-tentacles six; three on each side of a very narrow incision, which is squeezed between the side mouth-shield (which bears three of the scales) on one side, and the large first under arm-plate and the outermost mouth-papilla on the other side. Second pore with six scales, arranged round a narrow oval; third pore, two scales, side by side; and those beyond, only one scale, which, at some distance out on the arm, is very minute and difficult to be seen.

Color, in alcohol, white.

Variations. — Another smaller specimen had the disk 3 mm. and the arm 9 mm. The mouth-shields were proportionately longer than in the first mentioned, — a variation common to the whole genus.

Two specimens, in 377 fathoms, south of Rebecca Channel.

The plates on the disk indicate that these specimens, although by no means fully grown, are yet large enough to show the adult characters. Thus *O. Sarsii*, with a disk of 4.5 mm. (see Lütken Addit. ad Hist. Oph. Pt. I, Pl. I, fig. 3), is more *young*, in this respect, than *O. falcifera*, and yet has taken on all the parts needed for ready recognition of the species. We may look for an adult of this curious species about the size of *O. Sarsii*, or rather smaller, and having a large number of small plates on the disk. The stout, double-toothed hook, as a middle arm-spine, is only an embryonic organ carried forward. In the very tip of the arm of *O. acervata* I have found, on the last fourteen joints, only two spines; and of these the upper one was flattened, and bore on its *upper* edge (just as in *O. falcifera*) about nine microscopic, hooked teeth. It may be that the fully grown *O. falcifera* has the middle hook, at the base of the arm, so overgrown as to form a stumpy spine.

Ophiocten depressum Lyman, sp. nov. *

Special marks. — Disk very thin and flat, with a sharp edge. The granules of the disk are numerous, but irregularly scattered; none on the

* This species departs a good deal from the typical *Ophiocten*. The disk granulation is not continuous, but scattered; there are no combs of spines on the outer edges of the

interbrachial species, below. A row of papillæ along the outer end of the radial shield and the edge of the disk. Two arm-spines.

Description of a Specimen. — Diameter of disk 8 mm. Length of arm (broken) about 50 mm. Mouth-papillæ seventeen to twenty-one to each angle: of these, usually three are rounded, tapering, spear-head shape, and point to the centre of the mouth, being placed at the apex of the angle; the remainder are much smaller, and are flat and squarish; they form a connected row, the two outermost usually borne on the edge of the side mouth-shield, the remainder on the mouth-frames. Teeth, four; flat, delicate, long, and tapering to a point. Mouth-shields broad, rounded heart-shape, with a little peak within. Side mouth-shields long and narrow; they begin at the junction of the first under arm-plate with the side arm-plate of the second joint, and run thence across the end of the genital slit, meeting nearly, or quite, at the inner point of the mouth-shield. Under arm-plates in contact with each other along the whole basal part of the arm. First plate small, round hexagonal, longer than broad, and wedged between the outer ends of the neighboring side mouth-shields. Second plate narrowed within, and bounded by six sides; as follows: outer side nearly straight; laterals short and straight; inner laterals re-enteringly curved, to admit the large tentacle pores, and converging on the inner side, which is straight and very short. Fifth plate as broad as long; outer side slightly re-enteringly curved; inner side a little curved; laterals nearly straight, inner laterals short, and a little re-enteringly curved; length to breadth .6 : .6. Two thirds out on the arm, the side arm-plates meet below, along a line about one-half as long as the under arm-plate, which is there triangular, with its sides a little curved, and the apex directed inward. Side arm-plates robust, but not meeting below or above till near the end of the arm. Upper arm-plates four-sided, broader than long; outer side curved; inner side re-enteringly curved; laterals straight; length to breadth (4th plate) .6 : .8. The first upper arm-plate is very small, and fits in the little notch made by the outer ends of the radial shields. Two thirds out on the arm the plates have the same form, though much more elongated. Disk covered, above and below, with numerous rather large plates of very irregular outline, all of which, except those of the lower surface, are more or less studded with small, smooth granules; on the under surface is an irregular double row of granules, extending round the inner end of the genital slit, and along the genital plates as far as the third joint of the arm: a row of large granules, or short, stout papillæ, runs along the edge of the

basal upper arm-plates; the arm-comb of papillæ is continued along the edge of the disk; the side arm-plates do not join below; the first pair of pores of the arm-tentacles are surrounded by scales. Nevertheless, I am not clear enough as to the generic differences in this group to make a separation.

disk, and over the arm on the outer edge of the radial shield. The edge of the disk, in each interbrachial space, is composed above of three plates, and below of six.

Radial shields, of a very irregular triangular form, with the point inward; they nearly, or quite, touch without, but immediately diverge and are separated by a wedge of one small, one large, and part of another large plate; length to breadth 1.5 : .8. Two small, rounded, tapering arm-spines; the lower slightly longer; lengths to that of under arm-plates (5th joint) .4, .5 : .6. Tentacle scales, on second joint, six to each pore, arranged in an oval, three on each side; on third joint, two, arranged side by side; on joints beyond that, one. They all have the same shape of a small, thickened scale, but those towards tip of arm are proportionately larger. The mouth tentacles, of the first joint, have scales on either side, in form of an incision, somewhat as in *Ophioglypha:* on the side next the jaw, the two mouth-papillæ that stand on the side arm-plate are tentacle scales; and, on the side next the mouth slit, there are two more, which stand on a little plate, the homologue of a side arm-plate, running upwards into the mouth slit from the first under arm-plate.

Color, in alcohol, light brown.

Two specimens, off Double-headed Shot Keys, in 315 fathoms.

Ophiomusium, gen. nov.*

Teeth: no tooth-papillæ; mouth-papillæ soldered in a continuous row, so that their former outlines are scarcely to be seen. Disk covered by plates and radial shields, all of which are intimately soldered, forming a surface like porcelain. Upper and under arm-plates minute: side arm-plates meeting above and below; swelled, intimately soldered with the neighboring parts. No tentacle pores beyond the basal arm-joints. Small arm-spines on outer edge of arm-plates. Two genital slits in each interbrachial space.

In the nature of its covering, this singular genus has some affinity with *Ophiolepis*, as now restricted. But it is unique in having no tentacle pores on the greater part of the arm.

Ophiomusium eburneum Lyman, sp. nov.

Special Marks. — Two very small, blunt arm-spines, less than one third as long as the arm-joint. No tentacles beyond the first two joints. Surface of the disk and arm-plates microscopically granulated.

Description of a Specimen. — Diameter of disk 9 mm. Length of arm 25 mm. Width of arm 1 mm. The mouth papillæ, though closely soldered to each other, may be distinguished, in a partly dry specimen, by the light

* ὄφις, snake; μυσεῖον, mosaic.

lines between them; there are seventeen to each angle, of which the outer one is tooth-like and minute, and may be partially detached from the rest; the innermost, odd one is diamond-shaped, and lies immediately under the teeth; the others are squarish. Teeth four, flat, pointed, narrow; sometimes not placed regularly over each other. Mouth-shields small, of a truncated diamond shape, the truncation directed outward; length to breadth .8 : .6. Side mouth-shields broader without than within, where they meet, extending outwards beyond the mouth-shield, and joining the first side arm-plate; length 1.2 mm. Disk smooth above and below, and covered with a close mosaic of rounded scales, so intimately soldered that their outlines are indistinct. Radial shields blunt pear-seed shaped, widely separated by a group of small disk scales; length to breadth 1.8 : 1.2; they swell a little above the level of the others, and their surface, under the microscope, is composed of smooth grains, as is that of all the arm and disk plates. In the interbrachial space, between the pairs of radial shields, a single large scale occupies the margin of the disk. Under arm-plates three-sided and very small; the outer side is nearly straight, the laterals are re-enteringly curved and meet in a point within; length to breadth (5th joint) .5 : .4. Further out they rapidly become smaller, and, towards the tip of the arm, are scarcely to be seen. Side arm-plates very thick and swollen, meeting above and below, from the very innermost joint; at the fifth joint, their line of juncture is as long as the under arm-plate; and, further out, they constitute almost the whole of the joint. Upper arm-plates very small; longer than broad, diamond shape, with the outer angle shorter than the inner one; length to breadth (2d joint from disk) .8 : .6. Genital slits extending from the outer corner of the mouth-shield to a point about two thirds the distance to the margin of the disk; they are very narrow, and are bounded by two genital plates, which grow wider at their outer end, and are placed in a single line; moreover, there is a very narrow plate between the inner part of the slit and the side arm-plate. Arm-spines two, very short, scarcely tapering, cut square off at the end, nearly equal; lengths to that of the under arm-plate (5th joint) .3, .3 : 1. Near the tip of the arm the under spine is toothed, and hooked at the end, and the upper spine somewhat rough. There are tentacle-scales on the second and third joints, one to each pore; beyond this, neither tentacles nor scales; these scales are small, curved, and broader than long, and are situated close to the inner angle of the little under arm-plate, which gives them the look of being crowded towards the centre of the arm. The tentacles are short and small.

Color in alcohol, white.

Variations. — A young one had the disk 1.8 mm., the arm 6 mm. The scales of the upper disk were swollen and distinct, though closely soldered together; in the centre a large rosette of primary plates, a large round one in the centre; a large, rounded pentagonal one in each brachial space; a small narrow one, wedged between these last, in each interbrachial space. Outside this rosette were the radial shields, touching each other; and, finally, there were two narrow plates, on a radiating line, in each interbrachial space between the pairs of radial shields, making thirty-one plates on the upper surface. Below there were only three plates in each interbrachial space, arranged side by side. The mouth-shields were broad, heart-shape; the side mouth-shields and mouth-papillæ nearly as in the adult. Of under arm-plates there were but two (including the one at the corner of the mouth-slit): of upper arm-plates, only one, on the first joint. There were tentacles on the second and third joints, just as in the adult, and none beyond. The place where upper and lower arm-plates will appear is indicated by a depression, just where the side arm-plates meet; and in this depression appears a little papilla, or lump, which at last takes on the form of a true plate. Thus, a larger specimen with a disk of 3 mm. and arm of 10 mm. had already nine upper and three lower arm-plates, but none beyond. Off Sand Key, 270 and 325 fathoms.

Ophiacantha meridionalis Lyman, sp. nov.

Ophiacantha pentacrinus? Lütken, Addit. ad. Hist. Ophiur. Pt. III, 1869, p. 46.

Special Marks. — Disk closely beset with minute stumps, each bearing a crown of fine thorns. Six long, very slender arm-spines. Arms five or six times as long as the diameter of the disk, rounded and slender.

Description of a Specimen. — Diameter of disk 4 mm. Length of arm 22 mm. Seven mouth-papillæ to each angle of the mouth; three on each side, which are short, bluntly tapering, stout, and separated from each other, and one situated immediately below the teeth, which it resembles in form. Teeth three, short, flat and wide, with a much curved cutting edge. Mouth-shields between a diamond and a heart shape, much broader than long, with the outer side nearly straight, except a projection at the middle point, and a rounded angle within; length to breadth .4 : .7. Side mouth-shields wide and strong, nearly straight, meeting within, and resting without, on the rudimentary first arm-plate, which is conspicuous and strong. Under arm-plates separated by the side plates along the whole arm, wider without than within; bounded without by a clean curve, on the sides by a slightly re-entering curve, and within by an obtuse angle; nowhere do they present a sharp corner, their outline being much rounded. Length (4th joint) .4 mm. Side arm-plates meeting above and below, their line of juncture being, at the base of the arm, quite as long as the lower arm-plate. Upper arm-plates small, not as wide as the arm, strongly curved without, and with an angle within, so that they form a sort of broad diamond-shape. Disk completely covered, above and below, with very minute stumps, each of which bears a crown of microscopic thorns; on the back of the disc there are about 250 to a square mm. Radial shields entirely obscured, except just over the arms, where their outer ends are indicated by two little swellings. Arm-spines rounded, tapering, transparent, and very slender; under the microscope they appear finely prickly; on the basal joints six, of which the upper three are much the longest; lengths to that of the under arm-plate (4th joint) 1.5, 1.8, 1.8, 1.2, 1., .8 : .4. The two joints within the disk have but three spines, which are short, equal, flattened at their base, and quite rough. The end joints have three spines, also quite rough, and proportionately shorter and stouter than those of the basal joints, but there are no hooks, or toothed spines. Tentacle scales flat and sharp pointed, one to each pore. Color, in alcohol, pale blue gray for the disk, and white for the arms. The description given by Lütken of *O. pentacrinus* corresponds pretty nearly to this species. There is, however, one arm-spine less in *O. meridionalis*, and the under arm-plates appear to be of a different shape. Only a comparison of originals can determine the doubt.

In 237 and 327 fathoms.

Ophiomitra Lyman, gen. nov.*

Teeth: numerous, small, nearly equal mouth-papillæ; no tooth-papillæ. Disk flat, circular, and erect, covered with scales and radial shields, and beset with thorny spines, or stumps. Arm-spines rough. Side arm-plates large and nearly or quite meeting above and below.

So far as concerns the arms and the chewing apparatus, this is an *Ophiacantha*; but the disk, with its naked scales and conspicuous radial shields, separates it from that genus, which is characterized by the long, very narrow, radial shields, covered, together with the disk, by a thick skin bearing more or less thorny appendages.

Ophiomitra valida Lyman, sp. nov.

Special Marks. — Disk beset with thorny stumps; arm-spines about 9; the upper ones a little tapering, the lower ones flattened.

Description of a Specimen. — Diameter of disk 12 mm. Length of arm about 65 mm. Mouth-papillæ stout, rounded, tapering to a blunt point; from 10 to 11 to each angle of the mouth; of which one or two point directly inward. Teeth long, flat, tapering to a blunt point; 8 in number. Mouth-shields small, of a rounded diamond form, with a peak within; length to breadth 1.5 : 1.8. The madreporic shield has an ill-defined circular depression. Side mouth-shields large, meeting within, of a rude oval shape. They are quite as large as the mouth-shields proper. Under

* ὄφις, a snake; μίτρα, a cap.

arm-plates broader without than within, and broader than long; on 6th joint, length to breadth 1 : 1.3. The plates lying within the disk are much squeezed, laterally, by the large tentacles and their scales; beyond the disk they have a more regular shape, with the outer side strongly curved. Side arm-plates rather prominent, meeting above, but not below. Upper arm-plates wide fan-shape, with outer side strongly curved, and coming to a point within. Length to breadth 1 : 1.7. Disk, with a well-marked, round outline, standing off the bases of the arms; all its upper surface, except the radial shields, beset with little, rounded, thorny knobs or stumps, about .5 mm. high; they have a short, club form, like a folded toad-stool, and bear a thorny crown; there are about eight of these stumps to a square mm., where they are thickest. Interbrachial spaces below have like-wise a few of these stumps. The sealing of the disk, in a partly dried specimen, is easily seen. Radial shields of a blunt pear-seed shape, with a rather irregular and ill-defined outline; they are slightly separated, and are naked; length to breadth 2.2 : 1.5. Genital slits large and extending nearly to the margin of the disk. Arm-spines rough, and resembling those of the smoother species of *Ophiothrix;* the five upper ones slender, rounded, tapering gradually; the four lower ones somewhat flattened, scarcely tapering, blunt; lengths to that of the under arm-plate (6th joint) 3.8, 3.5, 2.5, 2.5, 2.2, 2.2, 2., 1.8, 1.8 : 1. Tentacle scales, two on the first pores; after that only one; those at base of arm are large, thin, longer than broad and cut square off at the tip; those further out are much smaller and tend to become pointed. In alcohol, the specimens are of a uniform faded straw-color.

Variations. — A specimen with a disk of 9 mm. had only eight arm-spines next the disk, and seven a little further out on the arm. The uppermost spine is sometimes shorter than the second, but the rest usually follow the proportions laid down. In large specimens the upper arm-plates have their outer curve very prominent.

This species has a rough resemblance to *Ophiothrix rosula;* and the genus has affinities with *Ophiothrix.* The lowest arm-spine, on the very tip joints, is a little curved and is strongly toothed on one edge, so as to form a partial hook.

Dredged off Sand Key, Florida, in 120 fathoms.

Ophiomitra sertata Lyman, sp. nov.

Special Marks. — Disk with small radial shields and beset with small spines and grains. Sixteen mouth-papillæ.

Description of a Specimen. — Diameter of disk 11 mm. Length of arm about 55 mm. Width of arm between the joints 2 mm. Mouth-papillæ about sixteen to each mouth-angle; two outer ones thin and nearly as wide as long, with the end cut square off; the next five thin, narrow, sharp; the innermost one lies under the teeth, and, with its mate from the other side, forms a pair of papillæ much stouter than the rest and having a spear-head shape. Teeth five; the lowest one similar to the pair of mouth-papillæ just below it; the other four flat, rather stout, with a curved cutting edge. Mouth-shields broad heart-shape, with a slight peak without; length to breadth 1.2 : 1.5 : just along their outer edge, in the interbrachial space, are five or six little spines. Side mouth-shields stout, broader without than within, running along the inner side of the mouth-shield and meeting within; they enclose the lateral corners of the mouth-shield by a little curved projection. Under arm-plates a little broader than long; bounded without by a clean curve, on the sides by slightly re-entering curves, and within by two curves which meet in a little peak on the median line. Side arm-plates stout, with a prominent ridge for the spines, meeting above and below, even at the first joint; they do not, however, encroach much more as they get further out on the arm; and it is only near the tip that they occupy as much as half of its upper surface. Upper arm-plates broad-triangular, the outer side cleanly curved, and the lateral sides straight and meeting within in a sharp point; length to breadth (4th plate) .8 : 1. Disk above beset with rounded, rough grains, mingled with delicate, rounded spines, .8 mm. long, and shaped like those of the arm; through this covering appear the delicate disk scales; and, just over each arm, a pair of short radial shields, of a blunt pear-seed shape; these are smooth, but are separated from each other, and from the arm below, by bands of grains and spines; length to breadth 1.5 : 1. In the interbrachial spaces below, the spines and grains are less numerous. Genital slits large and occupying the full length of the interbrachial space; the edge next the interbrachial space is bounded by the five disk scales. Arm spines seven, all rough, slender, and regularly tapering; upper ones cylindrical, lower ones, especially the lowest, a little flattened; lengths to that of the under arm-plate (6th joint) 3.3, 2.5, 2.3, 2.2, 1.8, 1.5, 1 : .8. Tentacle scales large and regularly oval, length .5 mm. Color, in alcohol, disk blue gray, arm yellow gray. A single specimen, off Double-headed Shot Keys in 315 fathoms.

Ophiochondrus, gen. nov.*

Teeth and mouth-papillæ: no tooth-papillæ. Disk granulated; contracted, so that the interbrachial spaces are re-enteringly curved, and are further much reduced by the encroachment of the stout arms. Side mouth-shields wide and thick and meeting within. Side arm-plates meeting below, and there closely soldered so as to form a continuous belt. Two genital slits in each interbrachial space.

* ὄφις, snake; χόνδρος, granule.

Ophiochondrus convolutus Lyman, sp. nov.

Special Marks. — Six nearly equal, rounded, tapering arm-spines. Radial shields twice as long as wide and considerably separated. Seven mouth-papillæ. One tentacle scale.

Description of a Specimen. — Diameter of disk 7.5 mm. Length of arm 24 mm. Mouth-papillæ seven, all short, stout, and flattened; the two outer ones on each side squarish; the third more tapering, like a blunt tooth; the innermost one lying just under the teeth, and similar to them, except that it is more pointed. Teeth four, flat, squarish, with a cutting edge a little curved at its corners. Mouth-shields broader than long, rounded heart-shape; length to breadth .8 : 1.2. Side mouth-shields large and stout, meeting closely within: wider without, where they are soldered to the first side arm-plates. Under arm-plates wide oval, with a slightly re-entering curve without, strongly separated by the side arm-plates; length to breadth (6th joint) .5 : 1. Side arm-plates large, thick and swollen, not joined above, but meeting below, even at the base of the arm, where they are so soldered together that their line of juncture cannot be seen; their surface is rough, contrasting with that of upper and under plates, which is smooth. Upper arm-plates broad fan-shape, with the wide curved side outward; the two lateral sides are straight, and converge to the inner side, which is very short; the first upper plate is more or less covered by the encroachment of the disk; length to breadth (3d plate) 1 : 1.4. Three fourths out on the arm the upper plate is long wedge-shaped, with a curved outer side; this shape is determined by the juncture above of the side arm-plates. Interbrachial spaces below, and upper surface of disk, except radial shields, closely granulated with minute, rough, nearly equal grains, about 150 to a square mm. Radial shields widely separated; long oval, wider without than within; length to breadth, 2 : 1. The disk rises well above the arms, on which it encroaches somewhat by growing out on them in a sloping direction, as is often seen in *Ophiura*. Over the arm there is a slight irregular notch in the disk. Arm-spines short, rounded, tapering, moderately stout, nearly equal; second one from top a little the longest; lowest one somewhat the shortest. Second joint, two spines; third joint, three; sixth joint, six; lengths to that of the under arm-plate, .6, .7, .6, .6, .6, .5 : .5. At the very tip of the arm the under spine becomes somewhat hooked on its side and end. Tentacle scale, one, small, short, and tooth-like.

Color, in alcohol, light yellow.

Variations. — A small specimen brought up in the same cast is supposed to be the young of this species. Disk 2 mm. Arms 16 mm. The upper surface of the disk is entirely occupied by the eight radial shields, which are broad wedge-shape, and have the outer side bevelled, so as to make a notch or re-entering angle in each interbrachial space. In the centre of the disk, and on the dividing lines between the shields, are a few rough grains or rather thorny stumps, of which each shield bears one or more near its outer end. Interbrachial space below wholly occupied by the very stout and swollen side mouth-shields, and the mouth-shield which closely fills the angle made by them. Under arm-plates bounded without by a curve, on the sides by re-entering curves, and within by an angle. Side mouth-shields stout and meeting above and below. Upper arm-plates fan-shape, with a curve without and a sharp angle within. Arm-spines (2d joint from disk) six; the three upper ones shaped as in the adult; the three lower much shorter and stouter, and suddenly swollen at the base; on the joints just beyond, five spines, which are short and stout. The chewing apparatus and other characters are nearly as in the specimen first described. It will be seen that, in character of arm-spines, armature of disk, and proportionate length of arm, this specimen differs much from its supposed adult; but I shall consider it as the young form, unless intermediate stages shall prove it a distinct species.

Both specimens from off Chozera, Cuba, in 270 fathoms.

This animal has a tendency to roll the tips of the arms upon themselves, which, with the contracted disk and the character of the arm-plates, give it the look of a young *Astrophyton.*

Ophiactis humilis Lyman.

Special Marks. — Disk covered with coarse scales, which are beset with short spines and short thorny clubs. Five spines, the two uppermost much the longest.

Description of a Specimen. — Diameter of disk 4 mm. Length of arm 11 mm. Seven long, rough, stout, spine-like tooth-papillæ .2 mm. long, standing well apart; the innermost one is broader and flattened, and very like the teeth, below which it stands. Three teeth, which are flat, longer than broad, with their cutting edge bluntly pointed. Mouth-shields broad heart-shape, broader than long, curved without, bounded within by two re-entering curves; length to breadth .3 : .5. Side mouth-shields large, extending outward as far as the outer corner of the mouth-shields; and loosely joined within, along a line equal nearly to the length of the mouth-shield itself Under arm-plates broader without than within; bounded without by a slight curve, within by an obtuse angle, and on the sides by re-entering curves; length (3d plate) .3 mm. Side arm-plates large, meeting below along a line equal to more than half the length of the lower arm-plate; and above, equal to the whole length of an upper arm-plate. Upper arm-plates thick, but small, only about half as wide as the arm itself; heart-shaped, being curved without and pointed within. Disk covered with coarse, somewhat irregular, overlapping scales, of which there are five or six in a line from the centre to the margin of the disk. These scales are beset with numerous bodies of two sorts; the first are short, stout, rough spines, similar in size and shape to the mouth-papillæ; the second are shorter but much thicker and have a thickened club form. In the interbrachial spaces below these spines are more scattered. Over each arm the outer points of the radial shields can just be seen; the rest is covered. Five rough, rounded, tapering, rather stout arm-spines; lengths to that of the under arm-plate (4th joint) 1.7, 1.5, .8, .7, .6 : .3. Towards the end of the arm there still are five spines, and the two upper ones much the longest. Tentacle scales, one to each pore; on the first two pairs of pores long, flat, and spine-like, resembling the mouth-papillæ; on the joints beyond, smaller and proportionately shorter.

Color, in alcohol, light brown.

Variations. — The two specimens from 125 fathoms had no spines on the disk, and only a few of the club-shaped grains.

In 125 and 324 fathoms.

This species, with *O. clavigera* Ljung., stands at one extremity of the genus and approaches *Ophiacantha* just as *O. Krebsii*, at the other extremity, tends towards *Amphiura*. The typical *Ophiactis* of Lütken is distinguished by great radial shields, flat arms, stumpy arm-spines, and feebly developed mouth-frames; its scaling is heavy, and the arm-plates are large and conspicuous; and, as such, it was set off from *Amphiura*. *Ophiacantha* is distinguished by the development of thorny appendages on the disk, which cover it closely; feeble upper and lower arm-plates; long, rough arm-spines; a stout chewing apparatus, which is somewhat like that of *Ophiocoma*, except the absence of tooth-papillæ; and very slender linear radial shields covered with skin.

O. clavigera is remarkable for its high arched disk.

Ophiactis plana Lyman, sp. nov.

Special Marks. — Disk scales smooth, without spines or grains. Four mouth-papillæ to each angle. Side mouth-shields touching the under arm-plate.

Description of a Specimen. — Diameter of disk 3.5 mm. Length of arm 10 mm. Mouth-papillæ,* two to each angle, situated at the outer corner

* It has been explained (see remarks on *Amphiura*) that this papilla is really the tentacle scale of the second pair of mouth tentacles. In describing *Ophiactis* there has been some confusion in this respect: thus, Mr. Ljungman says of *O. carnea*, "papillæ orales binæ" (four to each angle), "*altera* in summo sinu orali collocata"; but this *second* one is the tentacle scale of the first pair of mouth-tentacles; and at that rate the species usually described as having four papillæ to each mouth-angle ought to be reckoned as having *six*, because these tentacle scales of the first pair are commonly overlooked.

of the slit; large, round, scale-like. Teeth four, flat, a little swelled, with a convex cutting edge, which in the lowest one (and to a less degree in those above) has a little lobe at its inner point. Mouth-shields small, swelled, broad heart-shape; length to breadth .2 : .3. Side mouth-shields small and narrow, not meeting within; soldered without to the inner lateral side of the second under arm-plate. Under arm-plates nearly pentagonal, with the angle directed inward, and truncated, making a very short sixth side; outer side curved; laterals re-enteringly curved; inner laterals straight; length to breadth (5th plate) .3 : .3. Side arm-plates stout, meeting above and nearly below. Upper arm-plates as wide as the arm, broader than long, bounded without by a clean curve, within by a very obtuse angle; length to breadth (3d plate) .3 : .4. Disk covered above and below with neatly imbricated scales, which are rather larger near the centre, where there are about 30 to a square mm. Radial shields slender pear-seed shape; a little bent so as to present a concave side to each other; separated for nearly or quite their length by a wedge of two or more elongated scales; length to breadth .8 : .4. No grains or spines on the disk scales, which are quite smooth. Arm-spines smooth, moderately stout, rounded, regularly tapering to a blunt point; nearly equal; lengths to that of the under arm-plate (5th joint) .5, .5, .5 : .3. One large, round tentacle scale, which resembles the mouth-papilla. Color, in alcohol, pale brown.

This species is distinguished from others by its lobed teeth and the entirely naked disk scales. It belongs to the group that have the side mouth-shields joining the under arm-plate. Off Carysfort Reef, 117 fathoms; off Key West, 140 fathoms; off Boca Grande, 125 fathoms; off Tortugas, 13 fathoms.

Ophiactis loricata Lyman, sp. nov.

Special Marks. — Side mouth-shields with their outer side touching the side arm-plate, and the first and second under arm-plates. Radial shields small. Upper and lower arm-plates long. Six arms.

Description of a Specimen. — Diameter of disk 2 mm. Length of arm 7 mm. Mouth-papillæ usually four to each mouth-angle, two on each side mouth-shield, of which the inner is very small and spine-like, but situated at the same level. Sometimes this second minute one is wanting, sometimes it is nearly as large as the outer. These variations may be looked for, because these creatures are peculiarly liable to mutilation, so that, of five specimens dredged, only one was perfect and symmetrical. Teeth, four; the upper one more sharp and narrow; the lowest sometimes divided into two papillæ. In the teeth, again, there seems some variation. Mouth-shields small, broad oval, rather swollen. Side mouth-shields stout, long triangular, nearly meeting within; the inner corner of the outer side fits in just where the first and second under arm-plates touch each other; the outer side itself rests against the first side arm-plate. Under arm-plates longer than broad; touching each other; bounded within by a truncated angle, without by a curve, and on the sides by re-entering curves. Side arm-plates not meeting either above or below. Upper arm-plates much broader without than within; as long as, or longer than, broad; bounded without by a curve, on the sides by straight converging lines. Disk finely scaled below; above covered with irregular, rather coarse and swollen scales, some of which bear little, stout spines. Radial shields broad wedge-shape, small, their length not more than one fifth the diameter of the disk; touching each other only at their outer end; strongly diverging and separated by a wedge of two scales, placed end to end. Near base of arm, four short, stout, rough, nearly equal arm-spines; further out, three; one stout tentacle scale. Color, in alcohol, brown. In the covering of the disk, and especially the size and position of the radial shields, this species resembles the figures of *O. Ballii* and *O. abyssicola;* * but the upper and lower arm-plates are quite different, and *O. Ballii* has five arm-spines; and the upper arm-spine of *O. abyssicola* is much the longest. *O. virens* has the side mouth-shields joined in a continuous ring.† There is a single specimen of a different species, dredged in 45 fathoms, which comes perhaps nearer to one of the above European species; but I propose to disregard it until I can have originals for careful comparison.‡

In 110 fathoms.

Amphiura semiermis Lyman, sp. nov.

Special Marks. — No scales on disk underneath. Six mouth-papillæ to each mouth-angle, of which two are above the others, in the mouth-slits. Side mouth-shields broad triangular and meeting within.

Description of a Specimen. — Diameter of disk 4 mm. The arms were broken, but their length seemed to have been about 30 mm. Mouth-papillæ six to each angle of mouth; a pair at the point of the angle, which are stout and rounded and run upwards to the teeth; one spiniform on the inner edge of the side mouth-shield; and one intermediate on each side, also spiniform, and situated high up in the mouth-slit. Teeth three, flat, strong, squarish, with a slightly curved cutting edge. Mouth-shields rounded oval, with a slight point within; length to breadth .5 : .4. Side mouth-shields broad triangular, large, meeting within; they extend nearly to the median line of the arm and overlap the first, rudi-

* Sars, Oversigt af Norges Echinodermer, Tab. II.

† Ljungman, Ophiuroidea Viventia, p. 323.

‡ In Catalogue No. 1, of Museum of Comp. Zoölogy, I have placed *O. abyssicola* under *Ophiocnida*, because I mistook the drawing given by Sars. I have not the same excuse for my blunder in putting *O. Ballii* there, for I had seen a specimen at Berlin.

mentary under arm-plate; under arm-plates nearly pentangular, but there is a very short inner side, because the inner laterals do not meet on the median line; they are bounded without by a slight curve; on the sides by curves a little re-entering; the inner laterals are also somewhat re-enteringly curved: length to breadth (5th plate) .5 : .4. Side arm-plates quite large, and encroaching both above and below; nearly meeting above. Upper arm-plates rounded, with a peak within; they do not cover the whole upper surface, but on each side appear the side arm-plates; length to breadth (3d plate from disc) .5 : .5. Disk finely scaled above, naked below; scales rather larger towards middle of disk; near its edge there are about 140 to a square mm., all thin, and overlapping. Radial shields narrow, broader without than within; their sides overlapped by the disk scales; nearly, or quite, touching without; diverging a little within; separated near their outer ends by a single long scale, and, further inward, by a bunch of the imbricated disk scales, length to breadth 1 : .3; they vary somewhat, accordingly as they are more or less encroached on by the disk scales. Just outside and below each of them is a small radial scale. Arm-spines, near base of arm, five; further out, four; stout, rounded, tapering to a point, swelled at the base; the two upper ones slightly longer and more slender; lengths to that of under arm-plate (5th joint) .5, .5, .4, .4, .4 : .5. Tentacle scales two, small, broader than long, curved; placed at right angles to each other, one on the lateral side of the under arm-plate, the other on the outer edge of the side arm-plate.

Color, in alcohol, disk greenish gray, arms yellowish.

A single specimen, from 377 fathoms, south of Rebecca Channel.

The specimen was somewhat injured, and therefore I wait better examples before separating the species from *Amphiura*, from which it differs by its naked disk underneath, just as does *Hemipholis*. Otherwise, it belongs to the *Amphiura* group, in which are found the well-known European *A. Chiajii* and the Florida *A. Stimpsonii*. This group is commonly described as having one *mouth-papilla* at the outer corner of the mouth-slit, and *another* high up in the mouth-slit itself. As the term mouth-papilla is understood, this description is not true. The papilla at the outer corner of the mouth-slit is the *tentacle scale* of the second pair of mouth-tentacles; that within the mouth-slit is the tentacle scale of the first pair of mouth-tentacles. The scale of the second pair of tentacles may easily be found in such genera as *Ophiocoma*, but naturalists do not there speak of it, because it is hidden by the continuous row of true mouth-papillæ. The group, therefore, should not be spoken of as having six mouth-papillæ, but as having *two* mouth-papillæ at the apex of the angle, and one large scale to each of the mouth-tentacles. Its species are, moreover, characterized by the number of the arm-spines, which are rarely less than five and occasionally as many as eight, while the other group has three or four. When we can be sure of the full value of the characters these two divisions will doubtless appear as generically distinct.

Amphiura grandisquama Lyman, sp. nov.

Special Marks. — Five arm-spines, the lowest much the longest, and a little bent. One rounded tentacle scale, larger than is usual in the genus. Six mouth-papillæ to each mouth-angle, of which two are above the others in the mouth-slits.

Description of a Specimen. — Diameter of disk 6 mm. The arms, which were broken, had been not far from 28 mm. long. Of the six mouth-papillæ, to each mouth-angle, the innermost are stout and rounded, and stand side by side at the apex of the angle, running upwards to the teeth; the outer ones are very stout and taper to a blunt point, and one stands on the inner edge of each side mouth-shield; the intermediate ones are smaller and sharp spiniform, and are high up in the mouth-slit. Teeth flat, rather stout, with a cutting edge, a little curved. Mouth-shields broad, rounded diamond shape, more obtuse without than within; length to breadth .5 : .4. Side mouth-shields long triangular, small, not meeting within. Under arm-plates broader without than within; bounded without by a curve; on the sides by re-entering curves, which incline toward the median line; the inner laterals are short and nearly meet on the median line, so that the inner side is very small; length to breadth (6th plate) .5 : .5. Side arm-plates encroaching somewhat both above and below. Upper arm-plates extending quite across the arm, broader than long; they have a clean curve without, and a broken curve within, and these meet, on either side, in an obtuse point; length to breadth (3d plate from disk) .5 : .6. Disk covered with fine, overlapping scales, above and below, which are coarsest near the centre of the disk, and finest underneath; near the edge, above, there are about 100 to a square mm. Radial shields narrow; wider within than without, their side turned toward the other nearly straight; the opposite side curved; they are separated by a narrow wedge of two or three long scales; length to breadth 1 : .4: their size varies with the encroachment of the disk scales. Arm-spines five; further out on arm, four; rounded, tapering regularly, little or not at all swelled at the base; lowest one longest, and generally a little bent; lengths to that of the under arm-plate (7th joint) .6, .7, .7, .7, 1 : .5. Tentacle scale large, and round oval, resembling that in *Ophionereis;* length to that of the under arm-plate .2 : .5. Color, in alcohol, pale brown, with a light spot at the outer end of each radial shield.

Off Tennessee Reef, in 174 fathoms.

The species belongs to the same group as its neighbor, *A. Stimpsonii*, but is readily distinguished by its larger tentacle scales, and longer, more tapering arm-spines. *A. Sundevalli* is also similar, but has the side mouth-shields meeting within, and very broad, and the arm-spines more stumpy. *A. Stimpsonii*, hitherto only known by Lütken's description (Addit. ad Hist. Ophiur., Part II, p. 116) has the proportions of the disk and arms much as in *A. grandisquama.* The mouth-shields are longer than broad; the side mouth-shields small and narrow, meeting within, closely soldered to the surrounding parts, and, at their outer end, to a very small rudimentary under arm-plate; at base of arm, one very small tentacle scale; further out, none at all; radial shields closely joined at their outer ends; within, separated by a couple of long scales: five short, stumpy arm-spines.

Remarks on the Groups in the Genus Amphiura. — Any one who is really familiar with the range of species in this genus will, on the one hand, recognize striking differences, while, on the other, he will find a real difficulty in dividing the groups in a way to bear criticism. Lütken very properly set off the genus *Ophiactis;* and I have since separated the *Amphiuræ* with spiny disks under the name *Ophiocnida*, and those with a fence of scales round the discs as *Ophiophragmus.* Professor Agassiz had already recognized the generic position of the species with a naked disk below, under the name of *Hemipholis.* Mr. Ljungman * further distinguishes a genus *Amphipholis*, of which the type is *A. Januarii*, which seems to belong with such species as *A. elegans* (*Amphiura squamata* Ltk.) and *A. tenera.* It is by no means clear on what characters Mr. Ljungman grounds this new genus; because, after giving a number of characters common to nearly the whole of the old genus, he concludes with this distinction: "A generibus *Hemipholide* et *Amphiura* numero et dispositione papillarum oralium differt." But the species which he includes under *Amphipholis* do not at all agree *among themselves* in the number or disposition of their mouth-papillæ; e. g. *A. tenera*, *A. occidentalis*, and *A. atra.* There certainly is a group which includes *Amphiura elegans* (*squamata*), *A. tenera*, *A. violacea*, and *A. pugetana*, whereof the members are not only closely allied generically, but are even difficult to distinguish *specifically*, though coming from faunæ the most widely separated. Thus, Mr. Ljungman gives *A. elegans* as coming from the shores of Northwestern Europe, and also the Cape of Good Hope (!). And since this species has been shown to vary so considerably in its arm-spines, it seems difficult to separate it any longer from *A. tenera* of the West Indies; and, further, from *A. violacea*, *A. microdiscus*, and *A. Puntarenæ* of the Pacific coast of America. Should all, or a part, of these species prove identical, we must look upon this animal as the common thread that binds together distant faunæ, just as characteristic

* Ljungman, Öfversigt af Kongl. Vet. Akad. Förhand., 1866, p. 165.

fossils determine stratified rocks in different parts of the world. This idea of community of existence gets some strength from the varying depths at which *A. tenera* is found (4 to 128 fathoms), while its northern representative, *A. squamata* or *elegans*, is found from the Mediterranean, on the east, to Cape Cod, on the west; and from low water to three hundred fathoms* (var. *tenuispina*). The new genus *Amphilepis* Ljung.† seems better grounded. It contains the new species *A. norvegica*, and is characterized by only four mouth-papillæ to each angle and by absence of tentacle scales. However this may be, there are groups in *Amphiura* quite as clearly marked generically as is *Amphilepis*, and especially that already referred to as including *A. grandisquama*, which is characterized by having only two mouth-papillæ placed just under the teeth, a deficiency made up by the development of the tentacle scales of the two pairs of mouth-tentacles; furthermore, the many-spined *Amphiuræ* (4 to 8) are all found in this group. Its species, eighteen in all, are embraced in the table on pp. 338 and 339.

I by no means wish to suggest, because so many minor differences are thus indicated, that an equal number of generic differences should be recognized; on the contrary, no naturalist has a right to take such a step, unless he has had most of the species *under his own eye* for critical comparison.

Next to *A. planispina* stands the genus *Hemipholis*, which has two species, — *H. cordifera* Lym. and *H. affinis* Ljn.‡ *Ophiocnida* and

* Sars, Over det dyriske Livs Udbredning i Havets dybder, 1868.

† Ljungman, Ophiuroidea Viventia, p. 322.

‡ Its synonyme is *H. gracilis*, Vll. Professor Verrill (Proceed. Boston Soc. Nat. Hist. XII, 391) thinks that he has priority in the name, because, in a separate publication of Ljungman's Ophiuroidea Viventia, there is a note by Lovèn dated May 18, 1867. But this note has nothing to do with the original publication which is in the Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 1866, No. 9. Ljungman's paper was read November 14, 1866. Verrill's was read January, 1867, and published in Trans. Connecticut Academy, March, 1867. This whole matter of priority in descriptions is of no sort of interest to science, except as a matter of *registration*. Nor is it profitable to enter on the question of what constitutes *publication*. But we may say, that the partial distribution of loose sheets of an incomplete paper, though a useful and praiseworthy custom, constitutes no greater claim for *priority* than the reading of a paper before an ancient and distinguished Academy, and the speedy publication of that paper in its complete and connected form. There are now many zoölogists who seem to think that species must be continually "reported," just like stocks at the brokers' board. Agassiz showed, twenty-three years ago, in his preface to the Nomenclator Zoologicus, that the "authorities" placed after names were merely *references of registration*, and not marks of praise to the authors. Thus when we read *Ophioderma longicauda* Müll. and Trosch., it means not, "The illustrious zoölogists Johannes Müller and F. H. Troschel had the honor to give the above (wrong!) name to this species"; *but*, "If you look in the System der Asteriden, you will find what Müller and Troschel thought or knew of this species."

Ophiophragmus are distinguished, not by the chewing apparatus, but by the covering of the disk. The former has four species, — *O. hispida* Lym., *O. brachiata* Lym., *O. scabriuscula* Lym., *O. olivacea* Lym.* The latter has five species, — *O. septus* Lym., *O. Wurdemani* Lym., *O. marginatus* Lym., *O. antarcticus* Ljn., *O. gibbosus* Ljn.

Finally, to complete that part of Müller and Troschel's genus Ophiolepis, which centres in *Amphiura*, we must mention *Ophiostigma* and *Ophiactis*. The latter approaches *Amphiura* in one direction (*O. Krebsii*), *Ophiopholis* in another (*O. Kröyeri*), and *Ophiacantha* in a third (*O. clavigera*). See description of *Ophiactis humilis*.

Amphiura pulchella Lyman, sp. nov.

Special Marks. — Six mouth-papillæ to each angle, the inner pair thick and running upward to the teeth. Radial shields very narrow, and closely joined for nearly their whole length.

Description of a Specimen. — Diameter of disc 3.2 mm. The arm was broken off at 21 mm., but had apparently been about 28 mm. long. Mouth-papillæ three on each side, all on the mouth-frames; the two outer ones small, rounded, and scale-like; the innermost one thickened and running upwards to the teeth. Mouth-shields longer than broad, rather narrower within than without. Side mouth-shields very narrow within, where they meet; much broader without, where they touch the minute first under arm-plate with their corner. Under arm-plates separated; as broad as long, pentagonal with the angle inward; lateral sides re-enteringly curved; outer side nearly straight on the first three or four plates; beyond that, with a decided notch in the outer side. Side arm-plates meeting below and (after the second joint) above also; the separation, however, of the upper and under plates is narrow; length of third plate .2 mm. Upper arm-plates broader than long, of an oval form, with the inner curve greater than the outer. Beyond the second joint they are slightly separated. Disk closely covered with minute imbricated scales, of which there are about 100 to a square mm., where they are smallest, on the upper surface. In the centre is a distinct circle of five round primary plates, with a sixth in the middle. Radial shields narrow, and sunk in the disk, joined for their entire length closely, except just at their inner extremities; length to breadth .9 : .2. Arm-spines three; short, smooth, rounded, tapering, nearly equal; lengths to that of under arm-plate .3, .3, .3 : .2. One small, nearly circular tentacle scale.

Color, in alcohol, disk greenish gray, arms lighter.

In 39 fathoms.

* To these should apparently be added *Ophiophragmus Loveni* Ljn. and *O. echinatus* Ljn. Why he placed them thus, and still admitted the genus *Ophiocnida*, is not clear.

Amphiuræ with only a pair of mouth-papillæ just under the teeth; the tentacle scales of the two pairs of mouth-tentacles strongly developed; 4–8 arm-spines.

Two tentacle scales.	4 arm-spines; often an additional mouth-papilla	A. Eugeniæ Ljn.	Near R. La Plata.
	5–6 arm-spines; under arm-plates pentagonal	A. Çhiajii Fbs.	W. Europe.
	5–7 arm-spines; under arm-plates pentagonal	A. complanata Ljn.	Off Rio de Janeiro.
	7 divaricate arm-spines	A. divaricata Ljn.	Near Batavia.
	7 rather long arm-spines; side mouth-shields separated	A. flexuosa Ljn.	Brazil.
	8 sharp arm-spines; disk large (11 mm.)	A. crassipes Ljn.	Off Rio de Janeiro.
	Outer mouth-papilla scale-like	A. candida Ljn.	Mozambique.
	5 arm-spines; long arms; (probably belongs here?)	A. perplexa Lym.	Sidney.
	Side mouth-shields wide triangular; no scales below	A. semiermis Lym.	Florida.
	Two tentacle scales at base of arm; none beyond	A. verticillata Ljn.	Gallapagos.
One tentacle scale.	Minute tentacle scales	A. Stimpsonii Ltk.	Florida.
	Side mouth-shields wide triangular	A. Sundevalli Ljn.	W. Europe.
	Tentacle scales large, rounded oval	A. grandisquama Lym.	Florida.
	7 rough arm-spines; lowest longest	A. magellanica Ljn.	Str. Magellan.
	6 or 7 wide arm-spines	A. capensis Ljn.	C. Good Hope.
No tentacle scale.	5–7 arm-spines	A. latispina Ljn.	Off R. La Platta.
	6 arm-spines; arms very long	A. atlantica Ljn.	St. Helena.
	Very long arms; 5–7 arm-spines	A. filiformis Fbs.	W. Europe.

It is for this group that *Amphiura* must be retained, if the genus is to be subdivided. (See Forbes in Trans. Linn. Soc., Vol. XIX, p. 150.)

The rest of the genus embraces	A. elegans Norm. W. Europe and N. E. America.*
Two tentacle scales. Mouth-shield small, and wedged between two wide, thick, side mouth-shields, which meet within. Outer mouth-papilla much wider than the rest. The whole mouth apparatus with its shields forms a conspicuous raised pentagon. These species form part of *Amphipholis* Ljn., and are noted for their close resemblance	A. pugetana Lym. Puget Sound. A. tenera Ltk. W. Indies. A. depressa Ljn. Near Batavia. A. violacea Ltk. W. coast of tropical America. A. microdiscus Ltk. " " " A. puntarenæ Ltk. " " " A. Örstedii Ltk. " " " A. integra Ljn. Port Natal, S. Af. A. hastata Ljn. Mozambique. A. Januarii Ljn. Rio de Janeiro.†
Mouth-papillæ equal. Radial shields, short and stout and closely joined	A. grisea Ljn. W. Cent. America. A. Riisei Ltk. W. Indies.
7 or 8 short, wide (except the innermost) mouth-papillæ, under arm-plates wider within than without	A. atra Ltk. S. Carolina.
Six mouth-papillæ to each angle: radial shields very narrow and joined closely	A. pulchella Lym. Florida.
Mouth-papillæ equal. Side mouth-shields small and not meeting within	A. chilensis Ltk. Chili. A. occidentalis Lym. N. W. America. A. urtica Lym. N. W. America.
Outer mouth-papilla widest. Side mouth-shields small and not meeting within	A. geminata Ltk. W. Cent. America. A. gracillima Ltk. S. Carolina.
Four mouth-papillæ to each mouth-angle. No tentacle scales (*Amphilepis* Ljn.)	A. norvegica Ljn. Norway.
Two mouth-papillæ to each mouth-angle	A. planispina Pet. Rio de Janeiro.
Eight mouth-papillæ; two tentacle scales	A. impressa Ljn. Near Batavia.
Six arm-spines, two tentacle scales	A. lobata Ljn. Sidney, N. H.
Six unequal mouth-papillæ to each angle. Radial shields separated	A. limbata Ltk. Rio de Janeiro.

* Norman. Ann. and Mag. of Nat. Hist., 1865, p. 109.

† Mr. Ljungman informs me that *A. albida* and *A. subtilis*, Ljn., are probably identical with *A. Januarii*.

Despite the number of *Amphiuræ* described from the Gulf of Mexico and waters of Brazil, the species seem well defined and distinct; and there is promise of many more. This genus is remarkable fort he well-defined specific differences it presents in the character and position of its side mouth-shields, arm-plates, mouth-papillæ, radial shields, &c. For example, no other *Amphiura* presents the following combination found in *A. pulchella:* 1. Three mouth-papillæ on a side, the innermost thickened. 2. Slender radial shields, closely joined. 3. Upper and lower arm-plates separated. 4. Three arm-spines. 5. One tentacle scale.

Ophiocnida olivacea Lyman, sp. nov.

Special Marks. — Radical shields deeply sunk in the disk, long and narrow. Disk puffy, with a narrow notch over each arm. At the base of the arm two tentacle scales, of which one is small and stands on the side arm-plate, the other long spiniform and borne on the lateral side of the under arm-plate.

Description of a Specimen. — Diameter of disk 12 mm. Length of arm about 85 mm. Mouth-papillæ, twelve to each angle, arranged in three sets: first, two small, flat, tooth-like papillæ, one at each outer corner of the mouth-slit, standing well above the outer end of the side mouth-shield (these, of course, are the tentacle scales of the mouth-tentacles); secondly, four sharp, stout, rounded, tapering papillæ on each side, standing in a row, which runs from the middle point of the side mouth-shield, upwards and inwards, along the mouth-frames to a level with the second tooth; of these the outer one is largest, .7 mm. long; thirdly, two stout, conical papillæ standing on the point of the mouth-frames, and directed inward, but inclined from each other, so that they have the appearance of a blunt fork. Teeth six, of which the lowest is pointed somewhat like the mouth-papillæ next to it; the other five are flat, squarish, with a curved cutting edge. Mouth-shields small, of a broad, rounded heart-shape; length to breadth 1.4 : .7. Side mouth-shields narrow and small, pointed within (where they nearly meet), broader without, where they run to the lateral corner of the mouth-shield. Under arm-plates longer than broad, bounded within by a nearly straight line, on the sides by re-entering curves, and without by two little re-entering curves, which join in a small peak on the median line; length to breadth (10th joint) .8 : .6. Inside the disk these plates are especially encroached on by the tentacles, which are very large, and occupy much of the under surface of the arm. Side arm-plates moderately prominent, and conspicuous from below by reason of the narrow under arm-plates; they do not, however, meet, except at the very tip of the arm, where they come together above. Upper arm-plates broader than long, a little broader without than within; all their sides nearly straight; the outer one lightly curved; length to breadth (3d joint from disk) .8 : 1.1. Towards the tip of the arm they are triangular, with the outer side curved, and the apex directed inward. Disk covered with fine scales and radial shields; the former nearly hidden by the skin, except on the lower surface. Radial shields very narrow, and joined for their whole length; pointed within, swollen at their outer ends; length to breadth 2 : .5. They are sunk below the puffy surface of the disk, and are placed at the inner point of a notch in the disk, which exists over each arm; this inlacing of the soft disk is as deep as one or two arm-plates, portions of which are thus exposed, together with their spines, which are bent outward by the overlying disc margin. The sides of the notch are formed of an upward prolongation of the genital plate. The entire disk is pretty evenly beset with very slender, sharp spines about .6 mm. long. Genital slits with a distinct genital plate, whose edge is visible for its whole length, and which turns over and widens at each end, especially at the outer, where it runs upwards above the arm. Arm-spines, outside the disk and near base of arm, nine, whereof the two lowest are stout, rounded, pointed, and longer than the others; the next four flattened, tapering, and most slender; the three highest also flattened and tapering, but rather stouter; lengths to that of under arm-plate (10th joint) 1.1, 1.1, .9, .7, .7, .7, .7, .7, .7 : .8. On the second joint only two spines; on the other joints, within the disk, about three. Near tip of arm, four spines, lowest longest, slender, tapering, rounded, rather longer than the joint. Tentacle scales two, — one short, sharp, tooth-like and about .4 mm. long (10th joint), standing on the edge of the side arm-plate; the other slender, sharp, spiniform, and borne on the lateral edge of the under arm-plate; length (10th joint) .6 mm. The former of these scales is found to the very tip, where it takes on the form of a pointed oval; but the spiniform scale is only seen on the first third of the arm, where it disappears, having grown gradually shorter and smaller.

Color, in alcohol, dull olive for the disk; arms, light olive brown.

Three specimens, in 79 fathoms, off Alligator Reef; and two arms, in 40 and in 117 fathoms, off Carysfort Reef.

Ophiothamnus Lyman, gen. nov.*

Teeth: no tooth-papillæ: mouth-papillæ, of which the outer is much the broadest. Side mouth-shields long and stout, extending outside the mouth-shields, and making, with them, a conspicuous raised pentagon. Side arm-plates large, meeting above and below, and bearing slender, rough spines on their sides. Disk puffed, and overlying the bases of the arms, covered with scales and radial shields, which are beset with spines.

This genus, by its arm-plates and chewing apparatus, is allied to

* ὄφις, a snake; θάμνος, a thicket.

Amphiura; by its spinous disk and rough spines, to *Ophiacantha* and *Ophiomitra.*

Ophiothamnus vicarius* Lyman, sp. nov.

Special Marks. — Disk beset with numerous slender spines. Seven or eight arm-spines; the upper ones longest, and all slender and tapering. Seven mouth-papillæ.

Description of a Specimen. — Diameter of disk 3.5 mm. Length of arm 20 mm. Mouth-papillæ, seven to each angle, whereof the innermost one stands immediately below the teeth, and is just like them; of the three papillæ on each side, the two inner ones are together about as broad as the outer one. The seven make an even, crowded row, and are all stout. Teeth four, short, broad, flat, with the cutting edge slightly curved, the uppermost one thinnest. Mouth-shields small, .3 mm. long, pointed within, a little curved without, making a sort of heart-shape; they are closely wedged into the angle formed by the union of the side mouth-shields. Side mouth-shields large and strong, .5 mm. long, meeting within, and extending well outside the mouth-shield proper; they bear the outer wide mouth-papillæ, while the other mouth-papillæ are attached to the mouth-frames, except the central innermost one, which grows on the jaw itself. Under arm-plates wider without than within; outer side curved slightly, laterals encroached upon by the tentacle scales; inner side making a small peak or angle; length (4th joint), .3 mm. The first under arm-plate is oblong, and tightly pressed between the bases of the side mouth-shields. Side arm-plates large, and rather prominent, meeting above and below; their line of juncture below is about half as long as the under arm-plate. Upper arm-plates, .3 mm. long: outer side cleanly curved, and nearly as wide as the arm: within they are bounded by outer curves of the preceding side arm-plates, which give them the appearance of having a peak. Disk beset, above and below, with long slender spines, which are more numerous on the upper surface, where their length is .5 mm., while, in the lower interbrachial spaces, the longest are .3 mm. In a dry specimen, the somewhat coarse and irregular scaling of the disk is everywhere visible. Radial shields, roughly semicircular, so that together they make a round figure; their outline, however, is not regular, and they have a slight swelling at their outer point; they touch each other near the disk margin; but, within, are separated by one, and sometimes by two, large scales; on their edges they often have two or three spines. Arm-spines slender, rounded, gradually tapering, sharp, all similar in shape, upper ones longest; close to the disk they are much longer than just beyond; fourth joint, eight spines, whose lengths are, to that

* So called because it seems to replace the common *Ophiothrix* of the shallower water.

of the lower arm-plate, as 1.1, 1.1, 1.3, .9, .7, .6, .6, .5 : .3. Seventh joint, longest spines, .5 mm., and the rest are not much shorter. On the first two or three joints beyond the disk the two ranges of spines meet on the median line of the arm above. The second arm-joint has but three spines, and of these the lowest is, as an exception, longest, namely, .6 mm. Tentacle scales blunt, pear-seed shape, the apex outward; further out on the arm they grow more pointed; their length is about half that of the under arm-plate. The color, in alcohol, is pale brown for the disk, and light straw for the arms.

Variations. — The chewing apparatus shows few exceptions: sometimes, however, the central inner mouth-papilla is somewhat narrower than the teeth above it: very rarely one of the small, side mouth-papillæ is wanting. The number and lengths of the disk spines is not always the same; and especially are those near the margin sometimes shorter. In the larger specimens the second joint has four spines.

Among numerous specimens there was found one that had scarcely any spines on the disk, and those very short; while the radial shields were buried by the disk scales, except their outer ends. The arm-spines were essentially the same; on the fifth joint, lengths to that of the under arm-plate, 1., 1., .8, .8, .8, .6, .6, .5. : .3.

Numerous specimens, in 15 to 135 fathoms.

Ophiomyces Lyman, gen. nov.*

Teeth: no tooth-papillæ; numerous wide, flat mouth-papillæ, which are turned downwards and outwards, and arranged in two or more imbricated rows, covering the whole mouth-angle. Side mouth-shields large, and meeting above. Disk finely scaled, without visible radial shields. Arm-spines within the disk shorter, stouter, and of a different character from those of the joints further out.

This singular genus stands quite by itself, unless we compare its curious mouth-papillæ with the spatula-like tentacle scales of *Ophiopsila*. All the specimens I have seen had a tendency to raise the arms above the disk, vertically; which shows that the muscular tension must have some peculiar proportion.

Ophiomyces mirabilis Lyman.

Special Marks. — Six arm-spines, nearly equal; on the second joint a connected row of ten short, flat arm-spines, running across the under side of the arm, two of these spines being on the under arm-plate, and four on each side arm-plate.

Diameter of disk about 6 mm. Length of arm 17 mm. The inner mouth-papillæ are rounded, sharp, spiniform, and eight or ten in number;

* ὄφις, a snake; μύκης, a mushroom.

they form an irregular row about the inner mouth-angle, and usually are turned more or less downwards. The outer mouth-papillæ are all more or less widened and flattened; arranged rudely in four radiating rows, but so spreading and overlapping as to almost hide the whole outer part of the mouth-angle. There are five or six to each side (ten or twelve to each mouth-angle) all foliate in form (much like the woody fungus that grows from dead trees) the outer ones largest, and sometimes 1 mm. wide. Teeth five, flat, sharp, spear-head shaped. Mouth-shields very small, diamond shape, and almost totally hidden by the mass of papillæ and spines about them. Side mouth-shields large, meeting within, with a vacant space between their enclosed angle and the mouth-shield proper. They carry all the characteristic foliate mouth-papillæ, and are very much larger than the mouth-shield. The lower and inner point of the jaw, which in most Ophiurans is scarcely to be seen, is here quite large, and carries all, or nearly all, the spine-like mouth-papillæ. Under arm-plates much wider without than within; outer side curved, with a lateral projection from each corner, which joins the side arm-plate; laterals strongly re-enteringly curved, by the encroachment of the tentacle pores, which are very large; inner side making a sharp angle; length of plate (6th) to greatest breadth .5 : .5. Side arm-plates meeting above and below; above they cover almost the whole surface, the upper arm-plate being reduced to a minimum. Upper arm-plates with a curved outer side; the inner side with a rounded angle; they occupy only a small spot of about half the width of the arm, between the bases of the arm-spines. Disk uniformly covered with very fine, thin scales, about fifty to a square mm. Scattered over the upper surface are a very few short, delicate spines; in the lower interbrachial spaces, just outside the mouth-shield, a group of little flat papillæ. Arm-spines on joints beyond the disk six; the three upper ones slender, rounded, tapering; the three lower a little flattened and more blunt; upper spines longer; the longest (6th joint) .7 mm. Within the disk the spines have an entirely different form. Second joint with an unbroken row of ten equal, short, flat, scale-like papillæ, whereof two are on the under arm-plate, and four on each side arm-plate. Third and fourth joints the same, except that the papillæ get more rounded and longer, and that the fourth joint has only three on each side arm-plate. Tentacle scales of second joint two; of a shape similar to the outer mouth-papillæ, and lying on the side of the pore opposite the under arm-plate. All succeeding joints have but one scale, which lies on the inner angle of the under arm-plate. The two scale-like spines on the under arm-plate disappear beyond the sixth joint; they may, indeed, be considered *tentacle scales* just as properly as *arm-spines*. Some species of *Ophioglypha* give similar instances. The tentacle scales, except those of the second joint, are flat, oblong, and similar to the arm-spines which lie within the disk; far out on the arm they grow somewhat pointed.

Color, in alcohol, uniform pale gray.

The chief variations noticed were in the shape of the singular outer mouth-papillæ, which are sometimes more spreading in their form, or narrower. The number of these, as well as of the inner mouth-papillæ, varies by one or two, for each angle of the mouth.

Off Sand Key, Florida, in 237 to 306 fathoms.

The specimens, many of which had cast their disks, were singularly distorted, probably by the change of pressure from so considerable a depth. The arms were twisted upwards, so that they made a parallel bunch, in the midst of which was the disc, much elongated. By this torsion the mouth parts were all turned outwards, and almost inverted. This singular twisting is unusual.

The species may readily be distinguished from *O. frutectosus* by the fewer spines and their comparative equality.

Ophiomyces frutectosus Lyman.

Special Marks. — Twelve arm-spines, of which the uppermost is close to the median line of the arm. The five upper ones are short and sharp; the next three long, tapering, slender; the last four shorter, flattened, and equal.

Description of a Specimen. — Diameter of disk 7 mm. Length of arm about 28 mm. The inner mouth-papillæ are rounded, stout, spiniform, seven or eight in number; they form an irregular row about the inner mouth-angle, and are often turned more or less downward. The outer mouth-papillæ are flattened and broad; wider at their ends, which are cut square off, than at their bases; rudely arranged in four radiating rows, but inclining downwards and outwards, and so overlapping as to cover the outer part of the mouth-angle, like tiles; there are fourteen or sixteen to each mouth-angle; the longest are .7 mm., and are outside. Teeth four (rarely five), short, flat, stout, with a curved, cutting edge. Mouth-shields very small, diamond-shaped, and almost hidden by the numerous spines and papillæ about them. Side mouth-shields completely hidden by the outer mouth-papillæ. Under arm-plates nearly as wide within as without; their lateral sides with a strong re-entering curve from the encroachment of the large tentacle pores; length to breadth (6th) .6 : .5. Side arm-plates meeting above, but not below; near the base of the arm they barely meet above. Upper arm-plates very thin and delicate, except a median, thickened crest; their outer side strongly curved, their inner side with a slight peak; they occupy only about half the width of the arm; length to breadth .5 : 1.2. Disk covered with fine, slightly thickened scales; about

70 to a square mm. In the centre of the disk they are somewhat larger; and, in the interbrachial spaces below, much more minute; everywhere they are closely imbricated and somewhat irregular in size. The entire disk, above and below, is beset with a considerable number of very fine, sharp, slender spines; the longest about .8 mm.; just outside the mouth shields is a patch of stouter and blunter spines. Arm-spines, on the joints just outside the disc, twelve, arranged from the median line of the arm above to the tentacle pore below. The uppermost spines are very short and sharp, and project over the succeeding upper arm-plate. The sixth, seventh, and eighth spines long, slender and tapering; the four lowest spines not so long, but stouter, blunt, flattened, and smallest at the base. Lengths to that of the under arm-plate (6th joint) 3., .3, .4, .4, .5, 1., 1., .8, .6, .6, .6, 6, : .6. On the joints within the disk, the lower spines are wider, blunter and more flattened; while the upper ones are slender, but not so long as those on the joints beyond the edge of the disk. Third joint with twelve spines; the six lower ones are arranged on the side arm-plate, nearly at right angles with the length of the arm, but here the side arm-plate makes a sudden bend outwards and upwards, and this part bears six slender, sharp spines, of which the upper ones are somewhat the shortest; all these last are difficult of detection, wedged, as they are between the arm and the lower side of the disk. Tentacle scales two to each pore. On the first five or six joints the scales are shaped just like the peculiar outer mouth-papillæ, and are attached to the under arm-plate near the curved margin of the pore. On the joints beyond, the inner scale is pointed oval in shape, and attached to the side arm-plate next the lowest spine, while the outer scale is more elongated and is attached to the under arm-plate.* Close to the end of the arm the inner scale only remains, and gets somewhat more pointed. In alcohol, grayish straw color.

A single specimen off Sand Key, Florida, in 100 fathoms; others in 77 and 160 fathoms.

This species, when examined with a lens, presents a confused mass of thousands of spines and papillæ of all shapes and sizes; and it is only by patient study that all its parts can be properly referred. It is distinguished from *O. mirabilis* by its numerous arm-spines and by the different shape of the outer mouth-papillæ. It showed the same tendency to twist the arms upwards, above the disk.

By the kindness of Dr. Smitt and Mr. Ljungman, naturalists of the

* It will be noticed that the parts here called *outer tentacle scales* are, under *O. mirabilis*, Lym., termed *arm-spines*, because, in that species, they are continuous with the arm-spines and have the same shape. This is done to show that arm-spines and tentacle scales are homologous parts, and are differently named only to indicate their form or position.

Swedish frigate "Josephine," I was shown the Ophiuridæ dredged in 117 fathoms on the newly discovered Josephine Bank, southwest of Lisbon; and among them I recognized two fine specimens of *this very species!* We have, therefore, the same animal living on two sides of the Atlantic, and separated by nearly seventy degrees of longitude, but not yet discovered in the many deep dredgings made off the British and Scandinavian coasts.

Mr. Ljungman describes the color of the living creature as white underneath; yellow bars on the arms, two or four joints wide; a reddish spot at the insertion of each arm; a purple-gray, five-sided patch on the back of the disc. According to M. de Pourtales, the arms are white with an orange dorsal stripe; disk pink, with a greenish star; spines white, with orange specks at their bases.

ASTROPHYTIDÆ.

Ophiocreas Lyman, gen. nov.*

Disk and arms uniformly covered with soft skin bearing microscopic grains. Disk small; its interbrachial outlines re-enteringly curved; five pairs of narrow, rather high, radial ribs, running from the margin quite to the centre. Arms simple, very long and smooth; the joints indicated by very slight depressions. Small arm-spines standing just above the tentacles. Teeth: one or more tooth-papillæ; mouth-papillæ arranged in a clump on the side of the mouth-frame, and above its lower edge. Two genital slits, nearly as long as the disk is high.

This genus belongs to the Astrophytidæ, as the insertion of the arms in the disk, the character of the skin covering, and presence of radial ribs show; but in its chewing apparatus it presents more the characters of the Ophiuridæ. It stands near Astroschema, which, however, has no teeth.

Ophiocreas lumbricus Lyman, sp. nov.

Special Marks. — Radial ribs running quite to the centre of the disk. Two arm-spines, the lower longer. Arms gradually tapering, and nearly twenty times as long as the diameter of the disk. Skin beset with scattered microscopic thorny grains.

Description of a Specimen. — Diameter of disk 12 mm. Length of arm 230 mm. Height of arm near base 3 mm.; width of arm 2.5 mm. Mouth-papillæ nine or ten, forming a close, irregular clump of rounded grains on the side of the mouth-frame; none of them are as low as the under surface of the mouth, and are scarcely to be seen without forcing

* ὄφις, snake; κρέας, flesh.

it open. Teeth ten, very stout and uniform, except the lowest and uppermost, which are smaller; all are flat, a little longer than broad, with a curved outer edge, coming to a point on the median line, nearly of uniform thickness. Under the teeth are from one to three tooth-papillæ of irregular form. The joints of the arms are easily seen, even in alcoholic specimens, being marked by the interior bones, which are indicated through the skin. The arms themselves are high and arched; narrow below and divided into ridges by the bases of the spines; they are even and without depressions between the joints (except when the specimen is dried). The arms keep a uniform size for some time, and then taper very gradually. Arm-spines rounded, tapering, blunt, a little rough, but covered by the skin; there are two on nearly all the pores, but none on the first; one on the second and third, and two on the fourth, whereof the upper one is very small; lengths to that of the arm joint, 1.2, 2.2 : 1.5. At the tip of the arm both spines have three or four little hooks on their edge. Disk with five pairs of narrow, prominent, radial ribs, which diverge from the centre, where they meet, and run quite to edge, over the arms; the margins of the disk are re-enteringly curved, and its sides slope from the upper edge downwards towards the mouth region. The genital slits extend from near the upper edge of the disk to the mouth-ring below. Over the whole disk and arms are scattered microscopic thorny grains, which adhere lightly to a thin epidermal coat, which seems to carry the coloring matter. In alcohol the animal is of a dull flesh color, except the interbrachial spaces on the sides of the disk, which are purplish brown.

Variations. — A young one with a disk of 4.5 mm. had arms only one half as long as the specimen just described, to wit: 50 mm., from which it appears that the arms increase in a greater proportion than the disk. The teeth were only six; the grains of the skin were less thorny and more closely set than in the adult. Among many examined, the largest individual had the disk 17 mm. in diameter, and thirteen teeth, of which the two lowest were broken, so that each looked like two or three papillæ side by side; below these there was a small single papilla.

In 125 to 130 fathoms.

Astrophyton mucronatum Lyman, sp. nov.

Special Marks. — Radial ribs high, and beset with strong conical spines, a few of which are also found as far out as the third fork on the upper side of the arm. One madreporic body.

Description of a Specimen. — Diameter of disk 39 mm. Length of arm and distances of its forks from each other: —

1st	fork	to	2d	12	mm.
2d	"	"	3d	20	"
3d	"	"	4th	17	"
4th	"	"	5th	21	"
5th	"	"	6th	17	"
6th	"	"	7th	16	"
7th	"	"	8th	15	"
8th	"	"	9th	14	"
9th	"	"	10th	15	"
10th	"	"	11th	13	"
11th	"	"	12th	13	"
12th	"	"	13th	12	"
13th	"	"	14th	12	"
14th	"	"	15th	18	"
15th	"	"	16th	8	"
16th	"	"	17th	9	"
17th	"	"	18th	9	"
18th	"	"	end	16	"
	Total . . .			257	mm.

Teeth : tooth-papillæ and mouth-papillæ sharp, slender, spiniform ; those standing in the place of teeth are about nine, arranged partly in a single, partly in a double vertical row ; the longest 1.5 mm. Those near the outer corner of the mouth-slit are smaller, stouter proportionately, and irregularly crowded ; length not over .5 mm. One madreporic shield, like a small pimple, about 2 mm. long, placed in a depression near the inner angle of the interbrachial space. Top and sides of arms, down to the tentacle scales, covered with a smooth mosaic of flat, irregular, rounded grains. Lower surface of arm, between the tentacle pores, smooth. Skin of the lower surface of the disk studded with flat, smooth grains, somewhat rounded ; from six to nine to a square mm. but not confluent so as to form a mosaic. The space between the upper and lower surfaces of the disk is quite concave and very distinct, its skin being nearly naked and only covered by scattered microscopic grains. Whole upper surface of disk covered with a mosaic of grains like that of the arms ; in addition to which the high radial ribs and the round space enclosed by the inner ends of the ribs, bear stout, smooth, conical spines, the largest 1.5 mm. high ; of these there are ten or twelve to each rib, arranged in an irregular double row ; those in the centre of the disk are crowded and smaller ; the same spines form a row along the top of the arm, as far as the third fork ; they are smaller than those of the disk, and there is usually one to each joint. Toward the end of arm each joint is marked by an annular ridge, which consists of a double row of grains, each bearing a minute, usually simple, sickle-shaped hook; these correspond to arm-spines, but gradually disappear towards the base of the arm, where, however, the double rows of grains are still to be recognized. Tentacle spines short, small, tooth-like; on most of the pores two, but some within the disk have three. Genital slits large, 10 mm. long, and extending from the under to the upper skin of the disk.

Variations. — Another specimen of about the same size had some small spines in the interbrachial spaces of the upper disk, and from nine to fourteen spines on each radial rib. On the under surface of the disk the granulation of the skin near the mouth was prolonged into the under surface of the arms, between the tentacle pores.

Florida, in 120 and 125 fathoms.

Astrogomphus Lyman, gen. nov.*

Disk with ten low, very narrow radial ribs, running nearly to its centre, and beset with numerous spines. Arms simple. Skin of arms and disk covered by a mosaic of small flat grains; the joints of the former distinguished by ridges, each of which consists of belts of granules, some of them bearing minute hooks. Arm-spines like thorny stumps, and arranged in clumps just above the tentacle pores. Teeth: tooth-papillæ and mouth-papillæ all similar and spiniform. Two genital slits in each interbrachial space.

Astrogomphus belongs with the simple-armed Astrophytons. In the distinctness of its disk, and the character of the surface of its arms, it somewhat resembles *Trichaster*, while its dentition is rather like that of *Astroporpa*.

Astrogomphus vallatus Lyman.

Special Marks. — The whole upper disk beset with short, very stout spikes, arranged rudely in concentric rows; under surface paved with smooth, flat grains, except a fence of stout papillæ, which runs between the lower sides of the arms, where they join the disk.

Description of a Specimen. — Diameter of disk 17 mm. Length of arm 100 mm. Width of arm next the disk 3.5 mm.; height of arm 3 mm. Mouth-papillæ and tooth-papillæ similar to each other, short, sharp, stout; mouth-papillæ about ten on each side, arranged in two irregular rows, one above the other; tooth-papillæ about twelve, arranged in irregular pairs along the point of the jaw; the longest are .8 mm.; and both mouth and tooth papillæ are spiniform, sharp, rounded, and perfectly smooth. Arms high and rounded above, flattened below; they are divided by depressions

* ἀστήρ, star; γόμφος, spike.

into joints, except on the lower surface, which is smooth, and is uniformly paved with small flat grains, looking, under the lens, like a rough mosaic. Each of the raised joints is covered by a belt of four rows of grains running across the arm; the two middle rows have smaller grains, each of which bears a little saw, having four or five teeth, and at its end a strong hook; the two outer rows have larger grains, without any appendages. Each depression between the joints is paved with two or three cross-rows of more or less flattened grains, similar to the smooth grains of the raised joints. Towards the end of the arm the raised joints consist only of the double row of grains bearing the saw-hooks. Disk, above, covered with a mosaic of smooth, flat grains, from which rise a great number of short, blunt, tapering, very stout spikes, the longest .8 mm.; they are arranged in about seven, more or less distinct, concentric circles, growing confused at the centre of the disk, where there is a space about 3 mm. in diameter, from the periphery of which spring the ten radiating ribs, which are very narrow, though somewhat broader over the bases of the arms; over these ribs run the circles of spikes, giving them a rough, spinous appearance. The interbrachial spaces below have a strikingly smooth appearance, though really covered with minute, rounded, flattened grains of several sizes. Between the bases of the arms, below, and connecting the first groups of arm-spines, runs a little fence of three irregular rows of little, crowded spikes, more blunt and rounded than those of the upper disk. Just outside one of these fences lies the madreporic plate, which is small and elongated, and has about a dozen large pores in an irregular row. The disk about the mouth is quite flat and smooth, so that the animal, seen from below, is laid out in regular patterns; in the centre the stellate mouth rough with spines; outside this a five-sided smooth region, which is prolonged on each arm; outside this a five-sided fence of spikes, which separates the mouth region from the interbrachial spaces, and is prolonged by the bunches of arm-spines along the side of the lower surface of each arm; again outside is the smooth interbrachial space, where the genital slits run from the edge of the disk (marked by a margin of spikes) about two thirds of the way to the interbrachial fence of spikes. Arm-spines equal, rounded, a little bent, suddenly contracting at the end, where they bear a bunch of four or five thorns; they are arranged side by side, in close clumps, at the angle made by the under surface and side of the arm; length of the longest, 1.2 mm. The first tentacle pore has one little simple spine; the second has four thorny spines; the third, and several beyond, five; then the number is four; towards the end of the arm it diminishes to three, two, and one. Near the tip, where there are but two, these spines have hooks at their ends, and at the very end there is but one spine, which is like the saw-hook borne by the grains on the back of the arm. Color in alcohol, yellow gray, or straw color.

Variations. — A smaller specimen, with a disk of 10 mm., presented no important differences. The spikes on the ribs of the disk were proportionately larger; the concentric circles of spikes were ill marked; the arm-spines were more thorny.

In 94 to 119 fathoms.

As this number of the Bulletin was going to press I received from Dr. Lütken his Additamenta ad Historiam Ophiuridarum, Part III, 1869, in which he enters into a critical discussion of the relations of the genera of Ophiurans. The work is done with that ability and thoroughness which usually characterize the Scandinavian naturalists above all others of Europe. This is not, however, the place to give a review of the paper, and I shall merely notice a few points that particularly concern the Caribbean fauna.

Two interesting genera are added to those known, from the West Indies, — *Ophionema*, which stands in the Amphiura group next to *Ophiopeltis*, from which it differs by having no disk scales at all, and by having all the arm-spines of the same form; and *Ophionephthys*, which is in the same group, and characterized by a disk covered partly by naked skin, while there is a frame of scales round each pair of radial shields, and a line of them along the edge of the disk. The species are *Ophionema intricata* and *Ophionephthys limicola*. There is also an *Ophiacantha* (*O. pentacrinus*) which, as the description will show, is very near to, if not identical with, my *O. meridionalis*. In treating of *Ophiactis clavigera* Ljn., Dr. Lütken has run against the precise difficulty I have (see *Ophiactis humilis*); and the anomalous position of the species is shown by the fact that, while he places it with *Ophiacantha*, I incline to retain it with *Ophiactis*. The real trouble is, that so many new forms are constantly discovered, that the limits of the old genera are as constantly found to be defective, particularly when those limits are established on characteristics more or less partial. For example, take Dr. Lütken's description of *Ophiactis*: "Squamæ disci spinulis brevibus plus minus obsitæ. Brachia 5 – 6 satis brevia. Spinæ laterales 5 – 7, papilla ambulacris 1, orales 1 – 2." Now, then, what is to be done with *O. plana*, that has *no* disk spines? Or what should we do with a species that had *two* tentacle scales, or *four* arm-spines? Or what is the meaning of "satis brevia," as applied to the arms? I am free to acknowledge that my own genera *Ophiophragmus* and *Ophiocnida*, among the *Amphiuræ*, could be catechized in like manner; but I do not see that *Amphipholis* Ljn. is a better substitute.* In fact, Dr. Lütken, with his usual modest judgment, alludes to the transition state of his classification when he says: "Je ne doute nullement aussi que

* See remarks on the genus *Amphiura*, p. 335.

des découvertes ulterieures ne conduisent à un système encore plus naturel et plus satisfaisant."

' The *Ophiothrix violacea* of the Caribbean is said to be different from the similar form found on the coast of South Brazil. This is to be taken with great caution, considering that many Caribbean species go as far. Nevertheless, as pointed out in the Introduction to this Bulletin, there are *also* species apparently peculiar to the Brazil coast.

CAMBRIDGE, November, 1869.

No. 11. — *List of the Crinoids obtained on the Coasts of Florida and Cuba, by the United States Coast Survey Gulf Stream Expeditions, in* 1867, 1868, 1869. By L. F. de Pourtales, Assist. U. S. Coast Survey.

(Communicated by Professor B. Pierce, Sup't U. S. Coast Survey.)

Antedon Hagenii Pourt. (*Comatula Hagenii* Pourt., Bull. Mus. Comp. Zoöl. No. 6.) This species approaches nearer *A. rosacea* than any of the other species found in this region; it differs, however, in some important parts, such as the form of the centrodorsal plate, of the ovaries, of the joints of the cirrhi, &c. The arms are round, more flexible, and can be coiled entirely over the back.

Found from 94 to 195 fathoms.

Antedon meridionalis A. Ag. This species has long been known, from the coast of South Carolina, under the manuscript name of *Comatula Holmesi* Ag., but appears to have never been described. The above name was given to it by Mr. A. Agassiz in the "Sea-side Studies of Natural History."

Ten arms, centrodorsal plate flat, with about 15 cirrhi around its circumference. These are rather short, formed of 9 or 10 joints somewhat compressed laterally, the 3d, 4th, and 5th longest. The last joint with a strong claw, penultimate with an opposing point. Radials very short, the first almost concealed by the central plate. Axial radial also short and triangular. First brachials short and in contact with each other in a pair by nearly their whole side. First syzygium at the 3d brachial. Joints — of which there are generally four to a syzygium — very oblique, with raised and serrated edges. First pinnule rather long; the 5 or 6 first joints webbed by the perisom. The succeeding pinnules rather short, increasing again to the middle of the arm, formed of 15 or 16 joints, of which the 5 or 6 first ones are short triangular. Mouth eccentric, anus central; small calcareous concretions in the neighborhood of the mouth and brachial channels.

Color purple or yellow, or variegated of those two colors. Diameter, when fully expanded, 4 or 5 inches.

One specimen in 35 fathoms west of the Tortugas, and a large number off French Reef in 45 fathoms. It is also found off the coast of South Carolina, but the *Alectro dentata* Say, from the coast of New Jersey, appears to be a different species, — at least, as far as his description goes.

Antedon armata POURT. Ten arms; centrodorsal plate flat, rather large, bearing about fifteen cirrhi on its circumference. Cirrhi of about 20 joints, shorter than their diameter; all except the 3 or 4 first ones provided with a short spine on the concave side; last joint with a claw, and penultimate with an opposing spine. First radial protruding from the centrodorsal plate; second radial nearly as long as broad; radial axial pentagonal. First brachials nearly square, barely in contact by their lower corners; second brachial with a large socket for the first pinnule, which is twice as long and more than twice as thick as the second; of its 9 or 10 joints the 4th is remarkably long, forming about one fourth of the total length; the other pinnules are rather short, and are formed of the same number of cylindrical joints. Joints of the arms smooth, oblique, edges not prominent. Seven or eight joints form a syzygium.

One specimen only was dredged in 35 fathoms, west of the Tortugas. The spiny cirrhi make it resemble *Antedon* (*Comatula*) *Milberti* Müller, said to be from North America, but the other characters do not agree.

Antedon cubensis POURT. Ten arms; mouth central. Centrodorsal plate conical, covered with cirrhi nearly to the tip. Cirrhi very long and slender, of 28 cylindrical joints. First radial concealed by the centrodorsal plate, second very short; axial radial pentagonal or shield-shape. First brachials very short. Arm-joints with imbricated, serrated edges; five to seven forming a syzygium. First pinnule not much longer than the second, the others rather short and slender, consisting of about ten joints, and increasing in length towards the end of the arm.

Two specimens in 450 fathoms on the coast of Cuba. It resembles somewhat *A. Sarsii*, but differs from it by its flatter centrodorsal plate, and by an entirely different shape in the 1st and 2d brachials, particularly the second, which has not the projection into the first brachial, like *A. Sarsii*.

Antedon rubiginosa POURT. Ten arms; mouth central. Centrodorsal plate slightly convex, bearing 15 to 20 cirrhi in one or two rows around the circumference; each cirrhus of 10 nearly cylindrical joints, the 3d, 4th, and 5th longest, the penultimate with an opposing point. First and second radials visible, the latter about half as long as broad;

the axial pentagonal depressed in the middle into a shallow pit marked with a black spot. A similar pit on several of the brachials, which are long with imbricated and serrated edges. Buccal membrane filled with calcareous concretions. First pinnule much longer than the succeeding ones. All the pinnules are very slender, with fine spines on every joint, forming also a verticil at their distal end. The spines are directed forwards near the beginning of the pinnule, but gradually curve back, and the last joint terminates with several hooked claws; color rusty red, with a black dorsal stripe on every arm and black ambulacral furrow.

One small specimen was dredged in 9 fathoms off Orange Key, Bahama Bank, and several arms of a large specimen near the Tortugas in 17 fathoms.

Antedon brevipinna POURT. (*Comatula brevipinna* Pourt., Bull. Mus. Comp. Zoöl. No. 6.) Was not obtained again since the first specimen was dredged in 1867.

Still another species was noticed, but the specimen was too mutilated for description.

Pentacrinus Mülleri OERSTED. Joints of the stem of a *Pentacrinus* were dredged up off Havana in 270 fathoms, and again in 315 and 471 fathoms off Double-headed Shot Keys. No trace of it was found on the Florida side of the Gulf Stream.

A few of the joints, showing the mark of the attachment of cirrhi, and being double, show that they belong to this species, and not to *P. asteria* Linn., in which the cirrhiferous joints are single.

Rhizocrinus lofotensis SARS. (*Bourgueticrinus Hotessieri* d'Orb., Pourt. in Bull. Mus. Comp. Zoöl. No. 7.) This crinoid has been obtained again several times during the season's work of 1869; always in the foraminiferous bottom of the trough of the straits, in depths varying from 237 to 450 fathoms. An interesting addition to our knowledge of its geographical distribution is its occurrence on the "Josephine Bank," a new discovery of the Swedish Frigate Josephine between the coast of Portugal and the Azores.

During the stay of that ship in Boston Harbor, Dr. Smitt had the kindness to show me his dredging collections, among which I saw this species, also *Echinocucumis typica*, *Pteraster militaris*, and perhaps a few others, representatives of the Gulf Stream deep-sea fauna, which we know to occur also on the coast of Norway.

CAMBRIDGE, November, 1869.

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	
Antedon Hagenii Pourt.						94	—	—	—	—	-195										
meridionalis A. Ag.			35-	-45																	
armata Pourt.				35																	
cubensis Pourt.																					450
rubiginosa Pourt.		9-	—17																		
Pentacrinus Mülleri Oerst															270-	—	—	—	—	—	-471
Rhizocrinus lofotensis Sars														237-	—	—	—	—	—	—	-450

Note. — The depths at the head of the columns are in fathoms. The horizontal lines show the range of the species in depth.

No. 12. — *List of Holothuridæ from the Deep-Sea Dredgings of the United States Coast Survey.* By L. F. de Pourtales, Assist. U. S. Coast Survey.

(Communicated by Professor B. Peirce, Sup't U. S. Coast Survey.)

The Holothurians obtained in deep water off the Florida reef are few in number, and are very closely allied to, if not identical with, those of the deep-sea fauna of Norway.

The littoral species so abundant on the reef, and in the shallow waters encompassed by it, do not appear to extend into even moderate depths outside, — at least, they were never found in the dredge.

Cuvieria operculata Pourt. (*C. squamata* Koren? Bull. Mus. Comp. Zoöl. No. 7.)

A satisfactory comparison of the two species could not be made from want of well-determined specimens of the northern species. From *C. Fabricii* it is easily distinguished by the suckers on the ventral disk, which in *C. operculata* are always in a single row on the circumference of the soft disk, and a single row in the marginal plates, whilst in *C. Fabricii* they form a dense band of three or four rows. Two rather mutilated specimens, without names, in the Museum of Comparative Zoölogy, received from Professor Sars, and which are probably *C. squamata*, have the suckers disposed as in *C. operculata*. The granulation of the scales in the latter is finer than in the two northern species.

It is not very rare in 120 to 135 fathoms.

Thyonidium conchilegum Pourt. Ibid. = *Th. pellucidum* Vahl.?

Thyonidium gemmatum Pourt. One young specimen off Tortugas, in sixteen fathoms.

Echinocucumis typica Sars. In 320 to 350 fathoms.

Cucumaria frondosa Gunner. A rather small specimen of Holothurian, dredged in 118 fathoms, cannot be distinguished from this species by any satisfactory characters. The skin contains only a few calcareous needles and no plates. Its color was milk-white with yellow spots.

Molpadia borealis Sars. The differences between my only specimen and Sars's description and figures consist in the smaller number of calcareous granules and in the calcareous plates being somewhat more symmetrical in shape. I do not think the differences sufficient to establish a new species.

In my specimen the buccal disk is expanded as in Sars's figure, but no tentacles are visible. In the places they ought to occupy fifteen small holes can be counted. Sars never saw any tentacles, although he kept some specimens alive, dredged in 351 fathoms.

Why Selenka should have made out this species to be the same as my *Molpadia oolitica* I cannot well understand. My original specimens were in his hands, and I have re-examined them lately. The calcareous granules of *M. borealis* are small and irregular, in *M. oolitica* they are larger, always oval, and formed of concentric layers. The former has retiform calcareous plates, the latter none. The former has no visible tentacles, the latter has always distinct simple digitiform tentacles, even in mutilated specimens. One of the specimens sent from the Cambridge Museum to Mr. Selenka had received by some accident the label of "Cape Palmas?" and on this one he has based his new genus *Embolus*. I am perfectly satisfied that the *Embolus pauper* Sel. is the same thing as *Molpadia oolitica*. The figures he gives of the œsophagial ring of *Molpadia oolitica* and of a calcareous grain of *Embolus pauper* are both taken from specimens of *M. oolitica*. The absence of œsophagial ring in the specimen he examined is accidental, as is also the absence of the tail-like prolongation of the anal extremity of the body.

Cambridge, November, 1869.

	Lit.	10	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360
Cuvieria operculata POURT.								—	—135											
Thyonidium conchilegum POURT.							—	—125												
gemmatum POURT.		16																		
Echinocucumis typica SARS																		—	—	—350
Cucumaria frondosa GUNNER								118												
Molpadia borealis SARS.																				351

NOTE. — The depths at the head of the columns are in fathoms. The horizontal lines show the range of the species in depth.

No. 13. — *Report upon Deep-Sea Dredgings in the Gulf Stream, during the Third Cruise of the U. S. Steamer Bibb, addressed to* PROFESSOR BENJAMIN PEIRCE, *Superintendent U. S. Coast Survey*, by LOUIS AGASSIZ.

(COMMUNICATED BY PROFESSOR PEIRCE.)

THE survey of the Gulf Stream, including soundings and dredgings in deep waters, had been going on for two years under your direction, when I was invited by you to join a third cruise. The surveying party this year, as before, was accommodated on board the United States Coast Survey steamer Bibb, master commanding Robert Platt, who had charge of the hydrographic survey, while Assistant L. F. Pourtales, who had hitherto superintended the dredging operations, still continued to direct the same work. The object of my own connection with the present cruise was to ascertain how far the last investigations covered the ground to be surveyed, and to what extent and in what direction further researches of the kind were desirable in the same region, and likely to furnish important information. The work of M. Pourtales had been so eminently successful, the results obtained in this short time so unexpected and of such high scientific value, that little more than a repetition, or perhaps, in some respects, a modification of his results could be expected from my participation in this year's operations. It is a pleasure for me to state that our cruise — extending farther to the east in the Gulf Stream, between Cuba and the Bahamas on one side and Florida on the other, than those of previous years — confirmed in every feature the conclusions already reached by M. Pourtales. His results may therefore be considered as settled facts, deserving the fullest confidence of the scientific world, and requiring only, in order to obtain the appreciation they deserve, that kind of publicity which illustrated descriptions and maps can give them. When thus made known, it will be seen that we owe to the Coast Survey the first broad and comprehensive basis for an exploration of the sea-bottom on a large scale, opening a new era in zoölogical and geological research. I speak thus emphatically, because the data hitherto obtained concerning the animals of the deep sea have been rather isolated, and not methodically connected with one another, and with a study of the inhabitants of shallower waters, and the immediate seashore; nor have the previous collections been made over extensive areas, and so combined that every newly surveyed point was determined with reference to earlier investigations, as was the case with the dredgings of the last two years. In your recent surveys of the Gulf, the dredging operations have been pursued over an area so large as to preclude the possibility of any accidental and ill-considered conclusions. I should not speak in such terms of investigations in which I have had a share, had not the main results been secured by M. Pourtales before I joined the cruise.

There can be no doubt now that the area occupied by the reef which rises to the surface of the ocean has a peculiar, independent fauna, totally distinct from that of deeper waters. To this area belong those species of corals known as the true builders of coral-reefs, and to which, in a previous report to your predecessor, I gave, on that account, the name of reef-builders. The range of this fauna in depth is very limited; it does not extend below ten fathoms, and is mainly occupied by corals acquiring in their aggregate communities very large dimensions, such as *Madrepora palmata, cervicornis,* and *prolifera, Porites astræoides, Oculina diffusa, Eusmilia fastigiata, Astræa annularis* and *cavernosa, Isophyllia dipsacea, Manicina areolata, Colpophyllia gyrosa, Meandrina mammosa,* and other species of the genus, *Diploria cerebriformis, Siderastræa radians* and *siderea, Agaricia agaricites, Mycedium elephantotus, Millepora alcicornis,* the coarser and larger kinds of *Gorgonia,* and a host of animals of all classes living in and upon the reef, among which *Rhipidigorgia flabellum, Diadema antillarum,* and *Strombus gigas* are the most conspicuous. From this region (the only one of the kind which has been carefully surveyed by naturalists) I formerly secured those large and beautiful collections of corals which now adorn the Museum of Comparative Zoölogy.

Beyond this area, the width of which varies along the coast of Florida from a few miles, in the neighborhood of Cape Florida, to twelve, fifteen, or twenty miles and more off Cape Sable, we find another zone, rather sterile, or at all events not marked by that richness of animal and vegetable life which characterizes the reef range. The bottom of this second zone is a muddy mass of dead and broken shells, broken corals, and coarse coral-sand; it is chiefly inhabited by worms, and such shells as by their nature seek soil of this character, with a few small species of living corals, some Halcyonarians, and a good many Algæ. From the nature of the bottom of this zone, especially at a depth of from twenty to forty fathoms, it is evident that a large number of dead Mollusks and Zoöphytes are scattered over its surface by the agency of the currents and tides, after they have been broken up.

I do not now enumerate the particular animals and plants found in this and the other submarine regions herein described, because the work of identification is as yet very incomplete; moreover, some of the most common and characteristic species are as yet neither described nor named, and would therefore be necessarily omitted in any list of the characteristic species of the Gulf Stream fauna. Indeed, for the present, such a list could only be an enumeration of species with which naturalists have become acquainted from specimens cast ashore, and would give no idea of the actual living faunæ in their natural habitat. On that account it is particularly desirable that the scientific harvest of these surveys should speedily be made known, accompanied by the fullest illustrations.*

A third region or zone, beginning at a depth of about fifty or sixty fathoms and extending to a depth of from two hundred to two hundred and fifty fathoms, constitutes a broad slanting table-land, beyond which the sea-bottom sinks abruptly into deeper waters. The floor of this zone is rocky; it is, in fact, a limestone conglomerate, a kind of lumachelle, composed entirely of the solid remains of organized beings, a true concretionary limestone, such as we might find in several levels of the Jurassic formation, and more especially in that horizon which geologists call "Coral Rag." We have here a plateau extending for more than a hundred miles, beginning off the Marquesas and stretching to Cape Florida, corresponding to Coral Rag. It varies from eight to ten, twelve, or twenty miles in width, — the greatest spread facing Sombrero, — and is built up entirely of animals now living upon its surface, and constantly increasing the thickness of the bed

* The corals found in the two earlier cruises are described by M. Pourtales, in Numbers 6 and 7 of the Bulletin, pp. 103–141. A preliminary report on the Echinoderms is printed in Number 9 of the Bulletin, pp. 253–361. As I have not enumerated the species therein described, it may not be out of place here to remark, that, though I have made some additions since, this report was prepared before Numbers 9, 10, 11, and 12 of the Bulletin had been handed in. The remarks upon the growth of corals were written immediately after my return from Florida, in May last.

by their accumulation. Large fragments of this rock were brought up by the dredge; so that its structure and characteristic remains of animals could be studied at leisure. I do not know that there is on record in the annals of our science a more direct illustration of the manner in which mountain masses of calcareous deposits have been accumulated on the bottom of the ocean. The animals inhabiting this plateau are innumerable, and as varied as those found along the shores most fertile in animal productions. A great variety of corals occur there, all of small size, and, strange to say, belonging to genera never known before from our sea-shores. Their aggregate affinity is indeed not with the living corals, but rather with the types of the tertiary and cretaceous periods. Echinoderms are equally numerous; they are also small as compared to those found nearer shore, and likewise recall, by their zoölogical affinities, the types characteristic of the cretaceous period. Salenoid and Discoidea-like forms, never known among living Echinoderms before, have been discovered on this plateau. Among mollusks I may mention one species, — the *Voluta Junonia*, hitherto considered the rarest shell from the southern coasts of the United States, and known only from a very few worn specimens. Of that species, which is particularly interesting on account of its close affinity with *Voluta Lamberti* of the Crag, and with *Voluta mutabilis* of the Miocene beds of Virginia and Maryland, quite a number of living specimens, young and old, have been brought up by the dredge. Two species of Brachiopods, — *Terebratula cubensis* Pourt. and *Waldheimia floridana* Pourt. — are extremely common, and contribute greatly to give this fauna an antique character. Most of the other mollusks have not yet been identified. Worms and crustacea abound also, and a few fishes unknown to me have also been obtained. All these are still undetermined.

The extraordinary richness, profusion, and variety of animal life displayed upon this table-land amazed me, not only on account of the peculiarity of the types, but from the vast number of individuals found together. The dredge coming up from such a depth, laden and crowded with all sorts of living creatures, as if it had been dragged in shoaler waters, was indeed a rare and startling sight for a naturalist. Such a result is the more unexpected, on account of the current impression, fostered by Edward Forbes's and Captain McAndrew's extensive dredging operations in the Ægean Sea, that as we descend below the surface of the ocean animal life gradually and steadily diminishes, till in deep waters it entirely fades away. As we have already seen, this is not the case, and Captain McAndrew has himself lately helped to dispel the illusion. Nevertheless, it is true that a change is perceptible in the character and size of animals inhabiting respectively deeper and deeper waters, as compared with those of the shallow coast zone. It may very justly be said that we have in the sea something corresponding to the alpine and subalpine flora, when contrasting higher levels with the plains; only that our submarine deep-water flora, or rather fauna, consists mostly of creatures hitherto little known, or even entirely unknown.

It is a surprising fact that the variety of marine plants does not keep pace with the variety of animals; they make a poor show when compared with the many and diversified sea-weeds found in the littoral mud-flats and upon shoal rocky bottoms. The sponges, however, thrive in deep waters better than the ordinary algæ; but the large and valuable sponges now gathered in such quantity along the whole coast of Florida are found on the littoral shoals only. In deep water we find, with a variety of larger species, a great number of small species of the same type, and among them a diminutive *Hyalonema.*

Permit me a suggestion here. You have repeatedly commemorated the discovery, by officers of the Coast Survey, of some submarine ledge or ridge, or peculiar configuration of the sea-bottom, by associating their names with the field of their operations. It would be appropriate and just that this extensive coral plateau, the characteristic fauna of which M. Pourtales has so faithfully explored, should bear his name and be called the "Pourtales Plateau."

To the seaward of this coral table-land, the bottom sinks rapidly to a depth of four or five hundred fathoms, reaching even eight hundred fathoms and more, though our successive dredgings have hardly extended beyond seven hundred fathoms. Over the whole of this area, which properly constitutes the lower floor of the Gulf Stream, the sea-bottom presents a uniform accumulation of thick, adhesive mud,* in which animal life is much less profuse than upon the coral plateau. It cannot, however, be assumed that this diminution of life is owing

* When dried, this deep-sea mud, with its innumerable and characteristic Foraminifera, remarkably resembles the chalk-marls of the cretaceous formation. The greensand formation I have not investigated myself, but it has been minutely studied by Mr. Pourtales, who has ascertained that it is the result of a peculiar alteration, disintegration, and final aggregation of Foraminifera.

to the depth and consequent pressure of the water, or to the absence of light, but rather to the nature of the soil; for we find in it many animals to which such a habitat is congenial, — a variety of worms, for instance, and such shells as seek muddy bottoms. I have not the least doubt that a rocky foundation at eight hundred or even a thousand and more fathoms would yield a large harvest of animals; unquestionably fewer than are found in shallower waters, but yet as varied and as numerous comparatively as are the Alpine plants on the very limits of perpetual snow, wherever, in various latitudes, that vegetation can be compared with the flora of lower levels. If we have not succeeded in finding such a fauna in the deepest waters of the Gulf Stream, I hold that the cause lies chiefly in the absence of rocky bottoms in the deepest parts of the basin through which the great current of our southern coast flows. The character of the mud in the channel of the Gulf Stream does not warrant the supposition that the mud deposits derived from the turbid waters of the Amazons and Orinoco have extended as far north as the Gulf of Mexico, even though the great equatorial current sweeps past the mouths of these rivers.

There is one subject of scientific research, the connection of which with deep-sea soundings cannot fail to lead to unexpected results. When attempting to explain the structure of the stratified rocks, and many other phenomena connected with the general appearance of the earth's surface, geologists have not hesitated to ascribe, in a general way, the facts under observation to the agency of water; but they have rarely entered into such specific details as would establish a causal connection between all these facts, and the cause appealed to. In proportion as the sea-bottom becomes more extensively known, and the character of the materials lying beneath the water and their mode of arrangement are ascertained with greater precision, more accurate comparisons, in consequence of which current views may have to undergo considerable modifications, will certainly be made between geological formations of past ages, including all their deposits of various kinds, and the materials at present scattered in special ways over the ocean floor.

From what I have seen of the deep-sea bottom, I am already led to infer that among the rocks forming the bulk of the stratified crust of our globe, from the oldest to the youngest formation, there are probably none which have been formed in very deep waters. If this be so, we shall have to admit that the areas now respectively occupied by our continents, as circumscribed by the two hundred fathom curve or thereabout, and the oceans, at greater depth, have from the beginning retained their relative outline and position; the continents having at all times been areas of gradual upheaval with comparatively slight oscillations of rise and subsidence, and the oceans at all times areas of gradual depression with equally slight oscillations. Now that the geological constitution of our continent is satisfactorily known over the greatest part of its extent, it seems to me to afford the strongest evidence that this has been the case; while there is no support whatever for the assumption that any part of it has sunk again to any very great depth after its rise above the surface of the ocean. The fact that upon the American continent, east of the Rocky Mountains, the geological formations crop out, in their regular succession, from the oldest azoic and primordial deposits to the cretaceous formation, without the slightest indication of a great subsequent subsidence, seems to me the most complete and direct demonstration of my proposition. Of the western part of the continent I am not prepared to speak with the same confidence. Moreover, the position of the cretaceous and tertiary formations, along the low grounds east of the Alleghany range, is another indication of the permanence of the ocean trough, on the margin of which these more recent beds have been formed. I am well aware that in a comparatively recent period portions of Canada and the United States, which now stand six or seven hundred feet above the level of the sea, have been under water; but this has not changed the configuration of the continent, if we admit that the latter is in reality circumscribed by the two hundred fathom curve of depth.

Geologists have appealed very freely to oceanic currents as accounting for the presence of loose materials upon the surface of the earth. But now that the actual mode of distribution of such loose materials, under the action of extensive and powerful currents, begins to be known, those who explain the facts in this way are bound to show that their arrangement actually agrees with the effects of oceanic currents. I must confess that I have looked in vain, in the trough of the Gulf Stream, for traces of the characteristic mud which pours from the mouth of the Amazons in quantities sufficient to discolor the waters of the ocean for a great distance from shore; and yet the equatorial current of the Atlantic is one of the greatest and most powerful of all known currents.

Another side of this subject is also immediately connected with deep-sea soundings. Geologists, and especially those of the school of Lyell, have again and again assumed the slow rising of extensive tracts of land from beneath the water, and taken all sorts of loose materials irregularly scattered over the surface of the land as evidence of its former submersion. But since the dredge has been applied to the exploration of the deep, and a great variety of animals, in a profusion rivalling that of shoal waters, have been brought up, not only from the immediate vicinity of the land, but at various distances, in increasing depth, from one to two and even many hundred fathoms, no observer is justified in considering extensive deposits of loose materials as marine in which no trace of marine organic remains are found. The very mud and sand of the deep teem with innumerable microscopic living beings, the solid parts of which are easily detected in the smallest samples of marine deposits, and may therefore afford a satisfactory test where larger animals or plants are wanting. Now, after surveying the whole width of our Western prairies, without finding anywhere a sign of marine animals or plants, I cannot see that there is any evidence of their marine origin, or of the influence of oceanic currents in accumulating or distributing the loose materials scattered over those vast plains. On the other hand, I have ascertained that the foundation rock, upon which these materials rest, is everywhere polished, grooved, and scratched in the same characteristic manner as the well-known glaciated surfaces, wherever exposed. I have seen such polished rocks in the valley of the River Platte, not far from Omaha, and am now satisfied that the whole extent of the country, between the Alleghanies and the Rocky Mountains, was one unbroken glacier bottom. The scratched pebbles found among the loose materials of the great prairies confirm this view. For similar reasons, I am satisfied that the valley of the Amazons has not been under the level of the ocean since the tertiary period.

The most perplexing feature disclosed to me by our deep-sea dredgings and by my observations of the sea-shores along the Gulf Stream, on the Florida and on the Cuba side, is the irregularity of the stratification of the Spanish banks as compared with the deposits on the American side.

Taken as a whole, the trough of the Gulf Stream, between Cuba and Florida, as well as farther east and north, presents features in its configuration widely different from the relief of any equally extensive area of the dry surface of our continents. The floor of this basin is gradually and slowly shelving from the Florida coast to greater and greater depth, while on the Cuban side it is rapidly rising again. The slope is, indeed, so rapid on the Spanish shore that, at a distance of less than two miles from the abrupt shore bluffs, the depth of the trough is generally from 3,000 to 4,000 feet, and here and there reaches 5,000 feet at a slightly greater distance. We have thus here a slope as steep as that of the steepest mountain ranges of that height, and even steeper; and, what is most surprising, the great inclination of this floor is not the result of uplifted and slanting beds of rock, but unmistakably the effect of the abrading action of the great current upon older coral formations, judging from the aspect of the shore bluffs, and their evident continuity with the general slope from the water-edge down to the greatest depth reached with the plumb-line and the dredge. This difference in the inclination of the slopes on the American and on the Cuban sides of the basin obtains for more than one hundred miles, — from the Tortugas to Cape Florida, — with the peculiarity only that in the direction of Salt Key Bank there rises, on the Cuban side, a low ridge from the deeper part of the trough, trending nearly parallel with the coast. Another remarkable feature of the edge of the great Florida reef consists in its having a less abrupt slope to the seaward than is ascribed to all the coral reefs of the Pacific Ocean. Nevertheless, the seaward slope of the reef is really steeper than the shoreward slope; and this is, it appears, an essential element in the growth and rise of all the coral reefs.

But while the great coral reef of Florida presents this exceptional character, the Bahamas and the reefs to the northeast of Cuba exhibit very abrupt slopes, and a great depth is reached close to the shores of these Banks; so that the Bahamas resemble the coral-reefs of the Pacific much more than the reefs of the coast of Florida.

The whole group of banks and keys embraced between Double-headed Shot Key, Salt Key, and Anguilla Key is a very instructive combination of the phenomena of building and destruction. The whole group is a flat bank covered by four or five and occasionally six fathoms of water, with fine sandy bottom; evidently corals reduced to oölithes of various sizes, from fine powder to coarse sand, mingled with broken shells, among which a few living specimens are occasionally found. The margin of the bank is encircled on several points by rocky ridges of the most diversified appearance, and at others edged by sand-dunes. A close examination and comparison of the different keys show that these different formations are in fact linked together, and represent various stages of the accumulation, consolidation, and cementation of the same materials. On the flat top of the bank the loose materials are pounded down to fine sand; in course of time this sand is thrown up upon the shoalest portions of the bank, and it is curious to notice that these shoalest parts are its very edge, along which corals have formed reefs which have become the basis of the dry banks. The foundation rock, as far as tide, wind, and wave may carry the coarser materials, consists of a conglomeration of coarser oölithes, rounded fragments of corals, or broken shells, and even larger pieces of a variety of corals and conchs, all the species being those now found living upon the bank, among which *Strombus gigas* is the most common; beside that, *Astræa annularis*, *Siderastræa siderea*, and *Meandrina mammosa* prevail. The shells of Strombus are so common that they give great solidity and hardness to the rock. The stratification is somewhat irregular, the beds slanting towards the sea at an angle of about seven degrees. Upon this foundation rock immense masses of Strombus, dead shells, and corals have been thrown in banks, evidently the beginning of deposits similar to those already consolidated below; but there is this difference in their formation, namely, that while the foundation rock is slightly inclined, and never rises above the level of high water, the accumulation of loose materials above water-level forms steeper banks, varying from fifteen to twenty and thirty degrees. In some localities broken shells prevail; in other, coarse and fine sand; and the ridges thus formed, evidently by the action of high waves, rise to about twelve and fifteen feet. This is evidently the foundation for the accumulation of finer sand driven by the wind over these ridges and forming high sand-dunes, held together by a variety of plants, among which a trailing vine (*Batatas littoralis*), various grasses, and shrubs are the most conspicuous. These dunes rise to about twenty feet; on their lea side and almost to their summit grows a little palmetto. The sand of the dunes is still loose, but here and there shows a tendency to incrustation at the surface. The slope of these dunes is rather steep, sometimes over thirty degrees, and steeper to the seaward than on the landward side.

In the interior of Salt Key there is a pool of intensely salt water, the tint of which is pinkish or flesh-colored, owing to the accumulation of a little Alga. When agitated by the wind, this pool is hedged all round by foam of the purest white, arising from the frothing of the viscous water. Along the edge the accumulation of this microscopic plant forms large cakes, not unlike decaying meat, and of a very offensive odor. The foundation rock of this key is exactly like what Gressly described as the "facies corallien" of the Jurassic formation; while the deposit in deep water, consisting chiefly of muddy lime particles, answers to his "facies vaseux."

Double-headed Shot Key is a long, crescent-shaped ridge of rounded knolls, not unlike "roches moutonnées," at intervals interrupted by breaks, so that the whole looks like a dismantled wall, broken down here and there to the water's edge. The whole ridge is composed of the finest oölithes, pretty regularly stratified, but here and there like torrential deposits; the stratification is more distinctly visible where the rocks have been weathered at the surface into those rugged and furrowed slopes familiarly known as "karren" in Switzerland. It is plain that we have here the same formation as on Salt Key, only older, with more thoroughly cemented materials. The uniformity of the minute oölithes leaves no doubt that the sand must have been blown up by the wind and accumulated in the form of high dunes before it became consolidated. The general aspect of Double-headed Shot Key is very different from that of Salt Key. The whole surface is barren, — not a tree, hardly a shrub, and the scantiest creeping vegetation. The rock is very hard, ringing under the hammer, and reminds one of the bald summits of the Jura, such as Tête de Rang, near La-Chaux-de-Fond. It is evident that what is beginning on Salt Key has here been not only completed, but is undergoing extensive disintegration in Double-headed Shot Key, both by the action of atmospheric agents over the surface and by the action of tides and winds against the base of the key.

Among these older oölithic deposits, forming the main range of Orange Key and of Double-headed Shot Key, we recognize formations of more recent date, occupying the cavities of ancient pot-holes, which have gradually been filled with materials identical with those of the older deposits. The pot-holes themselves show nothing very peculiar;

there are many such upon these keys, — some large ones many yards in diameter and others quite small, — evidently formed by the wearing action of loose pieces of harder coral rocks thrown upon the key by great waves, and only occasionally set in motion by the waters dashing over the key during heavy storms. The pot-holes nearest the water-edge are the most recent, and are mostly clean excavations, either entirely empty or containing sand and limestone pebbles lying loose at the bottom of the holes. Some of these excavations are circular, others oblong, still others have the form of winding caves opening towards the sea or upon the surface of the key. Beyond the reach of ordinary tides and of the waves raised by moderate winds, the pot-holes are generally lined with coatings of solid, compact, and hard limestone, varying from a thin layer to a deposit of several inches in thickness, and following all the sinuosities of the cavities in which they are accumulating. It is plain from their structure that these coatings are a subaerial formation, increasing by the successive accumulation of limestone particles left upon the older rock by the evaporation of water thrown upon the key when the ocean is so violently agitated as to dash over the whole key. Frequently the hollow of these coated pot-holes is further filled with consolidated oölithes; or thin layers of minute oölithes alternate with a coat of compact limestone, throughout the excavation, which often has been filled again in this way up to the general level of the surrounding surface. Occasionally these regenerated surfaces are again hollowed out by the action of storms, and the result is a dismantled pot-hole, in which their structure and the mode of their filling is distinctly exhibited.

The stratification of the main mass of these keys is very peculiar. Though evidently the result of an accumulation of oölithes thrown up by high waves, the beds are pretty regular in themselves, but slant in every direction towards the sea, showing that they were deposited under the action of winds blowing at different times from every quarter. It is further noteworthy, that, while the thicker layers consist of oölithes readily distinguishable to the naked eye, there are at intervals thin layers of very hard, compact limestone, alternating with the oölithic strata, which have no doubt been formed in the same manner as the coating of the pot-holes.

As in their general aspect the coral formations of the Cuban side of the Gulf Stream differ from those of the American side, so do also the rocks of the latter differ from the rocks observed upon the banks of Salt Key, Double-headed Shot Key, and Orange Key. We find upon the Florida reefs, as well as between the innumerable keys stretching along the American coast, and upon the coral plateau sloping towards the main trough of the Gulf Stream, extensive beds of regularly stratified rocks of various kinds. I have already described the limestone conglomerate of the Pourtales plateau, p. 365. Such a formation exists nowhere else within the range of the Gulf Stream, unless it should be hereafter ascertained that a similar deposit extends along the submarine border of our continent, edging the American wall of the deeper part of the Atlantic trough. But in the shoal waters intervening between the coast of the peninsula of Florida and the keys and reefs there exist various deposits of an entirely different structure, the accumulation and increase of which is constantly going on. The most extensive of these formations is a regularly stratified oölithic rock, the grains of which vary from imperceptible granules to larger and larger oölithes, approaching the dimensions of pisolithes, and cemented together by an amorphous mass of limestone mud. The oölithes themselves are formed in the manner first described by Leopold von Buch. Hard particles of the most heterogeneous materials, reduced to the smallest dimensions, and tossed to and fro in water charged with lime, are gradually coated with a thin film of limestone, and then another and another, until it sinks to the bottom, to be further rolled up and down the sloping shore bottom until it becomes cemented with other similar grains, and forms part of the growing limestone bed. Of course the finer oölithes are seen nearest the shore line, and it is instructive to see at low tide the little ripples of successive larger oölithes left dry as the water subsides. Naturally these materials are frequently thrown up along the beaches in layers of varying thickness, and in course of time become cemented, and are transformed into solid rock, over which crusts of hard, compact limestone are in the end formed by the evaporation of calcareous water dashed upon the dry surfaces.

In very shallow waters, which are not powerfully affected by tidal movements, and upon the bottom of which no oölithes are forming, we find extensive beds of a dull amorphous limestone, formed of lime-mud, alternating with seams of a more compact, hard limestone, in which a few oölithes may occasionally be seen that were floated over the flats in which such formations are going on. These deposits resemble the marly limestone of the Oxford beds. Of course these different rocks may alternate with one another, as, owing to the increase of the whole formation, the conditions for the deposition of one kind of rock may be followed by those favoring another combination. Again, in consequence of the changes in the direction of the currents, or as the result of a heavy gale, considerable deposits which have been going on regularly for a long time may suddenly be worn away and destroyed, giving rise in turn to the formation of conglomerates made up of limestone fragments of various structure, united together into very peculiar conglomeratic pudding-stone with angular materials. The compact limestones are frequently as hard as the hardest limestones of the secondary formation, have a conchoidal fracture like the most compact Muschelkalk of the Triasic period, and may ring under the hammer.

Most of the keys consist of broken corals thrown up by the waves, including fragments of shells, sea-urchins, and occasionally bones of sea-turtles and fishes. At the Dry Tortugas and at the Marquesas, however, some of the keys are entirely made up of the decomposed fragments of corallines cemented together. The crescent-shaped joints of a large species of Opuntia are most prominent among them.

Nowhere, within the range of the Gulf Stream and its borders, have I seen a rock which could be supposed to have been formed by the materials accumulating in the greater depth of its trough, such as I have described above, p. 367. And no rock in the whole Jurassic formation could have been formed out of the kind of materials which are found in the deeper parts of the Atlantic basin, along the American shores; I therefore do not believe that any of the rocks of the Jura and the Suabian Alp have been deposited in very deep waters.

The extensive area occupied by the keys and reefs of Florida, including the sloping coral plateau of the American side of the Gulf Stream bottom, may fairly be compared to the Jurassic formation, as it stretches across Central Europe and farther east in the direction of the Caucasus and Himalaya Mountains. Indeed, the Jurassic formation, as a whole, bears the same relation to the older deposits upon which it rests, as the modern American coral formation sustains to the older parts of the coast of our continent. During the geological middle ages, the Jurassic formation was the submarine margin of a growing continent, as the Pourtales plateau forms at present the southern margin of North America.

These facts have an immediate bearing upon the question of the origin of submarine basins as compared with the inequalities of the mainland. The configuration and relief of our continents, as far as they are not the result of later denudations, have been determined by uplifts and the gradual rise of the land above the level of the sea, and hence have arisen the fractured ridges of mountain ranges, with their upright crests; while the areas of the great oceanic basins are surfaces of depression or subsidence, upon which prominent inequalities would of necessity be wanting, from the very fact that the breaks, where any occurred, must be turned downward. If this view is correct, it naturally follows that the main outlines and circumscription of the continents and of the oceans must have been determined at the very beginning of the formation of inequalities upon the earth's surface, and remained essentially the same through all geological ages, varying only as to their relative height and depth, as well as to their respective extension.

Such considerations enable us now to raise the question of the age of the Gulf Stream. Our present knowledge of the atmospheric and oceanic currents justifies the assumption that, — owing to the rotation of the earth upon its axis, and taking for granted that the latter has never changed its poles, — the great equatorial currents, fostered by the trade-winds, must flow in an east-westerly direction and be fed by northerly and southerly polar currents slanting westwards towards the equator. As long as the chain of the Andes did not intercept the Atlantic equatorial current, it must have been continuous with the great Pacific current; and, as stated by A. Agassiz, in another report, p. 305, there is palæontological evidence that during the cretaceous period the through channel was still open. I may add that I have myself seen the evidence, along the base of the Rocky Mountains, and on the western borders of the Amazonian Valley, of the post-cretaceous elevation of the great mountain range which rises like a huge barrier on the western side of the North and South American Continents, dividing the Pacific water-shed from that which feeds the Atlantic. We are thus justified in assuming that, even during the cretaceous period, there existed a great North Atlantic current, flowing from the northeast in a southwest direction, and that the Gulf Stream has assumed its present course in the opposite direction since that period; that is, since the Rocky Mountains and Andes have joined hands across Central America. This result adds greatly to the interest excited by the cretaceous and tertiary character of some of the animals discovered by M. Pourtales in the deeper parts of the Gulf Stream. The true significance of this fact is, however, too foreign to this report to justify a discussion of its bearing upon the question of the origin of the present faunæ.

It would be of the highest importance to ascertain, by actual observation, the whole extent of the range of the deep-sea fauna recently discovered in the Gulf Stream, between the coasts of Florida and Cuba. To secure this information a great amount of dredging must be done from the eastern shores of the United States to the deepest waters of the Atlantic Ocean, all along the coast from Florida to our Northern States. Until such a comprehensive survey has been carried out, we can only combine, as well as we may, the scanty data on hand, in our attempt to form any idea of the northerly extension of the animals now known to exist in that part of the Gulf Stream flowing between Florida, Cuba, and the Bahamas. Happily the English and the Scandinavian naturalists have already collected a vast amount of information concerning the marine faunæ of the coasts of Norway and the British Islands, and the recent expeditions undertaken by the Swedish and by the English governments, with a view of exploring the greatest depths of the Atlantic Ocean, cannot fail to afford the most valuable means of comparison between the faunæ of the two sides of the Atlantic in different latitudes. From the reports of the British Association for Advancement of Science, from the publications of Professor Sars, from the reports of Professors Carpenter, Thompson, and Jeffreys, and from the private communications received from Dr. Smitt and Mr. Ljungman, the naturalists of the Swedish man-of-war Josephine, which recently visited the harbor of Boston, we have been able to ascertain that some of the species of our deep-sea animals of Florida are found far to the north of the British Islands, on the western coast of Norway, and near the Azores, upon the newly discovered "Josephine Bank." Now all these stations lie in the course of the Gulf Stream, as it divides into a northern or Scandinavian and a southern or Lusitanic branch, after crossing obliquely the Atlantic Ocean from our own shores, in the direction of Ireland; and the question naturally arises, Is not this wide distribution of the Florida deep-sea fauna to be directly ascribed to the agency of the Gulf Stream? It can hardly be otherwise, at least within certain limits. But at the same time we must not forget that, in a comparatively recent period, the main motion of the North Atlantic must have been in a north-southerly direction, and that to this day there is a great northern current of cold water sweeping past the eastern shores of the United States; while the southern branch of the Gulf Stream flows in a southerly direction, past the western shores of Southern Europe; so that we may expect a strange mixture of arctic and subtropical animals in the great unexplored depths of the Atlantic, between America and Europe. It is to be hoped that the zeal with which the exploration of the deep ocean has begun may not flag before the whole problem is solved.

One of the most important results of this year's cruise, though not exclusively derived from deep-sea soundings, deserves a special mention in this Report.

Taught by former investigations, upon other classes of animals, that in their affinities and relative standing organized beings exhibit direct relations not only to the changes they undergo while growing, but also to their succession in past ages, and to their present distribution upon the surface of the earth, I lost no opportunity of ascertaining to what extent these relations may also be traceable among the corals. From their simpler organization, and the less prominent differences which distinguish their numerous representatives, it seemed hardly probable that facts could be ascertained plainly bearing upon these questions; and yet, the moment I proceeded with the investigation, I perceived that there was before me a vast field, thus far entirely unexplored, from the survey of which much valuable information could be secured.

A fortunate circumstance unexpectedly favored my researches. In consequence of injuries to a breakwater adjoining Fort Taylor, a large number of granite blocks, which had been three years under water, were hauled up on shore, and I found them covered with a great number of specimens of different species of corals, in various stages of growth. The surfaces of the granite were still so clean that it was possible to detect the smallest young corals upon them, and to trace so many stages between them and larger ones as to leave no doubt of their specific identity. I made, with the assistance of M. Pourtales, a large collection of these young corals, which I afterwards leisurely compared with one another and with adult stocks of the same species. The result of this comparison I may express in few words: Corals undergo a succession of changes peculiarly their own, and yet hardly less marked than the embryonic changes already known among many animals. If we combine into a series all the changes thus far observed among different families of corals, an unmistakable gradation appears among them, akin to the series which may be traced among other animals in their adult condition, when we take the complication of their structure as a standard of their arrangement. Combining the evidence obtained from adult coral stocks, and their young at various stages of growth, it becomes evident that the representatives of the class of Polyps do not stand upon the same structural level with one another; but that there are higher and lower types among them, recognizable without the aid of embryological data, even though it was the study of the young which led me to the recognition of their relative standing. This is not the place for a discussion of the principles of classification of Polyps. I will only state, what I trust I shall be able to prove hereafter, that the Actinians proper stand lowest; next to them the Madreporarians, and highest the Halcyonarians. And as the Madreporarians form the most prominent feature in the coral reefs, I may add that among them the Turbinolians stand lowest, the Fungians next, then the Astræans, and highest the Madreporians. Now it is a most interesting fact that the successive changes which any representative of these different groups exhibit during their growth recall the characteristic features of the groups immediately below. For instance, young Astræans, before assuming their solid frame, are Actinia-like; their first coral frame is Turbinolia-like; and from that stage they pass into Fungia-like condition, before they assume their characteristic Astræan features.

I will only describe a few cases, in order to establish this correspondence of growth and relative standing of adults upon a firm scientific basis. Besides multiplying through eggs, Actiniæ increase also by budding, and this takes place by a spreading of their base of attachment (abactinal area), from the margin of which new individuals arise and finally detach themselves. Such a mode of enlargement or spreading of a simple individual, by a widening of its base of attachment, I have observed in many genera among Fungians, Astræans, Oculines, and Madrepores. If we take, for instance, a *Siderastræa*, which, by the way, is a Fungian, and not an Astræan, as is shown by the structure of its tentacles, as well as of its coral stock, we find that the large rounded masses formed by these corals are at first thin, spreading disks, which only increase in thickness at a later time. The genus *Mycedium*, which, even in its perfect condition, constitutes a thin, spreading blade, may be compared, making allowance for the generic differences, to a young spreading stock of *Siderastræa.* In Mycedium the mode of growth is very plain. A series of specimens collected by M. Pourtales shows the beginning of such a coral community to be a single individual, the margin of which gradually spreads; from this spreading edge are developed additional individuals in the trend of the radiating partitions of the parent individual, spreading in their turn, while they remain connected with one another and with the central individual; this process going on until the coral stock has assumed its ordinary dimensions. Let us now conceive that the individual Polpys, united as a coral-stock in *Mycedium*, should increase vertically, as well as spread and multiply horizontally, the process of elevation beginning in the centre, we should have a *Siderastræa.* It is worth noticing, further, that the original central individual, from which the Mycedium community arises, is a diminutive Fungia, up to the time when new individuals arise around its margin. I have before me such young Mycediums, which might be mistaken for small specimens of Fungiæ, such as have been figured by Stuchbury and Milne Edwards. We are therefore justified in considering the genus *Fungia* as an embryonic form of the type of Fungians, when we compare it to *Mycedium*, *Agaricia*, or *Siderastræa;* and the propriety of assigning to Fungia proper a lower position in a natural system than that belonging to the compound types of the family must be obvious to all. The genus *Zoopilus* is only a Mycedium in which the individuals of the community are more intimately blended together than in *Halomitra*, thus forming a transition to Fungia proper. I have had an opportunity of examining also the growth of *Agaricia.* With the exception of generic differences in its structure, it exhibits in its growth the same features as Mycedium. The very youngest Mycediums exhibit Turbinolian affinities, inasmuch as the interseptal chambers are open from top to bottom and exhibit neither traverses nor synapticules.

Among Astræans the early growth of a community takes place in the same manner as among Fungians. Naturalists are accustomed to consider the formation of the hemispheric masses of these corals as arising from the formation of vertical buds around and between those which preceded. This mode of enlargement of the communities obtains really in later periods of their growth; but it is not in that way that the foundation of the community is laid. *Astræa annularis*, the most common species among the Madreporarians of Florida, exhibits the formation of these stocks very plainly. The vast number of young stocks of this species which I have collected in every stage of growth leaves no doubt upon the subject. A simple individual Polyp spreads by the elongation of its radiating partition, Mycedium-like, in every direction, giving rise at appropriate distances to new centres or individuals around the first; and this goes on, without a marked vertical enlargement of the new individuals, until the community has acquired a diameter of several inches; just as in the cases of *Mycedium*, *Agaricia*, and *Siderastræa.* The appearance of this spreading margin of the young Astræa stock is so like that of a spreading Fungian, that, if detached from the well-defined circular individuals occupying the centre of the disk, it would unhesitatingly be taken for a fragment of a Fungian. It is only at a later time that in *Astræa annularis* the members of the community are developed in a vertical direction, and the community as a whole is enlarged by the interpolation of new individuals, to assume the form of a hemispheric mass. I have observed the same mode of growth in *Astræa cavernosa*, in *Manicinia*, in *Symphyllia*, in *Favia*, in *Colpophyllia* and in *Meandrina.* Of *Manicina* I possess a series of young still exhibiting their Turbinolian characteristics, with interseptal chambers open from top to bottom, and without a trace of traverses. The corals with undulating and meandering trenches arise also, like compound Fungians and compound circular Astræans, from single individuals, with circular outlines spreading from the margin, after the fashion of Fungians, just as much as Astræa proper. The peculiarities exhibited by each type cannot well be described without figures; I shall therefore not attempt here a detailed report of all the facts I have observed, reserving a fuller statement for a special memoir. But *Meandrina* exhibits some features so particularly interesting that I cannot pass on without giving some more special account of them. When the young spreading Meandrina has acquired the dimensions of about half an inch, still plainly exhibiting Fungian characteristics, its marginal extension gives rise to the formation of isolated clusters of rising radiating partitions, which stand distinct from one another, just like the characteristic hills of a *Hydnophora;* in fact, the young Meandrina passes from a Fungian into an Hydnophora state, and in its farther extension, which takes place when the community has about two inches in diameter, when the trenches and walls begin to curve, while the margin is still spreading horizontally, the young Meandrina assumes the appearance of an *Aspidiscus*, a genus of the cretaceous period; in truth, it then resembles Aspidiscus and Hydnophora more than any adult representative of its own genus. We have here the highest complication of the Astræoid type, exhibiting successively Fungian characters, common Astræa characters, Hydnophora characters and Aspidiscus peculiarities, before it assumes its own prominent and permanent features. The Turbinolian stage I have had no opportunity of observing in Meandrina. This genus seems to grow more rapidly than other Astræans, and it was with difficulty I secured the earlier Astræan and Fungian stages of its growth.

Zoölogists are so accustomed to consider the *Oculinidæ* and *Madreporaidæ* as branching corals, that they may be surprised at the announcement that these families, like the Astræans, have their spreading Fungian-like stage of growth, — and yet I have before me a complete series of Oculina stocks, among which small clusters of individuals in simple juxtaposition exhibit the earliest condition thus far observed; others consist of flat spreading disks, several inches in diameter, without a vertical branch; while in others the branches seem to rise as small knobs and then begin to assume the ramified forms under which the Oculinas are generally represented in our museums. Even our most branching Madrepores, such as *Madrepora prolifera* and *cervicornis*, form spreading disks before they rise into branching stocks. *Madrepora palmata* is, as it were, an overgrown embryonic condition of the ramified species.

This summary of the facts concerning the growth of our coral-stocks can leave no doubt respecting the correspondence of the phases of growth of the Polyps and the gradation which may be recognized in full-grown communities of these animals. If we extend these comparisons to the representation of the class in earlier geological periods, down to the present time, we cannot fail to perceive that the series exhibiting their succession in time coincides also with that of their relative standing and that of their growth. In order to make this plain it would be necessary to enter into a discussion upon the real affinities of corals, for which this is not the place. I would state, however, that the knowledge I have acquired of the Fungian affinities of Siderastræa leaves no doubt in my mind that a large number of corals, among the representatives of the Oölithic series generally referred to the family of Astræans, are genuine Fungians; thus showing a preponderance of the Fungian type at a period anterior to that in which the Astræans became more numerous. That the genuine Madreporians are of still later date in geological history has long been known. I would state also that from an examination of the soft parts of several representatives of the family of *Eupsammidæ*, I have satisfied myself that they are not allied to the true Madrepores, as Milne Edwards and Haime supposed, but belong in the neighborhood of the Turbinolians. If we now remember that the Acalephian affinities of the *Tabulata* are unquestionable, and that, with them, the *Rugosa* must be removed from the class of Polyps and referred to that of the Acalephs; and if we further take into consideration the fact that *Palæodiscus* belongs to the type of Rugosa, and not to the family of Fungians, it becomes evident that in their order of succession from the Mesozoic era, in which they make their first appearance, the great types of the class of Polyps have succeeded one another in the following order: first Turbinolians, next Fungians, next Astræans, and last Madrepores; in exactly the sequence in which these types stand to one another, as far as their structural gradation is concerned, and in exactly the same order in which, during their growth, these corals pass from one stage to another.

If we now turn our attention to the distribution of these animals in the ocean at different depths, it is equally unquestionable that the lowest types — Turbinolians and Eupsammidæ — range in the greatest depths, and form there the principal feature of the coral population. It is equally apparent, from the facts ascertained by the dredgings of M. Pourtales, that the various types of Astræans, including Stylaster, Oculina, and Parasmilia, appear next, the Stylasterians and Oculinians as the lowest ranging deepest, and that Astræa proper, Manicina, Meandrina, and Colpophylia, with Porites, are already types of shallower waters, while the Madrepores are, of all the genuine corals, those which have the most limited bathymetric range. I have not yet sufficient data upon the relative standing of the different types of Halcyonaria to extend this comparison to that order of Polyps. The results enumerated above are, however, already sufficient to show that, in the relations animals exhibit among themselves and to the elements in which they live, there are other connections to be traced besides those arising from descent or the struggle for existence.

I have reasons for supposing that the investigation of the Gulf Stream, as presented in former Reports of the Coast Survey, has not yet reached its easternmost boundary. It was natural that the earlier explorations should have stopped where the great current no longer exhibits its characteristic peculiarities, and that its eastern range should have been traced with less minuteness than its alternate streaks of warm and cold water nearer shore. But now that the influence of the Gulf Stream upon the geographical distribution of organized beings appears distinctly as one of its most characteristic, though least suspected features, it will be necessary to extend the survey farther out into the Atlantic Ocean.

For the present I would suggest the following lines for soundings and dredgings: —

1°. One line from the Atlantic coast in Georgia or South Carolina to deep water, outside the range of the Gulf Stream, chiefly with a view of tracing the northern limits of the fauna of Florida.

2°. One line from the Atlantic coast in North Carolina or Virginia to the Bermudas and beyond; with the special view of connecting the deep-water fauna of the Gulf Stream with the shore fauna of these islands and that of our own coast, upon which Cape Hatteras marks the limits between two natural zoölogical littoral provinces.

3°. One line from Cape Cod or from the coast of Maine, in a south-east direction, across the Gulf Stream, with the special view of ascertaining the boundaries between the shore fauna and that of the Gulf Stream at this latitude. This line would afford the means of extensive comparisons with our Acadian fauna, which has already been carefully explored as far as Grand Manan by Dr. Stimpson, Prof. Verrill, and myself. Shorter lines from Sandy Hook to the trough of the Gulf Stream would add much value to the results obtained by dredgings from the coast of Massachusetts or Maine across the Gulf Stream.

I would also recommend one line across the Caribbean Sea, from Cumana or LaGuayra to Porto Rico, and one outside of the Small Antilles from the mouth of the Orinoco to Antigua; with the special view of ascertaining the area over which the mud deposits of the Orinoco spread, and how far they affect the Caribbean Sea.

But the most important line beyond our immediate shores, connected with the past history of the Gulf Stream, would be one from Panama westward into the deepest waters of the Pacific; for dredgings in that direction may prove that the deep-sea fauna is identical on both sides of the Isthmus, and that therefore, at a comparatively recent epoch, the great equatorial current of the Atlantic extended without serious obstructions over parts of Central America to the Pacific Ocean.

CAMBRIDGE, November 16, 1869.

BULLETIN

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT

HARVARD COLLEGE, IN CAMBRIDGE.

VOL. II.

Nos. 1–5.

CAMBRIDGE, MASS., U. S. A.
1870–1871.

University Press: Welch, Bigelow, & Co.,
Cambridge.

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[The figures are all one third natural size, when not otherwise stated.]

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" 2. Posterior view of the same skull.
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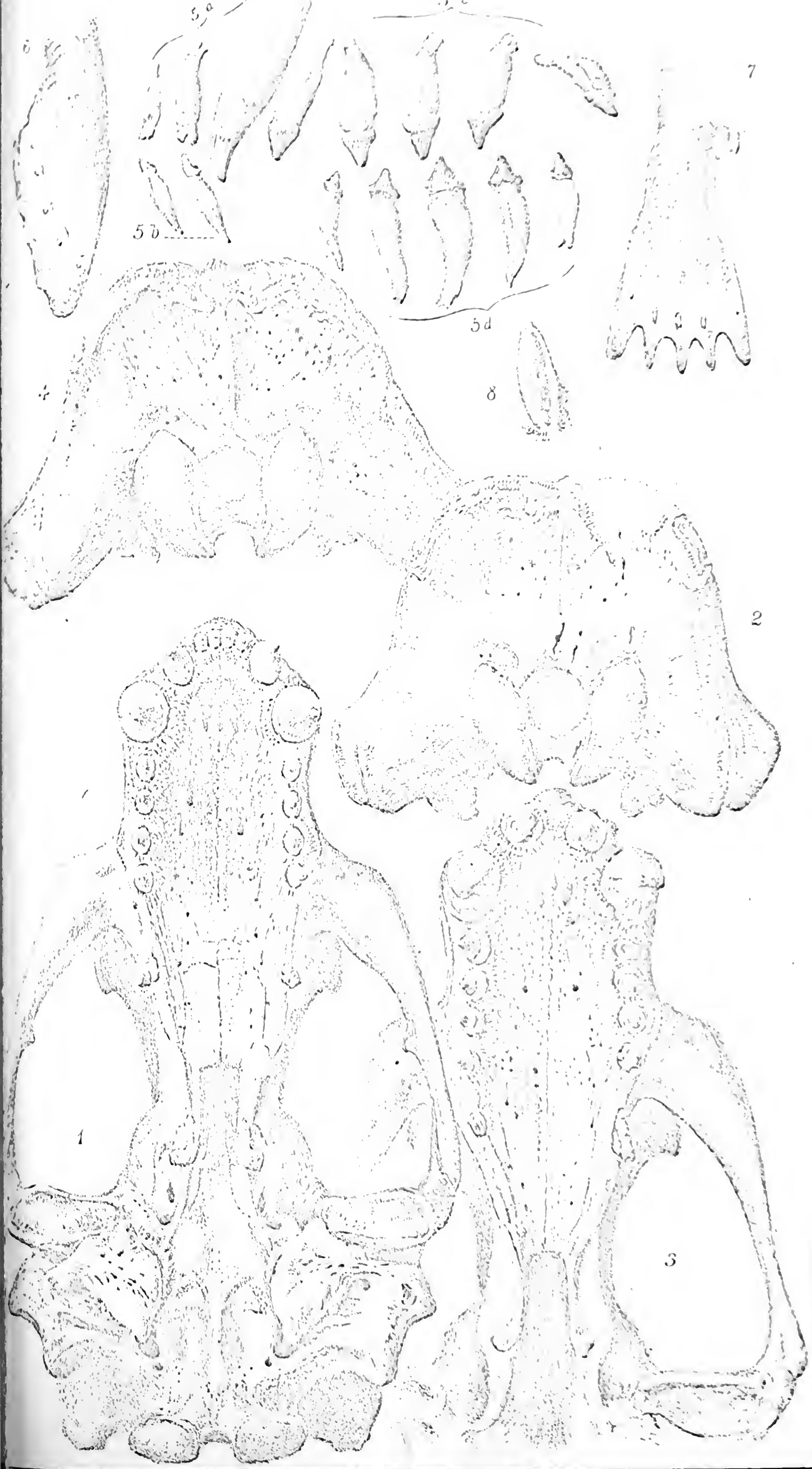

5 a
6
7
5 b
5 d
4
8
2
1
3

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Callorhinus ursinus *Gray*.

[The figures are all one third natural size, when not otherwise stated.]

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P. Roetter, on stone from nature.

New Eng. Lith. Co.

Plate III.

Callorhinus ursinus *Gray.*

[The figures are all one third natural size, when not otherwise stated.]

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Eumetopias Stelleri *Peters.*

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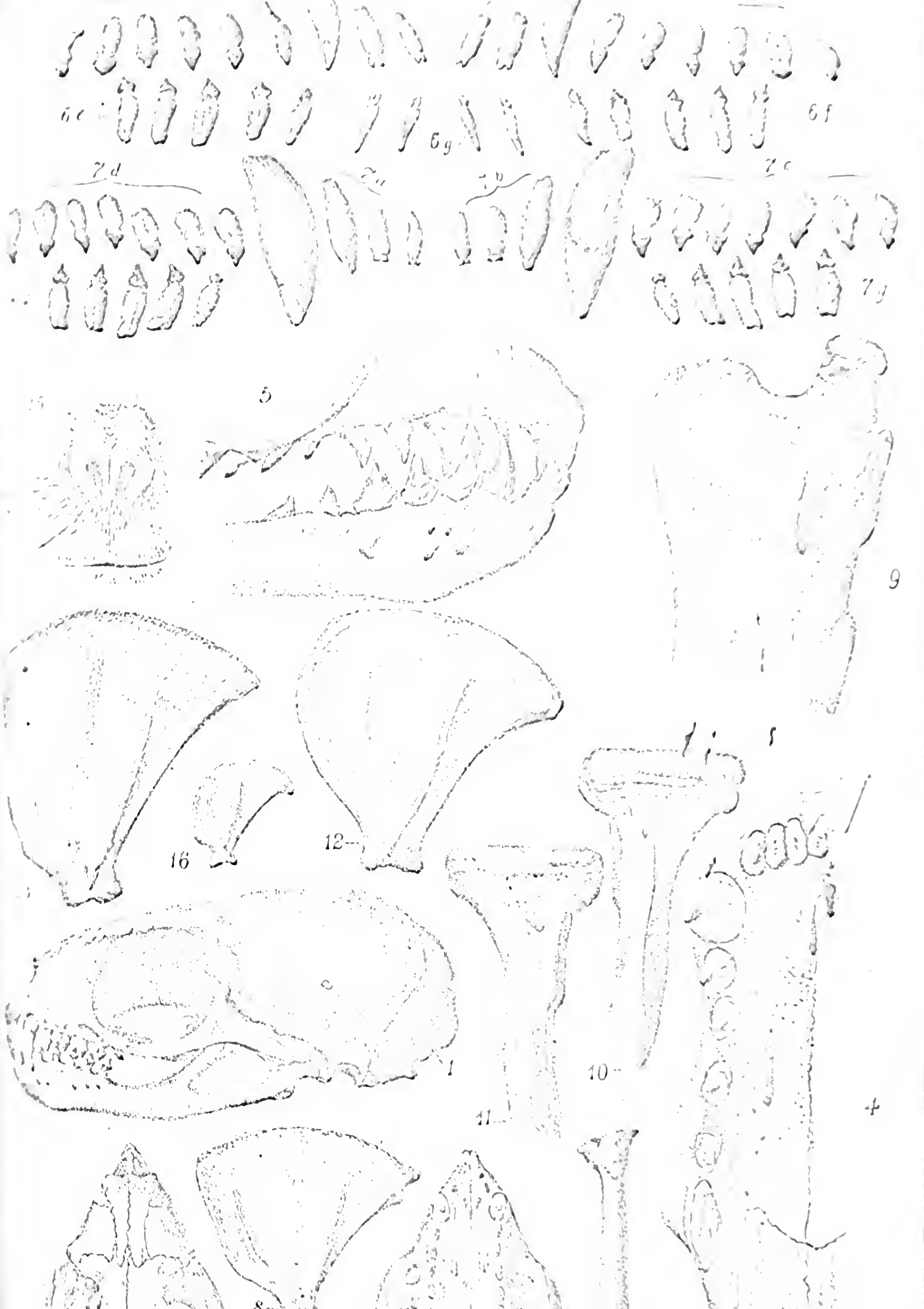


...ller on stone from nature. New Eng Lith. Co. Boston

No. 1.— *On the Eared Seals* (OTARIADÆ), *with detailed Descriptions of the North Pacific Species*, by J. A. ALLEN. *Together with an Account of the Habits of the Northern Fur Seal* (CALLORHINUS URSINUS), by CHARLES BRYANT.

I.

INTRODUCTION.

THE specimens on which the present essay is mainly based were collected by Captain Charles Bryant, at St. Paul's Island, one of the Pribyloff Group, situated near the coast of Alaska, and by him kindly presented to the Museum of Comparative Zoölogy. They consist of two perfect skins and two complete ligamentary skeletons of the *Eumetopias Stelleri* Peters, and six perfect skins, four complete ligamentary skeletons and two partial skeletons of *Callorhinus ursinus* Gray. The skins were sent preserved in salt, and arrived in excellent condition. The specimens of *Callorhinus ursinus* represent both sexes of this species and the young, both in skins and skeletons; while the notes kindly furnished by Captain Bryant give a minute account of its habits. A summer's residence at the Pribyloff Islands, as government supervisor of the seal fisheries, has given Captain Bryant an opportunity of becoming thoroughly familiar with the habits of these interesting animals, and the description he has given of them shows that he made a good use of his opportunites. His notes, given in full, form part second of the present paper. In addition to the specimens collected by Captain Bryant, I am indebted to the Smithsonian Institution and the Chicago Academy of Sciences for the opportunity of examining skulls of *Zalophus Gillespii* and *Otaria jubata*. I have also in this connection to make acknowledgments to Dr. Theodore Gill of Washington for various suggestions and other acts of kindness.

The only previous account of the Northern fur seal which has any great importance is that given by Steller, nearly a century and a quarter ago, and the observations of Krasheninikoff, published a few years later in his History of Kamtchatka. Krasheninikoff's account, however, was doubtless wholly or mainly derived from Steller's notes. The remarkable accuracy of Steller's account, considering the time when it

was written, is fully confirmed by Captain Bryant, who seems to have been the first naturalist who has had an opportunity of verifying Steller's observations. The history of this species is now far more fully known than that of any of its congeners, and better in fact than the majority of our best known mammals. A remarkable similarity of habits, however, so far as known, seems to pervade the whole group of eared seals, — a similarity which in many respects extends also to the walrus and the sea elephant (*Macrorhinus elephantinus*). As matter of collateral interest, for comparison with the account given by Captain Bryant of the species so fully described by him, the principal notices of the habits of the other species of the family have been cited as foot-notes to Captain Bryant's article, and occasional abstracts are given of those most pertinent to the subject.

Through the important labors of Messrs. Gray, Gill, and Peters our knowledge of the *Otariadæ* has recently been greatly increased; yet not a single species of the family has been hitherto very satisfactorily known. Regarding the able essays of these gentlemen published in 1866 as representing the state of our knowledge of these animals five years since, their somewhat discrepant opinions respecting the number of known species, their distinctive characters, and their mutual affinities sufficiently indicate how imperfectly they were then known. A comparatively large number of specimens of the *Otaria jubata* has since been received at different scientific museums, which, with the facts obtained from persons who have recently been able to observe this species in its natural haunts, have served to render it, up to the present writing, the best known of any of the family. The number of specimens formerly possessed by naturalists having been very small, and the sex, age, and habitat of the individuals they represented being generally but vaguely known, the unusually great differences resulting from individual variation, as well as from sex and age, which recent developments prove to exist in these animals, remained for a long time unsuspected, and are even now, it would seem, not fully appreciated by the few naturalists who alone have given them special attention. Hence there has arisen in many cases an almost unparalleled complication of synonomy and an unusually large number of nominal species.*

* The synonomy of *Otaria jubata*, for example, embraces no less than fifteen distinct specific names.

The collection of skins and skeletons above mentioned of two of the North Pacific species which has recently been received at the Museum of Comparative Zoölogy throws much light not only upon these species but also upon several of the others. The investigation of this material has led the writer to an examination of the whole group, the results of which are herewith presented.

Dr. J. E. Gray and others have recently made known the fact that great differences in the form of the skull in *Otaria jubata* result from differences in age. Also the existence of remarkably great sexual difference in size has been long established; whilst Professor Peters, of Berlin, has recently pointed out extraordinary variations in the dentition of *Zalophus Gillespii*. The specimens of *Callorhinus ursinus* and *Eumetopias Stelleri* in the Museum of Comparative Zoölogy show that greater and more radical differences even in the osteological characters than those previously known are to be expected in all the species. The two adult male skulls of the *Eumetopias Stelleri*, for instance, differ from each other so much in form that, if their habitat was not precisely known and the evidence of their co-specific relationship unquestionable, one might well be excused for regarding them as belonging to distinct species; and the same is true of the two adult male skulls of *Callorhinus ursinus*. These specimens also show that some of the characters that have been relied on most frequently as affording generic distinctions, — as the form of the palatal surface of the intermaxillaries and of the hinder edge of the palatal bones, — vary so much, not only with age, but in specimens of the same age, that no given form of these parts can be regarded as affording even reliable *specific* characters. The great degree of asymmetry, especially in the skull, seen in these animals is sufficient to indicate clearly that an unusually great tendency to individual variation in these animals is to be naturally expected. Professor Peters has already referred to the presence of a supernumerary molar in one side of the upper jaw in two skulls of eared seals in the Leyden Museum, and another instance of the same abnormality is exhibited by one of the skulls of *Callorhinus ursinus* previously referred to. Taken in connection with this tendency to variation, the interesting fact that the number of synonymes pertaining to the several species is in almost exact ratio to the number of specimens that naturalists have had for examination is readily explained. The incidental revision of the genera and species embraced in the present paper is based on these recent developments.

The greatest number of species recognized by any writer during the last five years is fifteen; but they have now been reduced, by general consent, to ten or eleven. These have been placed by Dr. Gray, in his later papers, in *ten genera*. In the present enumeration six species * are regarded as fully established, and two or three other species † are given as doubtful. All are referred to five genera. ‡

One of the most singular facts connected with the history of these animals is that they should have so long remained among the species least known to naturalists, when their commercial importance is such that their capture has given employment to thousands of men and millions of capital for more than a century.

For many years, as is well known, hundreds of thousands of the skins of the Falkland Island fur seal, and hundreds of tons of the oil of other species, annually reached England; yet specimens of either the fur seals, or of any of the other species that naturalists were able to obtain, were exceedingly few and imperfect. Add to this the fact that, in many cases, the localities whence these fragmentary and isolated specimens were received were frequently wholly unknown or but vaguely surmised, and we can well understand how it happened that only till within the last decade have naturalists been able to decide with certainty as to which of the species on their catalogues were to be referred the various fur seals of commerce.

1. *Résumé of Recent Contributions to the Natural History of the* OTARIADÆ.

A brief statement of the present state of our knowledge of the *Otariadæ* seems to be demanded in the present connection, inasmuch as since the publication of the last general synopsis of the subject our knowledge of the group has greatly increased, without the new facts having been given in a single summary. As a *résumé* of the contributions to the literature concerning this group of animals which have appeared during the last two decades would necessarily give such a statement, and also at the same time a connected history of the recent changes in their nomenclature and classification, a synopsis of the

* *Eumetopias Stelleri*, *Zalophus Gillespii*, *Z. cinereus* (= *lobatus*, Auct.), *Otaria jubata*, *Callorhinus ursinus*, *Arctocephalus falklandicus*.

† *Phocarctos Hookeri*, *Arctocephalus australis*, *A. antarcticus*.

‡ *Eumetopias*, *Zalophus*, *Otaria*, *Callorhinus*, *Arctocephalus*.

principal recent papers relating to the subject is accordingly here introduced. For references to earlier papers the reader is referred to the works cited in Dr. J. E. Gray's British Museum Catalogues of the Seals and Professor W. Peters's elaborate essay on these animals published in the Monatsberichte of the Berlin Academy for 1866.

The present notice of the literature of the *Otariadæ* begins with Dr. Gray's "Catalogue of the Seals in the British Museum," published in 1850, in which valuable work two genera (*Arctocephalus* and *Otaria*) and eight species* are recognized. The next paper requiring mention is that of Dr. McBain,† describing, in 1858, a new species (*Otaria Gillespii*) from a skull from the Gulf of California. A few months later Dr. Gray published some important notes relative to the Northern sea bear (*Arctocephalus ursinus* Auct.),‡ based on a skin and skull of an adult male from Behring's Straits, received at the British Museum by way of Amsterdam and St. Petersburg, under the name of *Otaria leonina*. This paper is accompanied by an excellent profile figure of the skull, which seems to be the only figure of the skull of this species that has been hitherto published.

Two weeks later Dr. Gray communicated to the Zoölogical Society another paper on the Eared Seals,§ in which the fur seal of the Cape of Good Hope was described anew from a specimen received by him from Paris, and of which he published a view in profile of the skull. He appends to this paper a synopsis of the genus *Arctocephalus*, in which he divides it into three unnamed sections, based on characters drawn from the skull. Short diagnoses are also given of the species, which he groups as follows: —

"I. *Arctocephalus ursinus;* II. *A. Hookeri;* III. *A. Delalandii, A. nigrescens, A. lobatus, A. Gillespii.*" He also gives a profile figure ‖ of a cast of the skull described by Dr. McBain as *Otaria Gillespii.*

Some months later the same indefatigable author published a paper

* These are *Arctocephalus ursinus, A. falklandicus, A cinereus, A. lobatus, A. australis, A. Hookeri, Otaria Stelleri,* and *O. leonina.*

† Proc. Edinburgh Royal Phys. Soc., Vol. I, p. 422.

‡ "On the Sea Bear of Forster, the *Ursus marinus* of Steller, *Arctocephalus ursinus* of authors," Proc. London Zoöl. Soc., 1859, pp. 101, 102, Pl. lxviii.

§ "On the Eared Seal of the Cape of Good Hope (*Otaria Delalandii*)," Ibid., pp. 107–110, Pl. lxix.

‖ Ibid., Pl. lxx.

on the Sea Lions of the Coast of California,* with a profile figure of an adult male skull of what he supposed to be a new species (*Arctocephalus monteriensis*), but which proved to be identical with the *Otaria Stelleri* of authors, as first suggested by Dr. Gill. Another young skull was described and doubtfully referred to the same species, as was also the skin of a fur seal. The latter, however, is undoubtedly identical with the Northern fur seal (*Callorhinus ursinus*). In this paper he gives a new classification of the eared seals, in which he properly raised the first of the sections of his genus *Arctocephalus*, which he had previously instituted, to the rank of a genus (*Callorhinus*). The second and third sections he seems to have reunited, for which he retained the name of *Arctocephalus*. His genus *Arctocephalus*, as now restricted, he again divided into four unnamed sections. A valuable table of comparative measurements of the skulls of eight species is appended.

Seven years from the date last given (1859) carries us to the appearance of Dr. Gray's "Catalogue of the Seals and Whales," † published in 1866, during which interval little or nothing of importance was published relating to the group in question. In this Catalogue all the species of his "Catalogue of Seals" of 1850 are retained; the synonymy is brought up to date, and the species he and others had described since the appearance of that Catalogue are added. These are the *Otaria Gillespii* McBain (= *Zalophus Gillespii* Gill, the *Arctocephalus monteriensis* Gray (= *Eumetopias Stelleri* Peters), and the *Arctocephalus Californianus* Gray (= *Callorhinus ursinus*, in part or wholly), making the whole number of species thirteen. Only one of the three species supposed to be new, however, proved to be so.

The specific nomenclature is not changed from that adopted in his previous paper, so far as the species mentioned in that paper are concerned, and the introduction of one generic name is the only change from the generic nomenclature employed by him in 1850. Another new classification of the species of the genus *Arctocephalus* is given, in which the species are grouped in two primary sections and seven subsections, upon the arbitrary basis of the differences in the form of the bony palate. No new material is described, and but little new matter added, the Catalogue being essentially a compilation from his previously

* "On the Sea Lions, or Lobos Marinos of the Spaniards, on the Coast of California," Ibid., p. 557.

† "Catalogue of the Seals and Whales in the British Museum," 1866, pp. 44–60.

published papers, generally without any change in the language, and often embracing important typographical errors. In the Appendix, however, some interesting notes are added in respect to the manner in which the eared seals walk, and their attitudes when in a state of repose, he having had the opportunity of observing a living sea lion in the Cremorne Garden.

Nearly coincident with the appearance of Gray's Catalogue of Seals and Whales was the publication of a "Prodrome of a Monograph of the Pinnipeds," by Dr. Theodore Gill,* of Washington. This important paper presents to a great extent a new classification of the Pinnipeds, and introduces numerous changes of nomenclature. The walrus, the eared seals, and the earless seals, for the first time for many years,† are again regarded as forming distinct families, as by Brookes, to which are applied respectively the names *Rosmaridæ, Otariadæ*, and *Phocidæ*.‡ The name *Otaria*, of Péron, is restricted to the Southern sea lion (*Phoca jubata* Schreber); *Eumetopais* is proposed as a generic name for the Northern sea lion (*Leo marinus* Steller, = *Otaria californiana* Lesson, = *Arctocephalus monteriensis* Gray); *Zalophus* is proposed as a generic name for the *Otaria Gillespii* McBain, and *Halarctus* for a group for which the *Arctocephalus Delalandii* is named as the type; *Arctocephalus* F. Cuvier is substituted for the generic name of *Callorhinus*, proposed by Gray for the *Phoca ursina* Linné. Brief diagnoses of these genera are given, and a species is indicated as the type of each. A list of the North American species is also added.

While most of the changes introduced by Dr. Gill in his Prodrome are judicious ones, errors occur in respect to the names of the genera of the *Otariadæ*. These were speedily pointed out by Dr. Gray § in a short critique upon Dr. Gill's paper, in which Dr. Gray calls attention to the fact that the type of *Arctocephalus* F. Cuvier was not, as Gill assumed, Steller's sea bear, as is clearly shown by Cuvier's figure of the skull of his type of *Arctocephalus*. Hence Gray properly reinstated his name *Callorhinus* for the generic name of Steller's *Ursus marinus*. He does not state, however, to what F. Cuvier's figure refers, this,

* Proc. Essex Institute, Vol. V, pp. 1–13, March, 1866.

† See my remarks on the synonomy of *Otariadæ* below.

‡ Catalogue of Brookes's Anat. and Zoöl. Museum, p. 36, 1828.

§ "Observations on the 'Prodrome of a Monograph of the Pinnipedes,' by Theodore Gill," Ann. and Mag. Nat. Hist., 3d Series, Vol. XVII, pp. 444–447, June, 1866.

as suggested to me by Dr. Gill, being first pointed out by Professor Peters.* The type of Cuvier's genus *Arctocephalus* being in all probability the *Arctocephalus Delalandii* Gray, *Halarctus* of Gill, based on the same type, became, as Gray points out, a synonyme of *Arctocephalus*.

Nearly contemporaneously with Gray's above-mentioned critique appeared an able paper on the *Otariadæ* by Professor W. Peters of Berlin.† In this essay Professor Peters reviews the whole family, and describes two species erroneously supposed by him to be new,‡ and gave figures of their skulls. The species are all described as *Otariæ*, but are arranged under seven named subgenera or sections,|| which appear in the main to be natural groups. The characters on which these divisions are based are drawn, not from the skull alone, but from all the available sources, the length of the ears, and the presence or absence of under-fur ("Unterwolle") being for the first time made use of as distinctive characters in determining the lesser groups; Gray and Gill in their classifications having, with slight exceptions, made use of only the characters furnished by the skull. The specimens of eared seals contained in the Berlin Museum are described with considerable minuteness, and the synonymy of all the species quite fully and carefully presented. Professor Peters agrees with Gray (though at the time of writing he could not have seen his [Gray's] paper) in referring *Halarctos* to *Arctocephalus* and in reinstating *Callorhinus*. The names of all the other genera recognized by both Gill and Gray were adopted by him for the names of his sections, and to which he added two others (*Arctophoca* and *Phocarctos*). The arrangement of Professor Peters for the first time separated the hair seals from the fur seals, and to this extent at least an advancement was made towards a natural classification. The fur and hair seals differ markedly from each other in

* Monatb. d. k. P. Akad. z. Berlin, 1866, p. 271.

† "Über die Ohrenrobben (Seelöwen und Seebären), *Otariæ*, insbesondere über die in den Sammlungen zu Berlin befindlichen Arten," Monatsberichte der k. P. Akadamie zu Berlin, 1866, pp. 261–281, with three plates.

‡ *Otaria Godeffroyi* and *O. Philippii.*

|| (1.) *Otaria*, containing *O. jubata*, *O. leonina*, *O. Godeffroyi*, and *O. Byronia*; (2.) *Phocarctos*, containing *O. Hookeri* and *O. Ulloæ*; (3.) *Arctocephalus*, containing *O. pusilla*, *O. cinerea*, and *O. falklandica*; (4.) *Callorhinus*, containing *O. ursina*; (5.) *Eumetopias*, containing *O. Stelleri*; (6.) *Zalophus*, containing *O. Gillespii*, and *O. lobata*; (7.) *Arctophoca*, containing *O. Philippii.*

numerous other general features, as well as in the pelage, as will be more fully noticed hereafter. Fourteen species have been recognized, but three of them (*O. leonina*, *O. Byronia*, *O. falklandica*) he seems to have regarded as doubtfully distinct from others. He refers Gray's *Arctocephalus Delalandii* to the *Phoca pusilla* of Schreber, and (with a query, however) Gray's *Arctocephalus nigrescens* to the *Otaria falklandica* of Shaw.

In consequence of the publication of these papers of Dr. Gill and Professor Peters, Dr. Gray was led to a re-examination of the specimens of the *Otariadæ* in the British Museum, and in September of the same year he published the results of his investigations.* In this paper he for the first time regards the *Otariæ* as a family (though several other writers had done so previously), and speaks of certain features that indicate their superiority to the *Phocidæ*. He adopts an entirely different generic classification from that given by him a few months before,† both as to the number of genera and their mutual relations. The seven named sections of *Otaria* of Peters he admits to the rank of genera, with the limits ascribed to them by Peters. He adds also one "new genus" (*Neophoca*), based on his *Arctocephalus lobatus*, which species Peters had referred to Gill's genus *Zalophus*. Gray had now eight genera and three subgenera.‡ Only ten species being recognized by him as valid, he has now but a single species to each of his generic and subgeneric subdivisions. Although the paper is a somewhat important one, containing as it does many valuable suggestions, no really new matter is described in it.

Another paper on the Eared Seals by Peters § immediately followed this one of Gray. In the few months intervening since the publication of his previous essay on this subject, Professor Peters had visited England and Holland, and examined the specimens contained in the principal museums of these countries, including among them the specimens in the Leyden Museum described and figured in the Fauna Japonica,

* "Notes on the Skulls of the Sea Bears and Sea Lions (*Otariadæ*) in the British Museum," Ann. and Mag. Nat. Hist., 3d Series, Vol. XVIII. pp. 228-237, September 1866.

† In his Catalogue of Seals and Whales.

‡ *Arctocephalus* is divided into *Arctocephalus*, containing *A. Delalandii*; *Euotaria*, containing *A. nigrescens*; and *Gypsophoca*, containing *A. cinereus*.

§ A supplement to his previous "Abhandlungen über die Ohrenrobben, *Otaria*." Monatsb. d. k. P. Akad. z. Berlin, 1866, pp. 665-672, November, 1866.

and those in the British Museum described and figured by Dr. Gray. A skull of Tschudi's *Otaria Ulloœ* is figured, and many interesting facts are given respecting several of the species described by him in his previous paper. A list of the species is added, and while all of those given by him a few months before are included in the enumeration, they are numbered in such a way as to indicate that his estimate of them had somewhat changed. The whole number is ten, but under No. 1 he has "Nos. 1 a," "1 b," and "1 c," and under No. 9, "No. 9 a."* One is left somewhat in doubt, however, as to whether he regarded these species as synonymous respectively with Nos. 1 and 9, or as subspecies. Gray's *Arctocephalus nigrescens* is now positively (previously with a query) referred to *O. falklandica* Shaw, to which species also his own *O. Philippii* is seemingly referred. Instead of dropping altogether his subgenus *Arctophoca*, based at first solely on his *O. Philippii*, which he now appears to regard as a nominal species, he transfers his *O. falklandica* from *Arctocephalus* to *Arctophoca*. The *Otaria Stelleri* of Schlegel is in this paper referred to *O. Gillespii* of McBain, instead of in part to the *O. cinerea* of Péron, and in part to the *Arctocephalus lobatus* of Gray, as both he and Gray had previously referred it. In addition to the determination of the character of Schlegel's *O. Stelleri*, the most important thing decided by this paper is the exact character of Tschudi's *O. Ulloœ*, of which Peters was able to figure and describe original specimens.

In addition to the above-mentioned five papers published in 1866,— an important year in the history of the literature of the *Otariadœ*,— Dr. Sclater states, in the Proceedings of the Zoölogical Society of the same year,† that a "young living male sea bear (*Otaria Hookeri*), captured near Cape Horn, in June, 1862, by a French sailor named Lecomte, had been added to the society's menagerie. This animal had been exhibited by its captor in Buenos Ayres, and in various parts of France and England, and is the one doubtless referred to by Gray in the Appendix to his Catalogue of Seals and Whales.

At about the same time Dr. Burmeister ‡ also gives a description

* *O. jubata* ex Forster and Blainville is given as "No. 1"; *O. Byronia* Blainv., as "No. 1 a"; *O. leonina* F. Cuv. as "No. 1 b," and *O. Godeffroyi* Peters, as "No. 1 c"; "No. 9" is *O. falklandica* Shaw, while his *O. Philippii* forms his "No. 9 a."

† Proceedings London Zoöl. Society, 1866, p. 80, January, 1866.

‡ Ann. and Mag. Nat. Hist., 3d Series, Vol. XVIII, p. 99, Pl. ix, February, 1866.

and figure of a young skull of *Arctocephalus falklandicus*, and some interesting facts in respect to the distribution of the eared seals on the east coast of South America, where he says but two species exist. Under the improper name of *A. falklandicus*, he also refers to the specimen captured and exhibited by Lecomte. One is led by Burmeister's remarks to infer that he believed this specimen (and another which did not live to reach Europe) was captured in the Rio de la Plata. Later the death of this "sea bear" is announced in the Proceedings of the Zoölogical Society, and Dr. James Murie * reports the results of his investigations as to the cause of its decease.

The next paper of moment on the Eared Seals appeared in February, 1868, and is entitled "Observations on Sea Bears (*Otariadæ*), and especially on the Fur Seals and Hair Seals of the Falkland Islands and South America."† In this paper Dr. Gray refers briefly to the two papers of Professor Peters, and very properly remarks, as it seems to me, that Peters in his first essay "formed no less than five species from the skulls of the Southern sea lion (*Otaria jubata*), — *O. jubata*, *O. Byronia*, *O. leonina*, *O. Godeffroyi*, and *O. Ulloæ*." He reviews at some length the complicated synonomy of the Falkland Island eared seals, and raises his subgenera of *Euotaria* and *Arctocephalus* (previously mentioned) to the rank of genera, and redescribes the Falkland Island and South American species. These are, (1) the *Arctocephalus falklandicus* Gray ex Shaw, (2) the *Euotaria nigrescens* Gray, and (3) *Phocarctos Hookeri* Gray. Dr. Gray contends that Peters's *O. falklandica* is not the *O. falklandica* of Shaw, but that it is the same as his *Arctocephalus* (or *Euotaria*) *nigrescens*. The *Arctocephalus falklandicus* of Burmeister‡ he, as it seems to me, erroneously referred to his *Phocarctos Hookeri*, doubtless from Dr. Burmeister having referred Lecomte's specimen of the "sea bear" already mentioned, which was really the *O. jubata*, to the "*O. falklandica*." The description of the skin by Dr. Burmeister, in Professor Peters's second essay,§ shows the animal to have been a *fur* seal, the *P. Hookeri* being a *hair* seal.

The young male sea lion (or sea bear, as it was also called), which

* Proceedings London Zoöl. Society, 1867, p. 243.

† Ann. and Mag. Nat. Hist., 4th Series, Vol. I pp. 99–110, February, 1868.

‡ Ibid., 3d Series, Vol. XVIII, p. 99, February, 1866.

§ Monatsb. d. k. P. Akad. d. Wissensch, z. Berlin, 1866, p. 670.

lived for a time in the Zoölogical Garden, and which was figured by Dr. Sclater as *O. Hookeri*,* he says is identical with the *O. jubata*,—an opinion subsequently shared by Dr. Sclater himself.†

A few weeks later Dr. Gray published another paper, on the *Otariadæ*, entitled "Observations on the Fur Seals of the Antarctic Seas and the Cape of Good Hope, with Description of a new Species";‡ he having in the mean time received additional material. In this paper he remarks still further concerning the complicated synonomy of the Falkland Island fur seals, and respecting the habitat of the specimens of Weddell, described by Mr. R. Hamilton,§ and the differences between these species and his *A. cinereus* of Australia and the fur seals of the Cape of Good Hope. He also describes what he regards as a new species, from two skins from the Cape of Good Hope, which species he calls *Arctocephalus nivosus*. These skins differ from those of his *A. Delalandii*, he says, in being so nearly destitute of under-fur, except just on the crown of the head, that he was convinced they could not be dressed as fur seals.‖

In "The [Cambridge, Eng.] Journal of Anatomy and Physiology" for November, 1868,¶ Dr. McBain describes an imperfect skull of a female *Otaria jubata* from the Chincha Islands, which he calls "*O. Ulloæ?*" suggesting for it, however, the name *O. Graii*, in case it should prove to be new. In the same number of this journal Professor Turner** describes, as that of a new species (*Arctocephalus schisthyperoës* ††), a skull with a peculiar conformation of the palatine bones, from Desolation Island, which Dr. Gray examined later and referred to his *Euotaria nigrescens*.

In the Monatsbericht of the Berlin Academy for March of the same

* Proc. Lond. Zoöl. Soc., 1866, p. 80.

† Ibid., 1868, p. 190, foot-note, March, 1868.

‡ Ann. and Mag. Nat. Hist., 4th Series, Vol. I, pp. 215–219, March, 1868.

§ Ibid., Vol. II, p. 81, Pl. iv. 1838.

‖ In this paper Gray repeats a misstatement made by him in his last paper preceding this, viz. that the *Eumetopias Stelleri*, a true *hair* seal, is one of the few eared seals that "have a close, soft, elastic fur." See further remarks on this point beyond under *E. Stelleri*.

¶ Vol. III, p. 109–112.

** Ibid., p. 113–117.

†† In the "Zoölogical Record" for 1868 Dr. Günther changes this name to *schistuperus*. McBain's "*O. Ulloæ?*" he regards as a new species, for which he proposes the name of *Arctocephalus Graii*.

year a letter from Dr. Burmeister to Professor Peters* is published concerning the eared seals of the coast of the La Plata States. In this letter Dr. Burmeister restates his opinion † that only two species of these animals exist on the east coast of South America, one of which he regards as the *Otaria leonina*, and the other as the *Otaria falklandica* of Peters's first essay. Of the first of these he had examined a number of specimens, which he describes somewhat in detail, and remarks especially upon the great variations presented by different specimens in consequence of differences in age, and also upon the great amount of purely individual variation they present. He is consequently led to believe that the species described by Professor Peters in his first essay as *O. jubata*, *O. Byronia*, *O. leonina*, and *O. Godeffroyi*, form but a single species. These several nominal species he regards as based merely upon individual differences, and not constituting even "permanent races or varieties." In the statement of this opinion he was anticipated by Dr. Gray, who, as previously stated, one month earlier referred not only these, but also the *O. Ulloæ* of Peters, to the *O. jubata*. To the *Otaria falklandica* of Shaw Dr. Burmeister also refers the *O. nigrescens* Gray and the *O. Philippii* Peters, as it seems to me with evident propriety. This short article contains highly important information respecting the South American eared seals. ‡

In the following month Captain C. C. Abbott § communicated to the London Zoölogical Society some interesting notes on the haunts, habits, and external features of *Otaria jubata* and *Arctocephalus falklandicus*, Among other things, he remarks that, in the hundreds of skins of the former (*O. jubata*) he had seen, he "never saw on any of them anything approaching fur." Captain Abbott's notes are the more valuable from the fact that he has deposited skulls of both these species in the

* Monatsb. d. k. P. Akad. Wissensch. z. Berlin, 1868, pp. 180 - 182. The same account is substantially given in the Anal. Mus. Buen. Ayr. 1868, p. 303; Act. Soc. Paleont., p. xxxix, and Zeitschr. ges. Naturw., XXXI, pp. 294 - 301.

† See Ann. and Mag. Nat. Hist., 3d Series, Vol. XVIII, p. 99, 1866.

‡ It is perhaps but proper to state in this connection that the specimens referred to by Dr. Burmeister in the above-mentioned paper were collected by Dr. G. A. Maack at Cabo Corrientes, near the southern extremity of Buenos Ayres (lat. 38° S.) They are the specimens referred to by Dr. Maack in his paper in "Der Zoologische Garten" (Jan. 1870), and in his notes to the present paper.

§ "On the Seals of the Falkland Islands," by Captain C. C. Abbott. Communicated, with notes, by P. L. Sclater, M. D., etc., Proc. Lond. Zoöl. Soc., 1868, pp. 189 - 182, March, 1868.

British Museum, so that it is well known to which species his remarks refer. In a note to this paper Dr. Sclater observes: "I agree with Dr. Peters* in thinking it best to retain the name *jubata* for the Southern species, and to call the Northern one *Stelleri*. I consider *O. leonina* Cuv. to be probably the same as *O. jubata*, as appears to be admitted by Dr. Peters in his last paper."† Dr. Sclater states that he was mistaken in referring the living specimen brought by Lecomte to the *O. Hookeri*, and agrees with Peters‡ and Gray in regarding it as *O. jubata*.

At the first session of the Zoölogical Society of London, held in November, 1868, Dr. Sclater§ announced that a young female sea lion (*Otaria jubata*), from the Falkland Islands, had been received during the preceding August at the society's menagerie. "This individual," he says, "was the only survivor of eight examples of this animal captured in various spots on the coast of the Falklands by Adolphe Alexandre Lecomte,‖ the society's keeper, who had been sent out there by the council of the society for the purpose of obtaining living specimens of it." The different localities at which M. Lecomte met with this species are mentioned in this communication, from which it appears that both this animal and "the fur seal of the Falklands (*Otaria falklandica*)" are far less numerous than formerly. The latter species was observed in considerable numbers at the Volunteer Rocks.

M. Lecomte also brought home a considerable number of skins and skeletons of the sea lion, concerning which Dr. James Murie¶ soon published an exceedingly interesting communication. Lecomte's collection consisted of parts of fifteen individuals of the *Otaria jubata*, and of one of the *Arctocephalus nigrescens* Gray. The latter species, however, was represented by merely the "pectoral extremities" of an adult female; the former by the skull and skin of an "adult male,"** the skins and skeletons — the latter nearly complete — of four adult females, the

* Monatsb. Berl. Ak. 1866, p. 670.

† Ibid., p. 670. ‡ Ibid., 666.

§ Proc. Lond. Zoöl. Soc., 1868, p. 527.

‖ François Lecomte, according to Dr. Murie. (See next foot-note.)

¶ "Report on the Eared Seals, collected by the Society's Keeper, François Lecomte, in the Falkland Islands," by James Murie, M. D., etc., Proc. Lond. Zoöl. Soc., Jan. 1869, pp. 100–109, Pl. vii, and two woodcuts.

** This specimen, according to Dr. Murie's measurements, was but little larger than the so-called adult female, and hence cannot have been adult. Respecting the

skin and partial skeleton of a young male, skins of two very young males,* skins of two young females, together with a partial skeleton of one of them, and five aged male skulls. The skins were preserved in salt, but the pelage of none of them was in perfect condition. The color of these skins is described in detail, and a few measurements are given of both the skins and skulls. The skulls are described only in general terms. The skull of a half-grown male is figured, as is also another skull of an adult female. Three figures of the animal (young male, adult female and young), showing its peculiar attitudes, also accompany the report. While the paper conveys highly important information in respect to these specimens, it is to be hoped that a far more detailed account of them will yet be given. Dr. Murie's paper also embraces valuable observations concerning the habits of these species, derived from M. Lecomte, who resided several months on the islands among them.

Dr. Murie remarks that he cannot agree with Dr. Gray, "that Dr. Peters's figured skull of *Otaria Philippii* is most nearly allied to *O. Stelleri* from California, inasmuch," he continues, "as I consider it nothing less than *O. Hookeri*"; both of these gentlemen evidently overlooked the fact that Dr. Peters states expressly that the *O. Philippii* has a *thick under-fur* ("die *dichte Unterwolle* ist rostroth"), whereas both the *O. Stelleri* and the *O. Hookeri* are true *hair* seals. On the other hand, Dr. Murie says he unhesitatingly supports Dr. Gray in his criticism of Dr. Peters as regards the species of sea lions termed respectively *O. Byronia*, *O. leonina*, *O. Godeffroyi*, and *O. Ulloæ*, as," he adds, "I am perfectly convinced they are but differently aged specimens of Forster's *jubata*." Dr. Murie further observes, and it seems to me justly, that the *Arctocephalus nivosus* Gray is "only a variety, seasonal, sexual, or of a different age" of a previously known species.

In October, 1869, Dr. Gray published some "Additional Notes on Sea Bears (*Otariadæ*)," † based mainly on an examination of three skulls from Desolation Island, and one from the Cape of Good Hope, which had recently been sent him by Professor Turner of Edinburgh.

comparative size of the sexes, see Captain C. C. Abbott's notes (Proc. Zoöl. Soc., 1868, p. 190) and Dr. Manck's remarks beyond. Also Burmeister's in the Monatsb. Akad. z. Berlin, 1868, p. 181; and D'Orbigny's in his Voyage dans l'Amérique Meridionale, Tome II, p. 140, 1839.

* About three months old, according to Sclater (Proc. Zoöl. Soc., 1868, p. 528).

† Ann. and Mag. Nat. Hist., 4th Series, Vol. IV, pp. 264–270.

The skull from the Cape of Good Hope is the one on which Professor Turner * had founded his *Arctocephalus schisthyperoës*. This skull Dr. Gray is induced to believe is that of a half-grown *Arctocephalus Delalandii*, presenting an individual abnormality in the form of the palatine bones. The three skulls from Desolation Island he refers to his *Euotaria nigrescens*. In his remarks respecting them he speaks of certain differences he had observed in the relative position of the hinder grinders in the Desolation Island skulls, and also in the form of the posterior nares. In this connection he also compares *Euotaria nigrescens* with *Arctocephalus Delalandii*, and says that the last upper molar teeth being "placed in front of the hinder edge of the front part of the zygomatic arch" in the former is, so far as the skull is concerned (on which his distinction of his groups is mainly based), all that distinguishes them. This difference, he says, is slight in the adult, but more marked in the young; but "even then," he adds, "the difference is more *imaginary than real*." We should hardly expect, after this admission, and his apparently appreciative remarks in the same paper on the notable differences he had observed in skulls he regards as specifically identical, that in his subjoined new synopsis of the "tribes and genera" of the *Otariadæ* he should place, as he has done, these two species in different genera! He remarks that he does not now regard the "form of the hinder opening of the nostrils, and the form of its front edge," as constituting "a good character." The position of the grinders he regards as affording reliable specific characters during youth, but that in maturity their form is so much altered by age, "and their position in different species so similar, that the distinction of the species becomes more difficult." He finally briefly recapitulates the principal distinctive family characters of the *Otariadæ*, and concludes the paper with a synopsis of its "genera and tribes." He having previously established as many genera as there are commonly recognized species,† no new genera could well be added. It is, nevertheless, a radically new classification, and one as arbitrary a could well be devised. The family is first divided into two primary groups, termed "sections." The first section embraces a single "tribe," called *Otariina*, containing the single species *Otaria jubata* of the east and west coast of Southern South America.

* See *antea*, p. 12.

† See his papers on the Eared Seals in the Ann. and Mag. Nat. Hist. for 1866 and 1868.

The other section is divided into four "tribes," which are named respectively, (1) *Callorhinina*, (2) *Arctocephalina*, (3) *Zalophina*, and (4) *Eumetopiina*. The first embraces the single genus *Callorhinus*; the second, *Phocarctos*, *Arctocephalus*, *Euotaria*, and *Gypsophoca*; the third, *Zalophus* and *Neophoca*; the fourth, *Eumetopias* and *Arctophoca*, — ten genera in all. The short generic diagnoses given are drawn almost entirely from two exceedingly variable features of the skull, namely, the form and relative length of the palatal bones and the form and position of the teeth. The geographical distribution of the supposed genera is also indicated, in which the habitat of *Zalophus* is given as "South America," whereas it was founded solely on the *Otaria Gillespii* McBain of the North Pacific. Three alleged species are mentioned whose skulls, he says, are not known. These are, (1) *Arctocephalus falklandicus*, habitat, "New Georgia"; (2) *A. nivosus*, habitat, "Cape of Good Hope"; (3) "*A. Forsteri* Fischer" habitat, "New Zealand." The character of the latter I cannot satisfactorily determine. I have never seen an "*Arctocephalus Forsteri* Fischer" elsewhere mentioned; the *Otaria Fischeri* Lesson and the *Phoca Forsteri* Fischer* have usually been referred to the *A. falklandicus*. Gray's *A. Forsteri* seems to be based, judging from his references, exclusively on the "sea bear" of Dr. J. R. Forster,† whose habitat was the Cape of Good Hope, as Gray in another place specially states. But this species Gray in this paper regards as the same as the *Phoca antarctica* Thunberg‡ and Fischer, § which, he says, is the same as what he had called *Arctocephalus Delalandii*, the name of which species he now consequently changes to *A. antarcticus*. Although Forster regarded the New Zealand fur seal as the same as the one he saw at the Cape of Good Hope, Gray's *A. Forsteri* seems to refer, from the habitat given, only to the New Zealand animal. I can see no evidence, however, of the New Zealand fur seal being specifically different from the fur seal of South Australia (*A. cinereus* auct.).

In this paper the dental formula of the eared seals is, for the first time correctly given by the author. ||

* Synop. Mam., p. 232.

† Cook's Voyages, Vol. I, p. 174; Vol. II, p. 528.

‡ Mem. de l'Acad. de St. Petersbourg, 3d Series, Tome III, p. 322, 1811.

§ Synop. Mam., p. 242.

|| For more than fifteen years, through some strange inadvertence, the dental formula of the molars of the eared seals was given in Dr. Gray's papers as "$\frac{6}{6}-\frac{6}{6}$."

In "Der Zoologische Garten" for January, 1870,† Dr. C. A. Maack describes his excursion to the Cabo Corrientes on the southern coast of Buenos Ayres (lat. 38° S.) for the purpose of obtaining specimens of the eared seals, and his difficulties in capturing them. He states that he met with both species (*Arctocephalus falklandicus* and *Otaria jubata* = *O. leonina* Maack) there, of both of which he secured examples. As these specimens had been previously described by Dr. Burmeister (l. c.), Dr. Maack's observations are mainly concerning the habits of the animals and the character of the locality. A figure of the *O. jubata* is also given, but through some mistake of the artist the limbs are improperly represented. The remarkable form of the nose, Dr. Maack informs me, correctly represents the specimen from which the figure was made. It differs greatly, however, in this respect from any other eared seal that has been figured or described, and may represent but an individual or abnormal variation.

In Mr. W. H. Dall's important work on Alaska† may be found valuable notes on the fur and other eared seals of the North Pacific, with a figure of the *Callorhinus ursinus* drawn from nature by Mr. Dall.

In addition to the above-mentioned scientific papers, other interesting articles of a popular character have recently appeared, but some of the statements given in them are evidently not wholly reliable.‡

In addition to the preceding summary of the more important of the recent contributions to our knowledge of the eared seals, the reader is

This mistake occurs in three consecutive synopses of the group (Cat. of Seals in Brit. Mus., 1850; Cat. Seals and Whales in Brit. Mus., 1866; Ann. and Mag. Nat. Hist., 3d Series, XVIII, 1866, — in the last case corrected, however, in the general list of errata appended to the volume), and twice in each synopsis (in the diagnosis of this group, called by him *Arctocephalina*, and in that of the genus *Arctocephalus*). The correct formula of the molars is, of course, $\frac{6}{5}-\frac{6}{5}$ for a part of the species, and $\frac{5}{5}-\frac{5}{5}$ for the others. In the diagnosis of *Arctocephalus* given in the "Catalogue of Seals and Whales" (p. 47), the molars are stated to be "$\frac{6}{6}-\frac{6}{6}$"; the molars of the *first*, *third*, and *seventh* species described under this genus are really, however, $\frac{5}{5}-\frac{5}{5}$, and in the others $\frac{6}{5}-\frac{6}{5}$.

† Vol. XI, pp. 1-8.

† Alaska and its Resources, Boston, June, 1870.

‡ One of the more important ones relative to the North Pacific species is a recent article in the "Old and New" Magazine (Vol. I, pp. 487-493, April, 1870), by Mr. O. Howes, Jr. In Hutchin's "Scenes of Wonder and Curiosity in California" (p. 187, figs. 1 and 2) are also a few interesting notes on the sea lions of the Farallone Islands. They contain, however, exaggerated statements, especially in respect to their size.

referred to three recent systematic synopses of the family for an expression of the later opinions relative to the genera and higher groups of the three eminent zoölogists who, within the last four years, have published special classifications of these animals, as no tabulated summary will properly represent them. These are Dr. Gill's "Prodrome,"* Professor Peters's revision † of the genera and species, published in 1866, and Dr. Gray's synopsis ‡ of the "tribes and genera," published in 1869.

2. *On the Affinities, Distinctive Characters, and Synonymy of the Family* OTARIADÆ, *with Remarks on Sexual, Age, and Individual Variation, and a Conspectus of the Genera and Species,* etc.

FAMILY OTARIADÆ BROOKES.

Phocacea auriculata PÉRON, Voy. Terr. austr., II, 37, 1816.
Otariadæ BROOKES, Cat. Anat. and Zoöl. Mus., 36, 1828.
"*Otaridés* GERVAIS, Hist. Nat. des Mammifères, II, 306."
Otariidæ GILL, Proc. Essex Institute, V, 7, 1866.
Otariadæ GRAY, Ann. and Mag. Nat. Hist., 3d Ser., XVIII, 228, 1866.
Otariina GRAY, Ann. of Phil., 1825.
Arctocephalina GRAY, Charlesworth's Mag. Nat. Hist., I, 583, 1837.
" TURNER, Proc. Lond. Zoöl. Soc., 1848, 88; Ann. and Mag. Nat. Hist., 1st Ser., III, 422, 1848.
Otaria PÉRON, Voy. Terr. austr., II, 37, 1816.
" PETERS, Monatsb. Akad. Berlin, 1866, 261, 665.

Distinctive Characters. — Body less attenuated than in the majority of the *Phocidæ;* more attenuated than in the *Rosmaridæ.* Fore limbs fin-like, situated very far back. Hind limbs comparatively free; hind feet directed forward when the animal is at rest, and serviceable for terrestrial locomotion. The digits terminate in long cartilaginous flaps, connected at the base by membranes. Bones of the upper and fore-arm and corresponding bones of the leg very short, exceedingly stout and heavy. The digits of the hand successively decrease in length from the first; without nails, or with extremely rudimentary ones, situated at a distance from the edge of the hand. Outer digits of the hind limbs longer than the middle ones; the latter sub-equal, and provided with well-developed nails; the outer digits without nails or with very rudimentary ones, and much shorter and thicker than the inner digits. Pubic bones

* Proc. Essex Institute, Vol. V, pp. 7, 10, 11.
† Monatsb. d. k. P. Akad. z. Berlin, 1866, p. 670.
‡ Ann. and Mag. Nat. Hist., 4th Series, Vol. IV, p. 269.

not anchylosed, and in the female considerably separated. Acetabula opposite the posterior end of the second sacral vertebra. Ears provided with a sub-cylindrical external conch. The skull has a well-developed orbital process and an alisphenoid canal; the mastoid process is strong and salient, distinct from the auditory bulla, which is much smaller than in the *Phocidæ*. Molars either $\frac{5}{5}-\frac{5}{5}$ or $\frac{6}{5}-\frac{6}{5}$; canines, $\frac{1}{1}-\frac{1}{1}$; incisors, $\frac{3}{2}-\frac{3}{2}$; whole number of teeth, $\frac{9}{8}-\frac{9}{8}=\frac{18}{16}=34$, or $\frac{10}{8}-\frac{10}{8}=\frac{20}{16}=36$. Testes scrotal, situated as in the *Suidæ*.

Rank and Affinities. — The seals were all referred by the earlier writers to the Linnæan genus *Phoca*. Buffon was the first naturalist who recognized the division of the seals made by seamen into eared seals and earless seals, accordingly as they possessed or were devoid of external ears. Later Péron,* in 1816, regarded these two groups as genera, and gave to the eared seals the name of *Otaria*, leaving the earless seals in *Phoca*. Finally these two groups were regarded by Brookes,† in 1828, as constituting two families, the walrus, in his system, forming a third.

These groups have been generally recognized as natural, but their rank has been variously estimated by different authors. Turner ‡ regarded the eared seals, the earless seals, and the walrus as together constituting a single family, which he divided into three sub-families, — *Arctocephalina*, embracing *Otaria* and *Arctocephalus*; *Trichecina*, embracing only the walrus; and *Phocina*, embracing all the earless seals. He observes, however, in referring to the classification of the Pinnipedia made by Gray in 1837, § that if the sub-families of the *Phocina*, proposed by that author, be entitled to that rank, "the walrus and the Arctocephaline group, which differ so decidedly from the other seals, would almost seem entitled to the rank of families."

All writers, except Brookes and Gervais, previous to 1866, seem to have regarded these three groups as constituting a single family. Gill, however, in his Prodrome, ‖ considered them as distinct families, which view has since been adopted by Gray.¶

* Voy. Terr. aust., Vol. II, p. 37, 1816

† Cat. of his Anatom. and Zoöl. Mus., p. 36, 1828.

‡ Proc. London Zoöl. Soc., p. 88, 1848.

§ Charlesworth's Mag. Nat. Hist., Vol. I, p. 583.

‖ "Prodrome of a Monograph of the Pinnipedes," Proc. Essex Institute, Vol. V, p. 7, July, 1866.

¶ Ann. and Mag. Nat. Hist., 3d Ser., Vol. XVIII, p. 229, 1866.

Believing that they have a higher than a sub-family value, I adopt for the present the classification elaborated by Dr. Gill in his Prodrome, which is, it seems to me, the most natural arrangement of the Pinnipedes that has been proposed. Gill's arrangement places the *Otariadæ* between the *Phocidæ* and the *Rosmaridæ*. No serial arrangement of these groups can, I think, fully express their relative rank and mutual affinities. The *Otariadæ* are evidently the highest, though they seem intermediate in general features between the earless seals and the walruses. Their affinities, as they appear to me, may be indicated as follows: —

OTARIADÆ.

ROSMARIDÆ.

PHOCIDÆ.

While the *Rosmaridæ* are lower than the *Otariadæ*, and the *Phocidæ* are still lower than the *Rosmaridæ*, the latter evidently do not connect the other two groups.

The evidence of the superiority of the *Otariadæ* over the *Phocidæ* consists mainly in that modification of their general structure, and especially of the pelvis and posterior extremities, by means of which they have freer use of their limbs, and are able to move on land with considerable rapidity; the *Phocidæ*, on the other hand, move with great difficulty when out of the water. But the higher rank of the former is also indicated by their semi-terrestrial habits, the scrotal position of the testes, and in the nearer approach in general features to the terrestrial Carnivores, especially in the more posterior position of the acetabula. Most of these modifications are, however, nearly equally shared by the *Rosmaridæ*, indicating likewise that their true station is above that of the majority of the *Phocidæ*.

Primary Subdivisions. — The members of the *Otariadæ* form among themselves a closely connected group, as well as a well-defined one. But in general form, in size, in color and in the character of the pelage, two tolerably distinct divisions of the *Otariadæ* may be recognized, which in a general way correspond with the sea bears* and sea lions of seamen, and the fur seals and hair seals of commerce. F. Cuvier† was the first naturalist who recognized these divisions, he regard-

* The term sea bear, however, has been sometimes applied indiscriminately to fur and hair seals, and even to the *same animal* by the *same person*, as in the case of the first living specimen of *Otaria jubata*, exhibited in England.

† Mem. du Mus., Tome XI, p. 205 *et seq.*, 1824.

ing them as constituting two genera. To the first of these genera, embracing the sea bears, founded in fact on one of the Southern sea bears, (? *Arctocephalus Delalandi* Gray), he gave the name of *Arctocephalus*, and to the other, founded on the Southern sea lion (*Otaria jubata* Blainville), that of *Platyrhynchus*. These names indicate to some extent the differences seen in the general form of the head, in the two groups. In the first, or sea bears, the muzzle is narrow and pointed; in the other it is broad, and the aspect is more leonine. The name *Platyrhynchus*, however, is antedated by that of *Otaria* of Péron. Besides these differences in the shape of the head, the form of the body in the Arctocephaline species is more slender than in those of the other group. The hind feet, especially, are longer and slenderer, with relatively longer swimming-flaps at the end of the toes. Their size is smaller, and they differ in general color. The Arctocephaline species are also all provided with a dense, soft, thick under-fur, while the others are either entirely without under-fur, or possess it in too small a quantity to render the skins of any commercial value as furs.* These two groups are as well defined as the several sub-families of the *Phocidæ*, and are co-ordinate with them. If the *Otariadæ* constitute a group entitled to family rank, — and the so-called sub-families of the *Phocidæ* have truly a sub-family value, — the *Otariadæ* must be considered as divisible into two sub-family groups, of which the hair seals constitute one and the fur seals the other.

In respect to what names should be used for their designation, none seem in themselves more appropriate than those derived from the names of the leading genera of these groups, *Otariinæ* for the hair seals and *Arctocephalinæ* for the fur seals. These names, however, in a slightly altered form (*Otariina* and *Arctocephalina*), have been used on different occasions in widely different senses, especially by Gray; the first for the whole group of eared seals, and afterwards the other in precisely the same sense. Later, both were again used simul-

* I am aware of the alleged exceptions in the Otarys of Australia: the *Zalophus lobatus* Peters, a true hair seal, having, it is said, considerable under-fur when young. This is probably the case, to a greater or less extent, with the young of all the hair seals prior to the first moult. I feel sure, however, that it is quite different in character from the soft, long, dense fur of the true fur seals. It may be added that the genus *Zalophus* is in other respects, as in size and the general shape of the head, somewhat intermediate between the fur and hair seals, though its affinities are decidedly with the latter.

taneously, as the names of different sub-divisions of the group, but *Arctocephalina* still embraced both hair and fur seals. Later still, the same author restricted *Otariina*, so that it embraced but a single species, while the other, also greatly restricted in its scope, embraced still both hair and fur seals. In view of this confusion, the name *Trichophocinæ* * is proposed for the hair seals, and *Oulophocinæ* † for the fur seals, in allusion to the different character of the pelage in the two groups.

Hitherto, owing to the fact that our best classifications of them have been based mainly on the number and position of the molar teeth, the hair and fur seals have been associated pell-mell and in almost every possible mode of combination. Formerly *Arctocephalus* was a heterogeneous association of members of two widely different natural groups. Although of late the hair and fur seals have been usually placed in different genera, the genera of the one set have variously alternated in the systems of different authors, and in the different systems of the same author, with those of the other set.

Comparison of the Skeleton of the Otariadæ with those of the Principal Types of the Phocidæ.

The chief osteological differences which serve to distinguish the eared seals from the other types of the Pinnipedes, as the common *Phoca*, ‡ *Cystophora*, *Monachus*, *Macrorhinus*, and *Rosmarus*, § may be indicated as follows: —

Comparison of the Otariadæ (Eumetopias) *with* Rosmarus. — The eared seals (of which *Eumetopias* is here taken as the type) differ

* θρίξ = hair, and φώκη = *Phoca*.

† οὖλος = soft, φώκη = *Phoca*.

‡ The materials mainly used in the following comparisons consist as follows: (1.) Of the eared seals, two complete ligamentary adult male skeletons of *Eumetopias Stelleri*, and two adult male and two adult female complete ligamentary skeletons of *Callorhinus ursinus*. (2.) Of the earless seals, a complete adult male ligamentary skeleton of *Phoca vitulina*, and other partial skeletons of the same species; three complete ligamentary skeletons of *Cystophora cristata*, and two nearly complete disarticulated male skeletons of *Macrorhinus elephantinus*, besides partial skeletons of other species. (3.) Of the walrus, two complete ligamentary skeletons. Cuvier's figures of the skeleton of the "Phoque à ventre blanc" (*Monachus albiventer*), Pander and D'Alton's of that of the *Otaria jubata*, and Schelgel's of that of *Zalophus Gillespii*, have also been examined.

§ *Trichechus*, as has been pointed out by Peters and Gill, was originally based by Linné (Syst. Nat., 10th Ed., 1758, I, 34) solely on the Manati (*T. Manatus*), and must hence be retained for that animal

from *Rosmarus* in the form of the skull, in the relative length of the cervical vertebræ, in the form of the scapulæ, and in general proportions. In respect to the limbs, the principal difference consists in the relatively greater shortness of the foot in the walrus as compared with the other extremital segments (the femur and tibia posteriorly and the humerus and radius anteriorly), and the great divergence of the digits of the hind feet.

A skeleton of an aged male Alaska walrus I find varies in length but a few centimetres from that of an aged male of *E. Stelleri*. The dorsal and lumbar vertebræ have the same length in both, but the cervical vertebræ in the walrus are considerably shorter, and the caudal somewhat longer, than they are in the other. A vast difference, however, is seen in the general form, the *E. Stelleri* being slender and the walrus exceedingly robust, the bulk of the body in the latter being nearly twice that of the former. This gives a greater length to the ribs of the walrus, and much larger centrums to its vertebræ; but the development of most of the vertebral apophyses is nearly the same in both. The great thickness of the body also serves to increase the disproportionate shortness of the neck, as well as to increase the relative size of the pelvis and the divergence of the ilia. The limbs also are hence necessarily longer in proportion to the length of the body. The feet, however, are proportionally less developed than in the eared seals, and the whole form of the body indicates an animal of slow movements, especially in the water, and of rather sluggish habits.

The scapula in the walrus is long and narrow, with its greatest breadth near the middle, and its spine or crest situated but little behind the median line. In *Eumetopias* the scapula is short and broad, with its greatest breadth at the upper border, and its spine quite near the posterior edge. These considerable differences seem to result necessarily from the correlation of the form of the scapula with the great depth of the body.

The great differences which obtain in the skulls of these types, through the enormous development of the canines in the walrus, are too well known to require a detailed description. In the latter the skull is exceedingly massive throughout, but is especially developed anteriorly, to afford support to the immense tusks, while in *Eumetopias* it has the normal carnivore form.

The bones of the walrus, it may be added, are lighter and softer than

those of the eared seals, but they are far less so than those of some of the earless seals, especially *Macrorhinus*, in which they are more porous than in some of the cetaceans. All the sternal segments in the walrus are much less ossified than in the *Otariadæ*; in the former the first and ninth are almost wholly cartilaginous, leaving but eight ossified. In *Eumetopias* all are ossified, the first being also developed anteriorly into a long bony point, and the ninth similarly developed posteriorly.*

Hence the *Otariadæ* differ from the walrus type not only in many details of structure, but radically in the general form and proportions of the whole skeleton.

Comparison with the PHOCA VITULINA. — The eared seals differ vastly from the earless seals, as represented by *Phoca vitulina*, in almost every feature. In addition to the well-marked differences of form existing between nearly all the principal bones, there are remarkable regional variations which indicate a wide difference in the zoölogical rank of the two types. In the eared seals the length of the cervical and thoracic regions of the body, as compared with its whole length, is much greater than in *Phoca*, but in respect to the lumbar and pelvic regions the reverse of this obtains, these regions being most developed in the *Phocidæ*.† In the eared seals (*Eumetopias* and *Callorhinus*, which represent the two leading types of the eared seals) the ratio of the length of the cervical vertebræ to the whole length of the spinal column is as 19 to 100; in *Phoca vitulina* as 18 to 100. In the former, the ratio of the length of the dorsal vertebræ to the whole length of the spinal column is as 44 to 100; in *Phoca vitulina* as 37 to 100. That of the lumbar to

* See the detailed measurements of the skeletons of *E. Stelleri* and *Callorhinus ursinus* given beyond.

† The following table gives the dimensions (in mm.) and the proportions of the different regions in *E. Stelleri*, *C. ursinus*, *P. vitulina*, and the Alaska walrus.

	E. Stelleri. ♂	*C. ursinus.* ♂	*Ph. vitulina.* ♂	*Rosmarus.* ♂
Length of the cervical vertebræ	480	400	235	330
" " dorsal "	1.130	780	480	1,130
" " lumbar "	370	270	220	370
" " caudal "	520	310	370	580
" " spinal column	2,500	1,700	1.305	2,410
" " sternum	840	630	270	590
Ratio of length of cervical vert. to spinal column,	15-100	23-100	18-100	14-100
" " " dorsal " " "	43-100	44-100	37-100	47-100
" " " lumbar " " "	15-100	15.1-100	17-100	15.4-100
" " " caudal " " "	21-100	20-100	28-100	24-100
" " " sternum " "	34-100	36-100	20.7-100	24.5-100

the whole length is in the former as 15 to 100; in *P. vitulina* as 17 to 100. The same proportion in respect to the caudal vertebræ is in the former as 20 to 100; in the latter as 28 to 100.* The relative length of the sternum to the spinal column is as 35 to 100 in the eared seals, and as 28 to 100 in *Phoca vitulina*, indicating in the latter the relative shortness of the thorax as compared with the whole length of the animal, and hence its eminently cetacean form.

In regard to the skull, Turner † showed many years since that the eared seals are distinguished from the others by important cranial differences. He compares them as follows: In the earless seals "there is no trace of a postorbital process, nor of an ali-sphenoid canal; the mastoid can scarcely be said to constitute a process; it is swollen, and appears to form a portion of the auditory bulla, more or less connected with the tympanic portion, from which it is separated by a depressed groove running from the stylo-mastoid foramen backwards and a little inwards. The paroccipital process is never large in any of the family, but it is always distinctly developed and salient backwards. The Arctocephaline group are distinguished at once by their having a distinct postorbital process and an alisphenoid canal; the mastoid projects as a strong process, and seems, as it were, to stand aloof from the auditory bulla." In *Phoca* and in other types of the *Phocidæ*, the bulla is many times greater than in the *Otariadæ*, its increased size being doubtless compensatory for the absence of an external conch. In the latter the occipital and sagittal crests in old age attain an enormous development, which only a few of the higher forms of the *Phocidæ* at all approach.

Considerable differences are also found in the form of the different bones of the extremities of the two types. In the anterior extremities, these consist in the reduced size and structurally low form of the scapula in *Phoca*, as compared with *Eumetopias* and *Callorhinus* ‡ (Figs. 12, 13,

* In *E. Stelleri* as 15 to 100; in *C. ursinus* as 23 to 100; in the latter there being a greater development of the post-sacral vertebræ.

† Proc. Lond. Zoöl. Soc., 1848, p. 84.

‡ The general form of the scapula in these groups (including *Rosmarus* and *Macrorhinus*) is indicated by the following table:—

	Rosmarus.	*Eumetopias.*	*Callorhinus*	*Phoca.*	*Macrorhinus.*
Length	420	370	215	125	325
Breadth	260	405	280	110	215
Ratio of breadth to length .	6-10	11-10	13-10	9-10	6.6-10

and 16, Plate III). In the latter the acromion is developed almost as much as in the terrestrial carnivores, the crests are high, and the expansion of the blade very great. In *Phoca* the blade is small, expanded about equally anteriorly and posteriorly, the crest moderate, and the acromion process slightly developed. The greater tuberosity of the humerus, though large, does not rise above the base of the head of the humerus, whilst the lesser tuberosity rises as a sharp point to a greater height than the head of the humerus. In *Eumetopias* and *Callorhinus* these conditions are reversed, the lesser tuberosity being but slightly developed, whilst the greater is excessively so, rising to a greater height than the head of the humerus, and extending downwards more than half the length of this bone, — much farther than in *Phoca*. Differences are also traceable in the form of the bones of the forearm, carpus, and metacarpus. In respect to the digits of the hand, they differ less in size and length in *Phoca* than they do in the *Otariadæ* and in *Rosmarus*.

By far the most important differences, however, are found in the posterior organs of locomotion, — the pelvis and the hind limbs. The latter are relatively smaller in the *Phocidæ* than in the *Otariadæ*, and are very differently constructed and adapted to widely different uses, as indicated in the following comparison.

In the *Phocidæ* the hind limbs are extended backwards in a line parallel with the body; the legs are so enclosed within the integuments of the body that they have little or no motion, and the feet are movable only in a relatively small degree, in an obliquely lateral direction.

In the *Otariadæ* the hind limbs are somewhat free, and when in a natural position (on land) the feet are turned forward, and serve to raise the body from the ground.*

* It may be added that the foot is also relatively longer, as compared with the length of the leg, than in *Phoca*, as shown by the following table, whilst the differences in the size of the outer toes as compared with the middle ones is also greater.

	Eumetopias.	*Callorhinus.*	*Romarus.*	*Phoca.*
Length of fore limb	1,045	705	1,010	330
" " humerus	320	200	350	120
" " radius	275	205	270	110
" " hand	450	300	350	130
Ratio of length of hand to that of radius	16-10	15-10	13-10	12-10
Length of hind limb	1,000	705	1,040	600
" " femur	200	135	250	100
" " tibia	350	220	370	210
" " foot	450	350	420	290
Ratio of length of foot to tibia	13-10	16-10	11-10	14-10

In consequence of this peculiar structure the only purpose which these organs can subserve is that of swimming. On land progression is mainly accomplished by a wriggling serpentine motion of the body, slightly assisted by the extremities.

They also (imperfectly) serve the purpose of walking; these animals being able to progress when out of the water several miles an hour, and to run for a short distance with nearly the rapidity of a man.*

In the *Phocidæ* the tarsal articulation allows but a small amount of movement of the foot, which when naturally at rest forms but a slight angle with the leg.

In the *Otariadæ* the foot when similarly at rest forms with the leg an angle of at least 90°.

In the *Phocidæ* no unusual sexual difference in the form of the pelvis is known to exist; the principal difference being that the pubic bones are united for a shorter distance in the females than in the males. In the *Phoca vitulina* the pelvis, seen from the front, presents a pyramidal outline, with the apex pointing backward. Laterally and ventrally its outlines are straight.

In the *Otariadæ* (in *Callorhinus* and *Eumetopias* † at least) there is an exceedingly great sexual variation in the form of the pelvis. In the males it is narrow throughout, and seen from the front the sides are nearly parallel for the greater part of its length, the pubic bones abruptly converging posteriorly, and the ilia diverging moderately at their anterior ends. The front outline is gently hollowed.

The ilia are short and broad (length and breadth about equal), expanding anteriorly in a transverse line. Their crests are turned abruptly outward and recurved, their posterior surfaces being concave.

The ilia are elongated (twice as long as broad), flattened posteriorly, with their dorsal and ventral borders parallel, and no lateral expansion or recurvation of the crest.

The pubic bones are straight, slender, and subcylindrical; posteriorly they become flattened and somewhat expanded dorso-ventrally. In the male they are appressed posteriorly for one third their length, their point of widest divergence being at their anterior ends. In the females, however, they merely meet at the end,

The pubic bones are stout and subcylindrical, a little broader and thinner behind, approximating both anteriorly and posteriorly. Barely meeting (in the males) at the latter point, they form with each other a more or less broad ellipse, which is only slightly open anteriorly in *Callorhinus*, but more widely in *Eumetopias*. They

* See Captain Bryant's account, given below, of the habits of *Callorhinus ursinus*.

† The pelvis of *Callorhinus* differs from that of *Eumetopias* somewhat in certain details of its structure, as will be shown later in the comparison of these two species under *C. ursinus*.

much as in the *males* of the eared seals.	are not partially united as in *Phoca*, but merely touch each other at their extremities, and are most widely separated at the middle.
The ischia are dorsally arched, especially their dorsal margins, which rise in a high angular point opposite the posterior third of the thyroid foramen. Anteriorly they are subcylindrical, but posteriorly are flattened into broad thin blades, and unite with the corresponding parts of the pubic bones.	The ischia are considerably arched above, but otherwise have nearly the same form and size as the pubic bones. Their dorsal margins have not the high angular prominence seen in *Phoca*.
The thyroid foramen is an irregular elongated ellipse, its pubic outline being nearly straight.	The form of the thyroid foramen is nearly the same as in *Phoca*.
The ilio-pubic spine is prominent, but the iliac tuberosity is wholly absent.	The ilio-pubic spine is very large, and the iliac tuberosity is not only present, but is enormously developed.
The middle of the acetabulum is situated a little in front of the posterior end of the *first* sacral vertebra, which is considerably anterior to its position in the eared seals.	The middle of the acetabulum is situated but a little in front of the posterior end of the *second* sacral vertebra, — the length of the second sacral vertebra posterior to its position in *Phoca*.
Four fifths of the length of the innominate bone is posterior to the acetabulum, — in other words, the proportion of the length of the ischio-pubic part to the length of the ilia is as *three* to *one*.	Only slightly more than one half of the length of the innominate bone is behind the acetabulum. Hence the proportional length of the ischio-pubic portion to the ilium is nearly as *one* to *one*.
The bones of the pelvis are all thin and slender.	The bones of the pelvis are all thick and stout, especially the walls of the acetabula. The acetabula are themselves very much larger than in *Phoca*.

In recapitulation it may be stated that the essential or most striking pelvic differences in the males between *Phoca* and *Eumetopias* and *Callorhinus* consist in the abbreviated ilia, with their outwardly produced crests, the greater elongation of the pubic and ischiac bones, and the more anterior situation of the acetabula in *Phoca* as compared with the others.

In *Phoca* and the earless seals generally no great sexual differences in the structure of the pelvis appears to be known. From the great breadth of the pelvis between the pubic bones in the male, no modification of the male form of the pelvis would seem requisite in the female. In the eared seals, however, especially in *Callorhinus*, the pelvis is exceedingly narrow, especially anteriorly, in the males, and of small capacity. In the females it is hence necessarily entirely open in front, and the pubic bones and the ischia are reduced to a mere bony rim enclosing the very large thyroid foramen. The ventral borders of the innominate bones are also less produced. The more posterior position of the acetabula in the eared seals places the hind limbs in a position better fitting them to support the body, and hence for terrestrial locomotion. They are, in fact, placed but little anterior to their position in many of the true walking mammalia.

The following table of comparative measurements indicates the difference in proportions and form of the pelvic bones in *Phoca*, *Macrorhinus*, *Eumetopias*, *Callorhinus*, and *Rosmarus*: —

	Rosmarus. ♂	*Eumetopias.* ♂	*Callorhinus.* ♂	*Callorhinus.* ♀	*Phoca.* ♂	*Macrorhinus.* ♂
Length of the os innominatum . .	330	350	235	140	190	380
Breadth (externally) at iliac crests	330	160	110	75	135	—
" " at acetabula .	195	120	55	40	67	—
Length of ilium	180	150	100	60	50	130
Breadth (antero-posterior) of do. .	90	80	45	23	57	—
Length of ischium and os pubis .	250	200	135	70	140	260
Greatest breadth of ischio-pubic bones	160	110	70	35	73	180
Length of thyroid foramen . .	150	125	65	45	87	150
Breadth " " . . .	65	50	28	20	25	73
Transverse diameter of the brim .		40	15	25	40	—
" " of the inferior outlet		70	28	35	25	—
Ratio of length of ilium to ischium	72-100	75-100	71.5-100	86-100	28-100	50-100

Owing mainly to the great elongation of the very thick neck in the *Otariadæ*, the fore limbs, as long since mentioned by Cuvier,* are apparently placed much farther back than in the *Phocidæ*.†

The neural spines in *Phoca* are but slightly developed, especially anteriorly, whilst in *Eumetopias* and *Callorhinus*, as well as in *Rosmarus*, they are largely developed, especially those of the anterior dorsal verte-

* Oss. foss., Vol. V, p. 216.

† By actual measurement they are found to be but little anterior to the middle of the entire length of the animal.

bræ, which in *Phoca* are the smallest. These features, with others of a similar character, especially the high crests of the skull in all the eared seals, show these animals to be possessed of relatively much greater muscular power than the common *Phoca*, and that they are not only fitted for greater activity on land, but that they must also possess superior powers of motion in the water. The most strongly developed features in the skeleton of the *Phoca* type are those that best serve its strictly aquatic mode of life, and the character of its whole structure, as previously mentioned, gives it a rank far below the *Otariadæ*.

Comparison with MACRORHINUS, CYSTOPHORA, *and* MONACHUS. — In respect to size the *Phoca vitulina* and the *Macrorhinus elephantinus* represent the two extremes, not only of the *Phocidæ*, but of the Pinnipedes, the sea elephant in size far exceeding the walrus. Yet in general osteological features *Macrorhinus* is strikingly like *Phoca*. In the form of the pelvis and scapulæ, however, it slightly approaches the *Otariadæ*, and what is known of its habits indicates that it has greater powers of locomotion on land than the common *Phoca*.

Cystophora differs in no important particular in the general skeleton from *Phoca* and *Macrorhinus*. *Monachus*, from Cuvier's* figure of its skeleton, much more nearly approaches the *Otariadæ*, and is hence a higher form than either *Macrorhinus*, *Phoca*, or *Cystophora*. The greater development of the neural spines and the other apophyses, the strongly developed crests of the skull, the very broad strongly keeled scapulæ, together with numerous other osteological features, indicate it to be an animal of great muscular power, whilst at the same time its comparatively slender form, and especially the elongated form of the thorax, indicate that it has a much nearer affinity to the *Otariadæ* than either *Macrorhinus*, *Cystophora*, or *Phoca* have.

These four forms — *Monachus*, *Macrorhinus*, *Cystophora*, and *Phoca* — represent four of the leading types of the *Phocidæ*. Their relative rank is doubtless in the order given, *Monachus* being unmistakably the highest and most like the *Otariadæ*. *Stenorhynchus*, it seems to me, is still lower than either of the above-mentioned genera. I should hence arrange the sub-families of the *Phocidæ* in the following order, with *Monachus* as the highest genus of *Phocinæ*, which is the highest sub-family:—

PHOCINÆ.

CYSTOPHORINÆ.

STENORHYNCHINÆ.

* Oss. foss., Tome V, Plate XVII.

OF THE SEXUAL, AGE, AND INDIVIDUAL VARIATIONS.

Sexual Differences. — Whilst in the carnivores generally the sexual variations are considerable, especially in respect to size, they seem to never exist in greater degree than in the *Otariadæ*. In all the species of this family in which the sexes are well known, — especially in *Otaria jubata*, *Eumetopias Stelleri*, *Callorhinus ursinus*, and *Arctocephalus falklandicus*, — it has been found that the weight of the adult females is rarely above one sixth to one fourth that of the old males; — a sexual disproportion in size rarely if at all elsewhere met with in mammals. In the Pinnipedes the nearest approach to it is in the sea elephant (*Macrorhinus elephantinus*), which in some of its habits, as previously mentioned, also approaches nearer to the eared seals than any other well-known species of the *Phocidæ*.

The sexes differ also in *color*, the females being generally much lighter colored than the males.

They also differ in the size of the teeth, especially of the canines; the females having relatively, as well as absolutely, much smaller teeth than the males. The form of the palatal surface of the maxillaries also varies in the two sexes, in the females it being usually flatter or less depressed than in the males, and its lateral outlines straighter. The females also lack the high crests of the skull possessed by the males, and have the processes of the bones less developed.

One of the greatest sexual differences, however, is seen in the pelvis. In the female it is much smaller than it is in the male, and the pubic bones instead of meeting behind, as in the males (and also in the females in the *Phocidæ*), are widely separated, and with the ischia are reduced to a slender rim enclosing the large thyroid foramen; at least this is the case in *Callorhinus ursinus*, and there seems to be no reason for believing that similar differences in the structure of the pelvis do not exist in the other species of the *Otariadæ*.*

* Respecting the sexual differences in the *Otaria jubata*, Dr. G. A. Maack has furnished me with the following note: —

"The most striking feature in *Otaria jubata* is the great dissimilarity between the males and females, not only in respect to size and general external features, but also in their osteological structure. It is a curious fact, that, whilst the male changes greatly with age in respect to its osteological characters, the female presents in this respect a greater or less constancy of character. In color, however, the reverse obtains, — the males preserving a greater constancy in this respect, whilst the females vary exceedingly at different ages."

Differences resulting from Age. — In color the young differ from the adult, as in most mammals, in being very much darker, especially previous to the first moulting of the pelage. During the first few months the young of both sexes of the fur seals are black, whilst the old males are more or less brownish- or grayish-black, and the females cinereous. In the hair seals the young are dark reddish-brown, whilst the adult are pale yellowish- or grayish-brown. The first coat of hair in the young is somewhat different in character from that they have later, in both the fur and hair species. The latter, whilst quite devoid of fur in adult life, or possessing only an exceedingly sparse undercoat of crisp curled hair rather than fur, are said to have more or less "fur" when young. This is affirmed more especially of the *Zalophus lobatus*, but doubtless the young of all the hair seals have a softer coat than the adult.

In respect to the form of the skull, the young greatly differ from the adult, as is sufficiently indicated by the figures of the young and adult skulls of *Callorhinus ursinus* given in Plates II and III, and described in detail in the account of that species, and as is also shown in the figures of young and adult skulls of *Zalophus Gillespii* given in the Fauna Japonica (Mamm., Plate XXII). It appears that the brain-case early reaches its full size, and changes later mainly through the thickening of its walls. The facial portion is more slowly developed, so that the proportions of the very young and the mature skull are widely different. As regards the general skeleton, my material does not allow me to speak.

Individual Variation. — In order to determine what characters may be most useful in distinguishing genera and species, it is necessary to take into account the individual variation to which the different parts are subject, as well as the differences resulting from sex and age. Formerly, when but few specimens of any species of the *Otariadæ* were known, it was natural to suppose that any characters based on the adult form of the skull or of its different bones might be regarded as affording reliable specific and generic characters. As more material was acquired, it became evident that these parts in the present group were unusually variable, and hence to a great degree unreliable as the foundation for specific or even generic diagnoses. The general form of the skull, the depression of the bony palate, the posterior extension of the palatines and their posterior outline, and also the situation of the last molar relative to the anterior edge of the zygomatic foramen, and the number and form of the molars, have been generally taken as the basis

of generic divisions. All these parts, however, have recently been found to vary greatly, not only with age and sex, but in specimens of the same age and sex. The form of the hinder edge of the palatines, as to whether it be convex, truncate, or emarginate, has been especially relied on for the distinction of both species and genera, yet the specimens before me show that in the same species, in skulls of equal age and of the same sex, the posterior border of the palatines may be either truncate or deeply emarginate.

The situation and form of the molars also vary in a similar way, as does also the depression of the palate. The general form of the skull varies greatly in adults of the same sex, as shown by specimens of adult males of each of the three North Pacific species now before me; so much so, indeed, as to materially alter the relative proportions of the different regions. The form of the frontal region, or third segment of the skull, is especially liable to great variation, as indicated by the two male skulls of *Callorhinus ursinus* figured in Plate II (Figs. 1 and 2). Two skulls of the *Zalophus Gillespii*, received too late for illustration, show much greater differences in this respect than these do. They closely resemble in relative size and form the two adult male skulls of the same species figured in the Fauna Japonica (Mamm., Pl. XXII, Figs. 1–4). In the figures of these skulls, as seen from above (Fig. 2 and 3, l. c., Fauna Japon.), these differences are very strikingly shown. Through the deep and abrupt postorbital constriction of the skull, the latero-anterior angles of the brain-case are sometimes well developed, whilst in other specimens of the same species, age, and sex, through the less abruptness of this constriction, they are either but slightly prominent or obsolete. These differences give in one instance a *quadrate* form to the brain-case, and in the other a *triangular* form. The length of the postorbital cylinder of the skull is also an exceedingly variable element, the difference amounting in some cases to nearly thirty per cent, and hence greatly changes the general form of the skull.

The great degree of asymmetry exhibited by these animals may be also cited as evidence of an unusually great tendency to variation.* Further evidence of the same tendency is seen in the somewhat frequent occurrence of supernumerary molars in the upper jaw, — instances of which will be presently cited.

* See remarks on this point beyond, under *Eumetopias Stelleri*.

The form and position of the molars in the same species is also far too variable to be of much taxonomic value, even in respect to genera,* although they form one of the principal elements on which has been based one of the latest generic revisions of the group.†

The roots of the molars often vary considerably in the two sides of the jaw in the same specimen, and most markedly in different co-specific specimens of the same sex and age. In one of the males of *C.*

* The details of the individual variation shown in numerous points by my specimens of the North Pacific species will be more fully given later.

† In October, 1869, Dr. J. E. Gray published the following classification of the *Otariadæ*, based, as will be seen, on a few eminently variable characters of the skull and teeth. That it should have been otherwise than palpably unnatural and arbitrary could hardly be expected. The *alleged* differences between the genera are very slight, and in some cases almost inappreciable, as for instance between *Zalophus* and *Neophoca*; the really important differences which sometimes exist between the different groups being unmentioned.

"Section I. *Palate produced behind to a line even with the condyles of the jaws. Grinders* $\frac{6}{5}-\frac{6}{5}$. SEA LIONS.

Tribe 1. OTARIINA.

1. *Otaria.* East and west coast of South America.

Section II. *Palate only extended behind to a line even with the middle part of the zygomatic arch.* SEA BEARS.

Tribe 2. CALLORHININA. Grinders $\frac{6}{5}-\frac{6}{5}$; skull oblong; face broad, shorter than the orbit; forehead arched.

2. *Callorhinus.* Northwest coast of America.

Tribe 3. ARCTOCEPHALINA. Grinders $\frac{6}{5}-\frac{6}{5}$; face of the skull shelving in front; the fifth and sixth grinders behind the front of the zygomatic arch.

3. *Phocarctos.* Grinders large, lobed, the six upper with two notches on their hinder edge. South America.
4. *Arctocephalus.* Grinders thick; crown conical. Africa.
5. *Euotaria.* Grinders large, subcylindrical; crown conical; face broad. South America.
6. *Gypsophoca.* Grinders moderate-sized, compressed, with a small, more or less distinct lobe on the front edge of the cingulum; face narrow, compressed. Australia.

Tribe 4. ZALOPHINA. Grinders $\frac{5}{5}-\frac{5}{5}$, large, thick, in a close, continuous series; the fifth upper in front of the back edge of the zygomatic arch.

7. *Zalophus.* Grinders large and thick, in a close uniform series. *South America.* [!]
8. *Neophoca.* Grinders large, thick, all equal, in a continuous uniform series. Australia.

Tribe 5. EUMETOPIINA. Grinders $\frac{5}{5}-\frac{5}{5}$, more or less far apart; the hinder upper behind the hinder edge of the zygomatic arch, and separated from the other grinders by a concave space.

9. *Eumetopias.* West coast of America.
10. *Arctophoca.* West coast of South America."

ursinus already mentioned, the fangs of several of the molars have a deep longitudinal groove on the outside, the fangs appearing to be formed of two connate roots, but in the corresponding molars of the other specimen there are no grooves, the fangs being wholly simple.

Great variations in the form of the teeth and the bones of the skull have also been pointed out as existing in several species of the *Phocidæ*.* Naturalists are fast becoming aware of the fact that the bones of animals generally are not so invariable in form and proportions as formerly supposed, and hence afford less reliable characters for the discrimination of species than has been generally believed.† Such facts evidently show that too high a value has been placed upon certain relatively slight differences in the form of the teeth and certain parts of the skull.

Color is one of the features commonly much relied on for the distinction of *species* among the higher vertebrates. In the case of the *Otariadæ*, as also happens in other groups, this feature proves to be in no small degree unreliable. In respect to the hair seals, the three or four best known species (*Eumetopias Stelleri*, *Zalophus Gillespii*, *Z. lobatus*, and *Otaria jubata*) so closely resemble each other in color, and different individuals of the same species at the same time vary so much in this regard, that a description of the color of either of the species is almost equally applicable to all. This is equally the case in the fur seals, where sometimes specimens of such really widely distinct species as the *Callorhinus ursinus* and the *Arctocephalus falklandicus* seem hardly distinguishable in color.‡

Habits.

In respect to general habits the eared seals seem to have much in common that distinguishes them from the *Phocidæ*, at least so far as the habits of the latter are known. All the species appear to assemble in

* See especially an important paper by Dr. J. E. Gray, entitled "On the Variations in the Teeth of the Crested Seal, *Cystophora cristata*," etc., Proc. Lond. Zoöl. Soc., 1849, pp. 90–93. Also, by the same author, another entitled "Notes on Seals (*Phocidæ*) and the Changes in the Form of their Lower Jaw during Growth," Ann. and Mag. Nat. Hist., 4th Series, Vol. IV, pp. 342–346, November, 1869.

† See "Mammalia of Massachusetts," Bulletin Mus. Comp. Zoöl., Vol. I, pp. 143–252, October, 1869.

‡ In respect to a skin of *C. ursinus* from California, Dr. Gray has remarked: "The skin is so like that of *Arctocephalus nigrescens* [=*falklandicus*] that we were induced to regard it as a second specimen of that species before we received the skull." (Catalogue of Seals and Whales, p. 52.)

vast numbers at certain favorite places of resort,—usually isolated rocky islands,—for the purpose of reproduction, where they spend several weeks or months, when undisturbed, almost entirely on land. They being eminently polygamous, the old males select their stations and assemble around them a numerous harem, which they guard with the utmost jealousy. Numerous bloody combats ensue between the rival males for the possession of the females, or for favorite stations, and the roaring of the males it is said can be heard for many miles. One young, or at most two, are annually brought forth by each mature female, the period of gestation being about twelve months. Captain Bryant's account* of the habits of the northern fur seal renders unnecessary a detailed account of the habits of any of the species here, especially since the notes added to Captain Bryant's paper sufficiently indicate the similarity of habits which all the species seem to share during the important season of reproduction.

One of the most striking features in their history is that at this period both sexes pass weeks, and even months, without food or without often visiting the water. Arriving at the breeding-grounds exceedingly fat and unwieldy, they seem to be sustained by the fat of their bodies, they finally leaving at the end of the breeding-season greatly emaciated.

A similar fact has been long known in respect to the walrus, whose period of fasting, however, seems to be shorter than that of the eared seals.

In respect to breeding habits, the sea elephant (*Macrorhinus elephantinus*) is the sole species of the earless seals which seems to quite closely resemble the *Otariadæ*. They assemble in a similar manner at their breeding-grounds, and pass much of their time during the reproductive period on the land, and probably without taking food; but the accounts of travellers are on this point somewhat contradictory. It does not appear, however, that they are to so great a degree polygamous. And they move on the land with great difficulty, and go but a short distance from the water.

OF THE GENERA AND SPECIES.

Of the Genera.—The genus *Otaria* was, as previously stated, proposed to embrace all the eared seals as a group distinct from the earless seals, for which the name *Phoca* was retained. But naturalists have found it necessary, as our knowledge of these animals has increased, to

* See Part II, beyond.

greatly subdivide each of these groups. *Otaria* is now restricted to a single species; while the original *Otaria* (=*Otariadæ*), as defined by Péron, has been separated into ten groups to which generic rank has been accorded; none of them containing more than a single species.

The first division of the *Otariæ* was made by F. Cuvier* in 1825, who separated them into two genera, *Platyrhynchus* and *Arctocephalus*, with the *O. jubata* of recent systematists as the type of the former, and *Arctocephalus Delalandii* (*antarcticus*) as the type of the latter. Dr. Gray,† in 1859, separated generically the Northern fur seal from *Arctocephalus*, under the name of *Callorhinus*.

The next subdivision of the group was made by Dr. Gill,‡ in 1866, who in his "Prodrome of a Monograph of the Pinnipedes," separated them into five genera.§ These appear to be natural groups, of true generic rank, and properly restricted; and, after a careful examination of the subject, and specimens of four of these five types, they appear to me to include all the natural genera of the family. As has been previously pointed out by Gray and Peters,|| Dr. Gill, as he himself now freely admits, wrongly retained the name *Arctocephalus* for Gray's genus *Callorhinus*, and consequently substituted *Halarctus* for what had previously been regarded as *Arctocephalus*. Two of these genera (*Eumetopias* and *Callorhinus*) include but a single known species each; *Otaria* has possibly two, *Zalophus* two, and *Arctocephalus*, according to the views of different writers, three or four.

Professor Peters,¶ in 1866, divided *Otaria* into seven sections or subgenera, he adding two (*Phocarctos*, type *Otaria Hookeri*, and *Arctophoca*, type *Otaria Philippii*, a nominal species, = *Arctocephalus falklandicus*) to the number of divisions recognized by Gill. The principal character on which the latter (*Arctophoca*) was first founded proved to be an invalid one,** yet it was subsequently transferred by Peters, with a slight modification of its diagnosis, to the *Arctocephalus falklandicus*.

* Mém. du Mus., Vol. XI, p. 205. † Proc. Lond. Zoöl. Soc., 1859, p. 359.

‡ Proc. Essex Institute, Vol. V, p. 7.

§ *Otaria*, type *Phoca jubata* Schreber; *Arctocephalus*, type *Phoca ursina* Linné; *Eumetopias*, type *Otaria californiana* Lesson, = *Arctocephalus monteriensis* Gray; *Zalophus*, type *Otaria Gillespii* McBain; *Halarctus*, type *Arctocephalus Delalandi* Gray.

|| See above, p. 7 of the "Résumé." ¶ Monatsb. Akad. Berlin, 1866, pp. 261, 665.

** The number of molars of *A. Philippii* was supposed to be $\frac{6}{6} - \frac{6}{6}$ instead of $\frac{6}{5} - \frac{6}{5}$, as in the other fur seals, but the skull figured and described by Peters as that of this species had evidently lost the fifth (last but one) pair of molars, as shown by his figure of the skull. Peters himself afterwards referred his *A. Philippii* to the *A. falklandicus*.

Dr. Gray, in his various papers published since the appearance of Professor Peters's papers, has not only recognized as genera all the genera and subgenera previously proposed by Gill and Peters, including *Arctophoca*, with essentially Professor Peters's *first* diagnosis of it (including the dental formula!), but has added three others (*Euotaria*, *Gypsophoca*, and *Neophoca*). Taking into account the nature of the diagnostic characters of his pseudo-genera given in his last synopsis of the family,* his classification is too palpably arbitrary to require a detailed review.

Of the Species. — For a long period the northern sea lions were by most writers regarded as specifically identical with the southern sea lions, and the northern sea bears with the southern sea bears. Péron in 1816 first called attention to the fact that the northern and southern sea lions and sea bears were distinct species. During the following twenty-five years many naturalists of high authority still regarded them as identical, whilst others considered them as distinct. In 1840 they were for the last time seriously confounded; but until within the last four years the two species of *Zalophus*, the one northern and the other southern, have been regarded as one. It is now generally believed, however, that in no case is the same species found on both sides of the equator.† In Péron's time there were commonly believed to be but a single species of sea lion and a single species of sea bear. He however affirmed that as many as twenty species of sea bears alone were confounded under that name. Since that time many nominal species have been described, — doubtless partly in consequence of Péron's remark, — until the number of distinct names applied to the different sea lions and sea bears exceeds fifty, while probably the number of veritable species is not more than ten. This, in fact, is the number now most commonly recognized. In consequence of the early confounding of the northern with the southern species, an extraordinary complication of synonymy has resulted, several of the earlier names having been applied by different writers to several different species. The synonomy of some of these species hence embraces a list of ten to fifteen different and variously applied names.

Of the hair seals, four apparently unquestionable species are now well

* Ann. and Mag. Nat. Hist., 4th Series, Vol. IV, p. 269. This synopsis has already been quoted in full on p. 35.

† See further remarks on this point below, under the head of "Geographical Distribution."

known, two of which (*Eumetopias Stelleri* and *Zalophus Gillespii*) are northern, and two (*Otaria jubata* and *Zalophus lobatus**) are southern. A fifth species (*Otaria Hookeri*), also southern, is likewise commonly recognized. But it appears to be known only from specimens in the British Museum,† collected many years since at the Falkland Islands, and does not seem to have been met with by recent collectors, either at the Falklands or elsewhere. It differs from the *O. jubata*, judging from the figures and the not wholly satisfactory descriptions we have of it, mainly in having the palatal bones less produced posteriorly; at least this is the difference that has been chiefly dwelt on as distinguishing the two, although certain differences in the color of the under-side of the body have also been mentioned. The skull figured by Gray is evidently that of a middle-aged or rather young animal. The form of the bony palate corresponds also with what is seen in middle-aged and young specimens of other hair seals. Having seen apparently as great differences in specimens of the northern species, unquestionably specifically identical, as exists between *O. jubata* and *O. Hookeri*, I am led to question whether the specimens described as *Otaria* [*Phocarctos*] *Hookeri* may not be an unusual state of *Otaria jubata*, the only hair seal now known to exist in the Falkland Islands; the difference resulting partly from age and partly from abnormal development. Not having seen specimens of the *O. Hookeri*, I do not presume to assume it to be referable to *O. jubata;* my design by this reference is mainly to call attention to its somewhat doubtful character.

Two genera of fur seals are also commonly recognized. One of these genera consists of the *Callorhinus ursinus*, or the fur seal of the North. The other genus embraces numerous nominal species, all but one of which have been referred by Peters, and also by Gray in his later papers, to three species, all of which have a southern distribution.

* Péron, under the name *Otaria cinerea* (Voy. aux Terr. austr., Tome II, pp. 54, 77), undoubtedly referred to the so-called *Zalophus lobatus* of recent writers. Although his description is rather meagre, the size given, as well as the character of the hair, and especially the context (at p. 77), render it clear that he must have intended to indicate by this name the species more fully described later by other writers. Péron's name was at first used by Gray to designate what he has since called *lobatus*. Although there is little reason to doubt that Péron's earlier name of *cinerea* refers to this species, it is perhaps not advisable to substitute for a well-established name one of possibly doubtful application.

† See Catalogues of the British Museum (Seals, 1850, p. 45; Seals and Whales, 1866, p. 54; Bones of Mammalia, p. 146, etc.).

These are, *Arctocephalus falklandicus*, — one of the earliest described species of the family, — *A. cinereus* and *A. antarcticus* (= *A. Delalandi*). *A. falklandicus* inhabits the shores and islands of Southern South America; *A. cinereus*, the Australasian Seas; and *A. antarcticus*, the southern coasts of Africa. These species hence have quite widely separated habitats, yet the alleged differences between them are slight, while in size, color, character of the pelage, and general conformation, they possess many features in common. Their distinctness has at times been doubted, and it seems still to remain an open question whether they form a single species or three. That the *A. falklandicus* and *A. antarcticus* hold a close relationship is generally admitted. The *A. cinereus*, or the Australian species, was believed, through certain differences in the fangs of the hinder molars, and the supposed less abundance of the under-fur, to be quite distinct from the others. Professor Peters, in his second paper, placed the *A. cinereus* and *A. antarcticus* in different subsections of his section *Arctocephalus*, characterizing them as follows: "*a.* mit sehr sparsamer Unterwolle" (referring to *A. antarcticus* = *Otaria pusilla* Peters), and "*β.* mit reichlicherer Unterwolle" (referring to *A. cinereus*). It is found, however, that the fur of the latter is equally rich with that of the other species.*

The distribution of these alleged species presents nothing incompatible with the supposition of their identity. They inhabit islands one third as distant from the shores of the South American, African, and Australian continents as these islands are from each other. Other Pinnipedes, as the sea elephant, range over nearly the same area. Moreover, the distance is one of longitude merely, and the physical conditions of this wide area are hence nearly uniform. Until favored with the opportunity of comparing specimens from these several distant points, my opinion as to the identity or diversity of these species must remain unsettled.

In respect to the synonomy of the eared seals, that of the northern species will be presently given in full, in connection with the descriptions of these species. To that of *Otaria jubata*, given so fully by Dr. Gray in his first memoir on these animals, may be added, as clearly shown already by other writers,† the following recently recognized names:

* Ann. and Mag. Nat. Hist., 3d Series, Vol. XVIII, p. 236, 1866.

† For references to the papers wherein the following-named synonymes occur, see the "Résumé of the recent Contributions to the Natural History of the *Otariadæ*," *antea*, pp. 4 – 19.

Otaria Byronia, *O. leonina*, *O. Godeffroyi* and *O. Ulloæ* of Peters, to which should be added the "*O. Ulloæ?*" McBain (= *O. Graii* Günther), the *O. leonina* Maack, and probably also the *O. Hookeri* of Gray.

To the synonomy of *Arctocephalus falklandicus*, given by Professor Peters, the *O.* [*Arctophoca*] *Philippii* Peters and Gray.

To that of the *A. antarcticus* — (= *Otaria pusilla* Peters, = *Arctocephalus Delalandi* Gray) — given by Professor Peters and in Dr. Gray's above-cited catalogues, *A. nivosus* and *A. schisthyperoës* Turner (= *A. schistuperus* Günther).

To the synonymes of *A. australis* may doubtless be added the *A. Forsteri* Gray.

Geographical Distribution. — As long since announced by Péron, the Pinnipedes have their habitats as definitely circumscribed as do the land mammalia. Previously, as already stated, the northern sea lions and sea bears were popularly regarded as specifically identical with the southern sea lions and sea bears; and even as late as 1840 Nilsson entertained the error regarding their identity so universally made by the early writers. It has been found, however, that in only one instance can the species living north and south of the equator be regarded as referable to even the same genus. In this case the species living north of the equator (*Zalophus Gillespii*) ranges the furthest to the southward of the northern species, while its congener living south of the equator ranges furthest to the north of any of the southern species. The habitat of no species, so far as certainly known, quite reaches the tropics.*

The eared seals hence occupy two distinct areas, separated by the broad expanse of the tropical waters. Furthermore, and what is most singular in their distribution, none, as is well known, exist on the shores of the North Atlantic. South of the equator they occupy a broad circumpolar belt, extending from near the tropics to the region of antarctic ice. Here also they reach their greatest numerical development in respect to the number of species; for while three species only are known from the northern waters, at least seven are commonly reckoned as inhabiting the southern waters. As previously remarked, however, this number is probably much too large.

* There is a skull of *Otaria jubata* in the Anatomical Museum of Harvard University, labelled as having come from "Arica, Peru," but I think it doubtful if it was collected at that point.

In respect to genera, the number existing in the northern and southern waters is equal; there being two of hair seals and one of fur seals at the north, and the same number at the south. One genus, *Zalophus*, is found both at the North and South. *Eumetopias* of the North may be regarded as represented at the South by *Otaria;* and *Callorhinus* of the North by *Arctocephalus* at the South. *Callorhinus* and *Arctocephalus* are undoubtedly representative groups; but if we regard the latter as composed of three intimately related species instead of one, we shall have three species of fur seals at the South against one at the North. *Zalophus* is the most southern genus, its single species on each side of the equator nearly reaching the tropics, if not actually existing within them at Moluccas, as represented by Mr. Murray* in his map of the distribution of these animals. Another interesting fact is that on the coast of Asia the northern species of *Zalophus* (*Z. Gillespii*) is well known to inhabit Japan, whilst the home of the southern species (*Z. lobatus*) includes the shores of Australia and the neighboring islands, so that the only two congeneric species of the eared seals distributed on opposite sides of the equator are those whose habitats most nearly approach each other. The distribution of the species is further indicated in the following conspectus, which is designed to give a concise view of the different groups of the eared seals, with their principal distinctive characters, affinities, and the geographical distribution of the species.†

* Geographical Distribution of Mammals, Map XXVIII, 1866.

† The following observations respecting the distribution of the eared seals of the eastern coast of South America have been kindly communicated to me by Dr. G. A. Maack, who in November and December, 1867, visited the coast of Buenos Ayres for the purpose of obtaining specimens of these animals: —

"The eared seals, of the eastern coast of South America, exist especially between the 34th and 40th degrees of south latitude. North of the Rio de la Plata they occur at the Islas de los Lobos, near Maldonado. South of this river they occur in great numbers at the Cabo Corrientes, where they frequent the rocks at the base of the vertical and even overhanging cliffs (160 to 170 feet high) of these shores. I visited the latter locality during the months of November and December, 1867, where I had the opportunity of observing these animals alive. But as Professor Burmeister and myself have already published the scientific results of this excursions [see above pp. 13 and 18], but little requires to be added here.

"As stated in my paper in 'Der Zoologische Garten' (Jan., 1870), only two species of these animals exist on the eastern coast of South America: one, the *Otaria jubata*, from its having but a single kind of hair, is known to the natives as the *Lobo marino con uno pelo;* and the other, *Arctocephalus falklandicus*, from having both external hair and under-fur, is called the *Lobo marino con dos pelos*. Of both I obtained specimens. The

Conspectus of the Genera and Species.

Subfamily I. — TRICHOPHOCINÆ.

Without under-fur. Size large and form robust. Ears short and broad. Molars either $\frac{6}{5} - \frac{6}{5} = \frac{12}{10}$ or $\frac{5}{5} - \frac{5}{5} = \frac{10}{10}$.

I. *Genus* Otaria *Gill ex Péron.*

Palatines usually extending nearly to the pterygoid processes (sometimes reaching them and sometimes terminating considerably anterior to them); their posterior margin generally nearly straight. Molars $\frac{6}{5} - \frac{6}{5} = \frac{12}{10}$.

1. *Otaria jubata* Blainv.* Habitat: Coasts and islands of South America, from Chili, (Arica, Peru?) on the west, and the Rio de la Plata southward to the Antarctic Islands.

II. *Genus* Eumetopias *Gill.*

Palatines much less produced posteriorly than in *Otaria*. Molars $\frac{5}{5} - \frac{5}{5} = \frac{10}{10}$.

2. *Eumetopias Stelleri* Peters. Habitat: Coasts and islands of the North Pacific, from California and Southern Kamtchatka northward.

III. *Genus* Zalophus *Gill.*

3. *Zalophus Gillespii* Gill. Habitat: Coasts and islands of the North Pacific, from Lower California and Southern Japan northward.

4. *Zalophus lobatus* Peters. Habitat: Australasian Seas, especially the shores of Australia and New Holland.

Subfamily II. — OULOPHOCINÆ.

With thick under-fur. Size smaller; form more slender, and the ears, and the toe-flaps of the hinder limbs, much longer than in *Trichophocinæ*. Molars $\frac{6}{5} - \frac{6}{5} = \frac{12}{10}$.

IV. *Genus* Callorhinus *Gray.*

5. *Callorhinus ursinus* Gray. Habitat: The continental coasts and islands of the North Pacific, from California and Southern (?) Kamtchatka northward.

males and females of *Otaria jubata* are both abundant at the Cabo Corrientes, where in the month of December they bring forth their young; but of the *Arctocephalus* I observed only males. The females of the latter are entirely unknown at this point, this species probably repairing to other localities to breed. One of the native gauchos informed me that, during the fifteen years he had been accustomed to kill them here, he had never met with a female."

* Including *Otaria Hookeri* Gray et auct.

V. *Genus* ARCTOCEPHALUS *F. Cuvier.*

6. *Arctocephalus falklandicus* Gray. Habitat: Coasts and islands of South America, from Chili on the west and the Rio de la Plata southward to the Antarctic Islands.

? 7. *Arctocephalus cinereus* * Gray. Habitat: Southern shores of Australia and New Zealand and the islands to the southward.

? 8. *Arctocephalus antarcticus* * Gray. Habitat: Southern coast of Africa and the adjoining islands.

3. *On the North Pacific Species of* OTARIADÆ.

SUBFAMILY I. — TRICHOPHOCINÆ.

Without under-fur. Size large and form robust. Ears short. Molars either $\frac{6}{5}-\frac{6}{5}=\frac{12}{10}$, or $\frac{5}{5}-\frac{5}{5}=\frac{10}{10}$.

Genus EUMETOPIAS Gill.

Eumetopias GILL, Proc. Essex Institute, V, 7, 11. July, 1866. Type "*Otaria californiana* Lesson, = *Arctocephalus monteriensis* Gray."

Molars $\frac{5}{5}-\frac{5}{5}=\frac{10}{10}$; the upper hinder pair separated from the others by a considerable interval; the last only double-rooted. Postorbital processes quadrate. Palatine surface of the intermaxillaries flat, only slightly depressed, and greatly contracted posteriorly; the palatals moderately produced, extending about three fourths of the distance from the anterior end of the zygomatic arch to the pterygoid process; their posterior margin straight, or slightly or deeply emarginate; rarely deeply so in old age.

Eumetopias hence differs from *Otaria*, as restricted by Gill, in having one pair less of upper molars,† a much less posterior extension of the palatine bones, and in having the posterior portion of the surface of the intermaxillaries less than one third, instead of more than one half, the width of the anterior portion, and but slightly instead of deeply depressed; also in the form of the postorbital processes, which in *Eumetopias* are quadrate, while in *Otaria* they form an obtuse, nearly equilateral triangle, the apex of which points outward. In *Otaria* they are also more produced. In the general character of the pelage, in color, in proportions and size, there seems to be a close resemblance

* Perhaps the *A. cinereus* and the *A. antarcticus* are to be referred to the *A. falklandicus*, in which case the habitat of this species is the southern seas generally.

† See the characters of *Otaria* given in the preceding "Conspectus," p. 43.

between the single known species of *Eumetopias* (*E. Stelleri*) and the single known species of *Otaria* (*O. jubata*).

Eumetopias differs from *Zalophus* through the presence of a wide space between the fourth and fifth pairs of upper molars, the less emargination of the posterior border of the palatine bones, the quadrate instead of the triangular and posteriorly pointed form of the postorbital processes, the less relative breadth of the posterior nares, and the larger size of the facial angle; also through its much broader muzzle, the less degree of the postorbital constriction of the skull, and its much less developed sagittal crest. It differs from *Neophoca* Gray, as nearly as can be determined from the published figures and defective descriptions, in nearly the same manner.

Eumetopias Stelleri *Peters*. STELLER'S SEA LION.

Leo marinus STELLER, Nov. Comm. Petrop., XI, 360, 1751.
"*Phoca jubata* SCHREBER, Saugeth., 300, lxxxiii, 1775 (in part only; not *P. jubata* Forster)."
Phoca jubata GMELIN, Syst. Nat., I, 63, 1788 (in part).
" " PANDER and D'ALTON, Skelete der Robben und Lamant., Pl. III, Figs. d, e, f, 1826.
Otaria jubata PÉRON, Voyage Terr. austr., II, 40, 1816.
" " NILSSON, Arch. f. Naturgesch., 1841, 329 (in part only).
Otaria Stelleri LESSON, Dict. Class. Hist. Nat., XIII, 420, 1828.
Phoca Stelleri FISCHER, Synop. Mam., 231, 1829.
Otaria Stelleri J. MULLER, Arch. f. Naturgesch., 1841, 330, 333.
" " GRAY, Cat. Seals in Brit. Mus., 47, 1850.
" " SCLATER, Proc. Zoöl. Soc., 1868, 190.
" " GRAY, Cat. Seals and Whales in Brit. Mus., 60, 1866.
Otaria (*Eumetopias*) *Stelleri* PETERS, Monatsb. Akad. Berlin, 1866, 274, 671.
Eumetopias Stelleri GRAY, Ann. and Mag. Nat. Hist., 3d Ser., XVIII, 233.
Otaria californiana LESSON, Dict. Class. Hist. Nat., XIII, 420, 1828.
Phoca californiana FISCHER, Synop. Mam., 231, 1829.
Eumetopias californianus GILL, Proc. Essex Inst., V, 13, July, 1866.
Arctocephalus monteriensis GRAY, Proc. Zoöl. Soc., 1859, 360, Pl. lxxii (in part).*
Le Lion marin BUFFON, Hist. Nat., Suppl., VI, 337, 1782 (in part).
Leonine Seal PENNANT, Arctic Zoölogy, I, 200 (in part).

Color. — General color of the upper side of the body varying from pale yellowish brown to reddish brown; much darker towards the tail, and not

* Excluding the skin (and young skull?), here doubtfully referred to *A. monteriensis*, and afterwards described by the same author as *A. californianus*, in Cat. Seals and Whales, p. 51 (1866).

unfrequently marked on the back and sides with irregular-shaped dark brown patches. The sides below the median line are reddish, shading above into the lighter color of the back, and below into the darker color of the lower surface. Lower side of the body dusky reddish-brown, darkest on the hinder portion of the abdomen. Limbs dark reddish-brown, approaching black, especially externally.

While the general aspect of the color is as above indicated, the hairs individually greatly vary in color. While some are entirely pale yellowish, others are yellowish only at the tip, and dark below, and others are dark reddish-brown or nearly black throughout. The mixture of these two colors gives a brindled appearance on some parts of the body, and to a much greater extent in some specimens than in others. The relative proportion of the light and dark hairs determine the general color of the different regions of the body.

The color appears to vary much in different individuals, not only with age and sex, but irrespective of sex and age.

Hair. — The hair is of two kinds, the outer of which is straight, coarse, stiff, and flattened. Beneath this is an exceedingly sparse, very short, finer under-coat, so short and in such small quantity as to be detected only with difficulty. The hair is longest on the anterior half of the body, where it has an average length of 40 mm.; it decreases in length posteriorly, and towards the tail has an average length of only 15 mm. It is still shorter on the abdomen, whilst on the limbs it is much more reduced, and disappears entirely towards the ends of the digits. The end of the nose, the soles and palms, the anal region, and the extra-digital cartilaginous flaps are naked and black. The whiskers are long, slender, and cylindrical, white or brownish-white, and set in four or five rather indistinct rows. Some of the longest sometimes reach a length of 50 cent., or about twenty inches, with a maximum thickness of 2 mm.

Size. — The length of full-grown males is about twelve or thirteen feet. According to Captain Bryant they frequently reach the latter size, and a weight of from fifteen to eighteen hundred pounds. The females, he observes, are much more slender than the males, and do not attain to more than one fourth the weight of the latter.

Ears. — The ears (Fig. 8, Pl. I) are short and pointed, but much broader than those of the Northern fur seal (Fig. 13, Pl. II), though of only half their length.

Hind Limbs. — The hind feet (Fig. 7, Pl. I, $\frac{1}{25}$ nat. size) are broad and, gradually widening from the tarsus, reach their greatest breadth at the end of the toes. Their length is short as compared to their breadth, the distance between the ends of the outer toes when spread nearly equalling the whole length of the foot. The toes are terminated with strong

cartilaginous flaps, covered with a thick leathery naked membrane, which is deeply indented opposite the intervals between the toes, and serves to connect the rather diverging digits. The three middle toes are provided with long, well-developed nails; the outer toes are without true nails, but in place of them are thickened, horny disks, which may be regarded as rudimentary nails, which an examination of the skeleton shows them to be. The outer toes are slightly shorter than the three middle ones, which are sub-equal.

Fore Limbs. — The fore feet (Fig. 6, Pl. I, $\frac{1}{20}$ nat. size) are large, triangular, and situated but a little in front of the middle of the body. They terminate in a thick, hard, membranous flap, which is slightly and somewhat irregularly indented on the inner side. The terminations of the digits are indicated by small circular horny disks or rudimentary nails.

Measurements. — The following table of external measurements of two males, one very aged and the other mature, indicates the general proportions of the body. A part were taken from the moist skins before stuffing, and the others from the same skins mounted.

Measurements of Two Skins of EUMETOPIAS STELLERI.

	No. 2920. ♂ 10 years old.		No. 2921. ♂ 15 years old.	
	Unmounted.	Mounted.	Unmounted.	Mounted.
Length of body	2,750	2,790	2,896	3,010
" " tail	100	100	—	110
Extent of outstretched fore limbs . .	2,362	—	—	—
Length of hand	575	560	635	620
Breadth " "	337	335	—	360
Length " foot	559	540	—	610
Breadth " " at tarsus	216	210	—	230
" " " " ends of the toe-flaps	483	445	—	440
Length of flaps of outer toe . . .	200	200	—	220
" " " " 2d toe . . .	179	156	—	210
" " " " 3d toe . . .	152	147	—	190
" " " " 4th toe . . .	164	150	—	190
" " " " inner toe . . .	164	150	—	165
Distance from end of nose to eye .	215	190	—	170
" " " " ear . .	368	365	—	380
" between the eyes . . .	190	195	—	210
" " " ears . . .	372	370	—	420
Length of the ear	37	35	—	35
" " longest barbule	342	342	—	—
Dist between points of longest barbules	800	800	—	—
Circumference of the body at fore limbs	—	2,250	—	2,600
" " " near the tail	—	1,000	—	1,020
" " head at the ears	—	1,000	—	980
Length of body to end of hind limbs . .		3,450		3,790

Skull. — The skull (Figs. 3 and 4, woodcuts, pp. 57–58, and Figs. 1–4, Pl. I) varies greatly in different individuals, not only in its general form, but in the shape of its different bones. The occipital and median crests are doubtless not much developed before the fifth or sixth year. The bones thicken greatly after the animal attains maturity, and the palate becomes more flattened. In the adult male the brain-box may be described as subquadrate, narrower anteriorly, where the skull is abruptly contracted. The greatest diameter of the skull is at the posterior end of the zygoma, and is equal to three fifths of its length. The post-orbital processes are strongly developed and quadrate; the forehead is flat, and the facial profile is either abruptly or gradually declined; the muzzle is broad, equal in breadth in front to the distance between the orbits. The palatal surface of the intermaxillaries is flat, or slightly depressed anteriorly, and very slightly contracted posteriorly. Laterally the intermaxillaries reach nearly to the end of the palatals. The latter are much contracted posteriorly, and terminate quite far in front of the hamuli pterygoidii.[1] Both the anterior and posterior nares are a little narrower than high. The nasals are widest anteriorly. The last (fifth) pair of upper molars is placed far behind the fourth pair, the space between them being about equal to that occupied by two molars. The males in old age have exceedingly high occipital and sagittal crests, most developed posteriorly; anteriorly they diverge and terminate in the hinder edge of the postorbital processes.

The lower jaw is massive and strong. Its coronoid processes are greatly developed, as are the tuberosities at the angles of the rami, and a second tuberosity on the lower inner edge of each ramus (see Figs. 9–11, Pl. III).

It should be added that the above description of the skull refers exclusively to the male. Having no skulls of the female, I am unable to state definitely how the sexes differ in respect to the form of the skull. Judging, however, from the sexual variations seen in *Callorhinus ursinus*, *Otaria jubata*, and other species of the *Otariadæ*, the skull of the female would be not only very much smaller, but it would lack almost totally the high occipital and sagittal crests exhibited by the male, and have all the processes for the attachment of muscles less developed. The teeth, especially the canines, are relatively much smaller, as is also the lower jaw. In other words, the female skull would doubtless closely resemble the skull of a yearling male. The annexed table of measurements indicates still further the general form of the male skull and the relative proportions of its different regions.

Measurements of the Skull.

	No. 2920. Middle aged. ♂	No. 2921. Very old. ♂
Length	374	385
Breadth	220	246
Dist. from ant. edge of intermaxillary to hamuli pterygoidii	243	247
" " " " to last molar (left side)	160	160
" " " " " " (right side)	160	150
" " " " to ant. edge of zygm. arch	140	140
" " " " post. " "	246	250
" " " " to auditory orifice	290	300
Length of left palatine bone (inner edge)	50	64
" " " " " (outer edge)	55	68
" " right " " (inner edge)	45	63
" " " " " (outer edge)	49	63
Breadth of right palatine anteriorly	16	19
" left " "	19	21
" right " posteriorly	12	16
" left " "	13	18
Distance from edge of palatals to ptyg. process	43	46
" " " last molar to post. edge of palatals (left side)	32	42
Depression of palate below alveoli of canines	19	17
" " " " 2d and 3d molars	41	38
" " " " 4th molar	18	20
Length of the nasals (outer edge)	60	64
" " " (inner edge)	47	48
Breadth of nasals (anteriorly)	32	38
" " " (posteriorly)	45	44
" of the skull at the canines	95	110
" " " postorbital processes	120	130
" " " paroccipital "	200	235
" " anterior nares (vertical)	54	54
" " " " (transverse)	48	55
" " posterior nares (vertical)	32	42
" " " " (transverse)	30	36
Length of zygomatic foramen	116	120
Breadth " "	80	80
Diameter of foramen magnum (transverse)	30	33
" " " " (antero-posterior)	33	36
Greatest height of skull (paroc. proc. to top of occip. crest)	145	165
Distance from lower edge of condyles " " "	132	140
Height of skull from hamuli pteryg. to top of sagittal crest	150	160
Length of sagittal crest	80	180
Greatest height of sagittal crest	38	35
Length of lower jaw	270	280
Breadth of the lower jaw at the condyles	185	210
" " " " last molar	100	110
" " " in front	65	65
" " condyle	60	60
Height of lower jaw at the coronoid process	85	95
" " " at symphysis	65	75

Teeth. — Last upper molar is double-rooted, and its crown directed backwards. All the other molars are single-rooted, with a slight median longitudinal groove on the outside. Their crowns are irregularly conical, pointed, and jut out over their contracted necks; inner side of the crowns hollowed. Surface of the crowns roughened with minute, longitudinal grooves and ridges. The upper molars have no trace of the supplemental points to the crowns seen in many species of this family. The lower molars, particularly the third and fourth, have very slight accessory cusps. Necks of the molars uniform in size with the upper part of the fangs. Fangs of the molars gradually tapering, those of the first and second upper much curved inwards; that of the third less so; that of the fourth straight; the two fangs of the fifth are directed abruptly forward, the posterior one much the smaller. Canines of both jaws very large, the upper, however, much the larger; the lower more curved. Of the six incisors of the upper jaw, those of the outer pair are much larger than the middle ones, two thirds as long as the canines, and much like them in form. The middle ones have their antero-posterior diameter nearly twice their lateral diameter, and their crowns are divided transversely. The fangs of the inner pair are slightly bifid. Of the four lower incisors the outer are much the longer. Figures 5–5 *e* (one half natural size), Plate I, shows the form of the teeth, and the subjoined table their size.*

Measurements of the Teeth.

A. — Teeth of the Upper Jaw.

	Molars.					Canines.	Incisors.		
	5th.	4th.	3d.	2d.	1st.		Outer.	Middle.	Inner.
Total length	27	33	36	37	40	84	63	29	25
Length of the crown	9	13	13	13	11	34	23	5	4
" " neck †	6	6	6	6	6	6	7	7	7
" " root ‡	12	14	15	18	23	—	—	—	—
Antero posterior diameter §	11.5	13	13	13	11.5	24	15	7	6
Lateral diameter §	6.5	9	10	10	8.5	20	12	5	4

* These figures and dimensions (the latter given in millimetres) are taken from the younger or middle-aged specimen, in which the dentition was perfect and normal. In old age many of the teeth are usually broken, and a portion of them often entirely wanting, through loss from accident. As the lower canines could not be removed without removing a portion of the jaw, they have not been figured nor fully measured.

† The distance from the crown to the alveolus.

‡ The portion of the tooth inserted in the jaw.

§ At the base of the crown.

B.—TEETH OF THE LOWER JAW.

	Molars.					Canines.	Incisors.	
	5th.	4th.	3d.	2d.	1st.		Outer.	Inner.
Total length	28	42	42	39	30	—	31	25
Length of the crown	10	12	14	12	10	35	8	5
" " neck *	5	5	5	5	5	7	4	4
" " root †	13	25	23	22	15	—	19	16
Antero-posterior diameter ‡	9	13	15	12.5	10.5	26	7	6
Lateral diameter ‡	6	9	10	9	8.5	17	9	5

Skeleton. — Vertebral formula: Cervical vertebræ, 7; dorsal, 15; lumbar, 5; caudal (including the four sacral), variable; probable average, 16. Ten of the fifteen ribs articulate with the sternum; their sternal portions are entirely cartilaginous. Their osseous portions evidently increase much in length after middle age. The apophyses of the vertebræ are well developed. Of the neural spines of the dorsal vertebræ, the first, second, and third are sub-equal, 130 mm. long; they gradually shorten posteriorly, the last having a length of only 75 mm.

The sternum is normally composed of nine osseous thick and broad segments, the first and last very long, the eighth shortest. Between the eighth and ninth a shorter cartilaginous one is sometimes intercalated (as in specimen No. 2920).

The pelvis (already fully described on pages 27–29) is well developed. The ilia are very long and narrow antero-posteriorly. The pubic bones are unanchylosed, they being merely approximate at their posterior extremities. Probably in the females (as in *Callorhinus ursinus*), they are widely separated, and the whole pelvis much smaller than in the males and differently shaped.

The humeri, as in the other Pinnipedes, are short and thick, with the greater tuberosity enormously developed. The bones of the fore-arm are also very large and strong, with all their processes greatly developed; in length they but slightly exceed the humerus. The length of neither of the segments of the arm quite equals the length of the bones of the first digit (including its metacarpal bone) of the hand. The first digit of the hand is the longest, twice as long as the fifth, and very thick and strong.

The bones of the hinder limbs are also short and thick, especially the femur, which is scarcely more than one third as long as the tibia. The latter in length about equals the foot. The relative length of the digits

* The distance from the crown to the alveolus.

† The portion inserted in the jaw.

‡ At the base of the crown.

is as follows, the longest being mentioned first: 5th, 1st, 2d, 3d, and 4th. The third and fourth are of equal length, and but little shorter than the second. In respect to size, the tarsal and phalangeal bones of the fifth digit are nearly twice as large as those of the first, whilst those of the first are about twice the size of those of either of the other three. As previously noticed, the three middle digits of the foot are supplied with long narrow nails; the first and fifth with rudimentary ones, scarcely visible in the skin but quite distinct in the skeleton.

Measurements of the Bones of the Hand (metacarpal and phalangeal).

	Middle-aged Specimen.					Very old Specimen.				
	1st digit.	2d digit.	3d digit.	4th digit.	5th digit.	1st digit.	2d digit.	3d digit.	4th digit.	5th digit.
Length of metacarpal and phalanges . . .	352	310	240	200	177	357	320	250	205	185
Length of metacarpal bone	152	110	85	80	80	160	110	90	80	85
" " 1st phalanx .	140	95	70	55	65	140	95	70	60	65
" " 2d " .	60	80	60	45	20	57	80	65	45	18
" " 3d " .	—	25	25	20	12	—	35	25	20	17

Measurements of the Bones of the Foot (metatarsal and phalangeal).

	Middle-aged Specimen.					Very old Specimen.				
	1st digit.	2d digit.	3d digit.	4th digit.	5th digit.	1st digit.	2d digit.	3d digit.	4th digit.	5th digit.
Length of metatarsal and phalanges . . .	310	290	290	305	328	320	317	327	350	350
Length of metatarsal bone	120	95	95	110	130	145	110	110	120	130
" " 1st phalanx .	140	90	90	90	93	130	100	105	105	110
" " 2d " .	50	75	75	80	70	45	80	85	95	75
" " 3d " .	—	30	30	25	35	—	27	27	30	35
" " nail . .	—	40	40	37	—	—	50	55	50	—

The hyoid bone is greatly developed. Each ramus consists of five segments, its two rami being connected together by a transverse segment articulating with the juncture of the fourth and fifth segments. All the parts of the hyoid bone are very thick, especially the transverse and anterior segments; relatively much more so than in *Callorhinus*. In the common *Phoca* the hyoid bone is reduced almost to a bony filament. The length of the hyoid bone in the present species is 270 mm.; of the transverse segment, 65 mm.; circumference of the transverse segment, 45 mm.; of the segment at the thickest part, 95.

Measurements of the Skeleton.

	No. 2920. ♂ 10 y'rs old.	No. 2921. ♂ 15 y'rs old.
Whole length of skeleton (including skull)	2,750	2,935
Length of skull	374	385
" " cervical vertebræ	500	540
" " dorsal "	1,050	1,090
" " lumbar "	340	400
" " caudal "	440	520
" " first rib	260	224
" " " osseous portion	130	140
" " " cartilaginous portion	130	100
" " second rib	345	295
" " " osseous portion	175	185
" " " cartilaginous portion	170	120
" " third rib	410	410
" " " osseous portion	230	270
" " " cartilaginous portion	180	140
" " fourth rib	470	470
" " " osseous portion	280	330
" " " cartilaginous portion	190	140
" " fifth rib	535	530
" " " osseous portion	320	370
" " " cartilaginous portion	215	160
" " sixth rib	580	590
" " " osseous portion	360	420
" " " cartilaginous portion	220	170
" " seventh rib	640	620
" " " osseous portion	400	440
" " " cartilaginous portion	240	180
" " eighth rib	670	670
" " " osseous portion	420	480
" " " cartilaginous portion	250	190
" " ninth rib	710	685
" " " osseous portion	420	485
" " " cartilaginous portion	290	200
" " tenth rib	750	745
" " " osseous portion	420	485
" " " cartilaginous portion	330	260
" " eleventh rib, osseous portion only	430	510
" " twelfth rib " " "	490	500
" " thirteenth rib " " "	450	470
" " fourteenth rib " " "	410	460
" " fifteenth rib " " "	340	350
" " sternum (ossified portion)	700	840
" " " 1st segment	130	180
" " " 2d "	70	90
" " " 3d "	70	85
" " " 4th "	65	80
" " " 5th "	63	85
" " " 6th "	60	75
" " " 7th "	60	73
" " " 8th "	55	65
" " " 9th "	70	77
" " " supernum. cartilag. seg. (bet. 8th and 9th)	30	—

	No. 2920. ♂ 10 y'rs old	No. 2921. ♂ 15 y'rs old
Length of scapula	830	370
Breadth of "	350	380
Greatest height of its spine	45	52
Length of humerus	300	285
Circumference of its head	300	290
Least circumference of the humerus	170	180
Length of radius	260	260
" " ulna	310	310
Longest diameter of upper end of ulna	100	130
Length of carpus	80	80
" " metacarpus and 1st digit	350	360
" " " " 2d "	310	320
" " " " 3d "	240	250
" " " " 4th "	200	2,050
" " " " 5th "	170	1,850
" " femur	170	220
Circumference of neck	125	120
Length of tibia	320	340
" " fibula	310	330
" " tarsus	140	160
" " metatarsus and 1st digit	310	270
" " " " 2d "	290	290
" " " " 3d "	290	270
" " " " 4th "	305	285
" " " " 5th "	227	310
" " innominate bone	320	360
Greatest width of the pelvis anteriorly	140	160
Length of ilium	140	160
" " ischio-pubic bones	140	200
" " thyroid foramen	—	200
" " os penis	170	170
Width of hand at base of digits	160	—
" " foot " "	130	140

The os penis (Fig. 13, Plate III) is 170 mm. long, slightly arched, somewhat flattened above, especially posteriorly, sharply convex below, and abruptly expanded and squarely truncate at the end. Its circumference at the base is 72 mm.; just behind the terminal expansion, 32 mm.; and the terminal expansion itself, 65 mm.

The above table gives the principal measurements of the bones of the skeleton. Measurements of both specimens are given, as in previous tables, for the purpose of illustrating the variations that occur in the relative size of different parts after maturity is attained, and also for the purpose of illustrating individual variation, which in some particulars these specimens exhibit in a marked degree. The ribs, it will be observed, differ but slightly in total length in the two; not nearly so much as would be expected from the much greater bulk of the body of the older specimen. It will be noticed that the principal differences in the ribs consist in the

relative length of the bony to the cartilaginous portions, in the older the ossified portion being much longer and the cartilaginous much shorter than in the other. An irregularity will be also observed in respect to the sternal segments, the younger specimen having a supernumerary cartilaginous one between the 8th and 9th normal ones.

Age and Sexual Variations. — In regard to the present species my material does not furnish many facts in respect to these points, since the two males contained in Captain Bryant's collection constitute at present my only resources. These examples, he writes me, were selected "as average specimens of full-grown males, but in the selection," he says, "we were governed somewhat by the desire to have skins perfectly haired, many of the animals being chafed by the rocks, even to having sores." "I should estimate," he further adds, "the age of one of them to be nine or ten years, that of the other fifteen." These specimens, however, differ considerably from each other in color, size, and proportions. Some of these differences are clearly due to age, but others equally great cannot be thus explained. These specimens show that the body increases greatly in bulk, and the bones in size and density, after the animal has reached its adult length. The crests of the skull are almost wholly developed after this period, and in great measure also the spines or ridges of the scapulæ. The processes for the attachment of the muscles also increase, as do the vertebral or osseous portions of the ribs. The teeth also change greatly in size and form after maturity is attained. They not only increase in size, especially the canines, but become much worn and misshapen by long use. In old specimens a greater or less proportion of the teeth are said to be either entirely wanting or broken, as is the case in the older of the two specimens before me.* Respecting the younger stages I am without data, as well as in respect to sexual variation. In these points the present species does not probably differ much from *Callorhinus ursinus*, adult females and the young of which are described further on. It is well known, however, that the females are much smaller than the males; as already suggested, they doubtless also lack the greatly developed sagittal and occipital crests of the males, as do the females of *C. ursinus* and *Otaria jubata*.

Individual Variation. — The present specimens, though only two in number and of different ages, indicate that the species under consideration is subject to a great amount of individual variation. This variation is strikingly shown in the skull, as seen in the following woodcuts (pp. 57–58). After allowing for the differences age would make, as in the smaller size of the sagittal crest, the rounded outline of the front edges of the intermaxillaries, the smaller size of the postorbital processes, the greater distinctness of the sutures, and perhaps the more sloping outline of the fore-

* See Fig. 3, Plate I.

Fig. 1.*

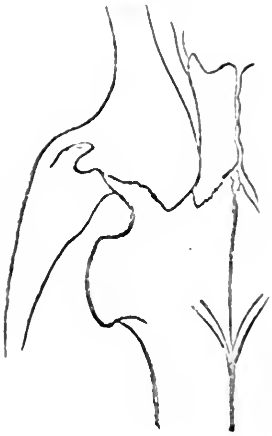
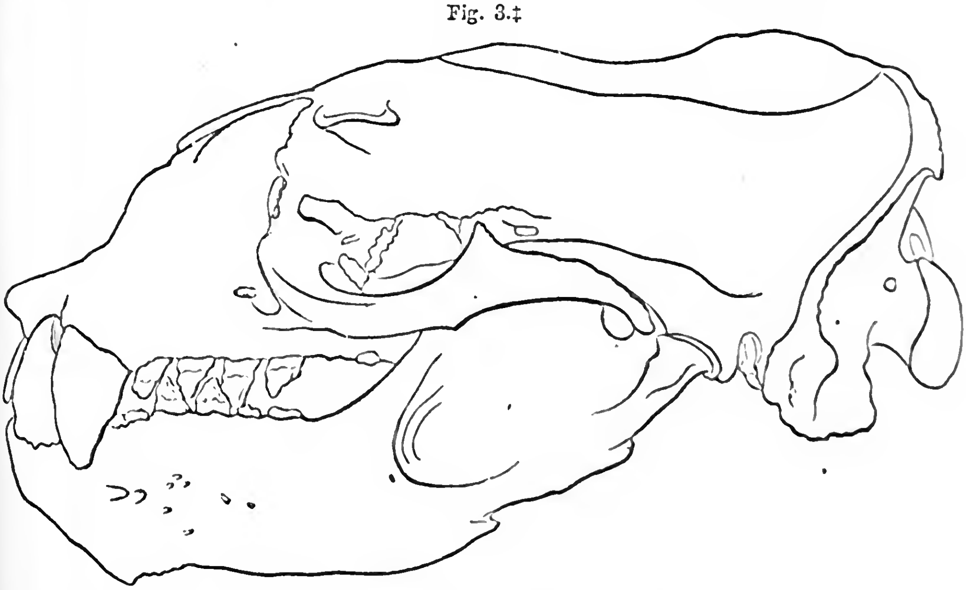


Fig. 2.†

head in the younger (Figs. 1 and 4), there is left a radical difference in the general form of the two skulls, which must have increased as the younger animal advanced in years. In length the two skulls vary only about a tenth of an inch; the younger, however, is considerably the narrower and much deeper, especially posteriorly, while its facial angle is much less. The direction of the latero-occipital crests, the form, and projection of the occipital condyles, and especially their situation relative to the par-occipital processes, are exceedingly different in the two skulls, as clearly shown in Figs. 3 and 4, — as different as might be expected to occur in

Fig. 3.‡



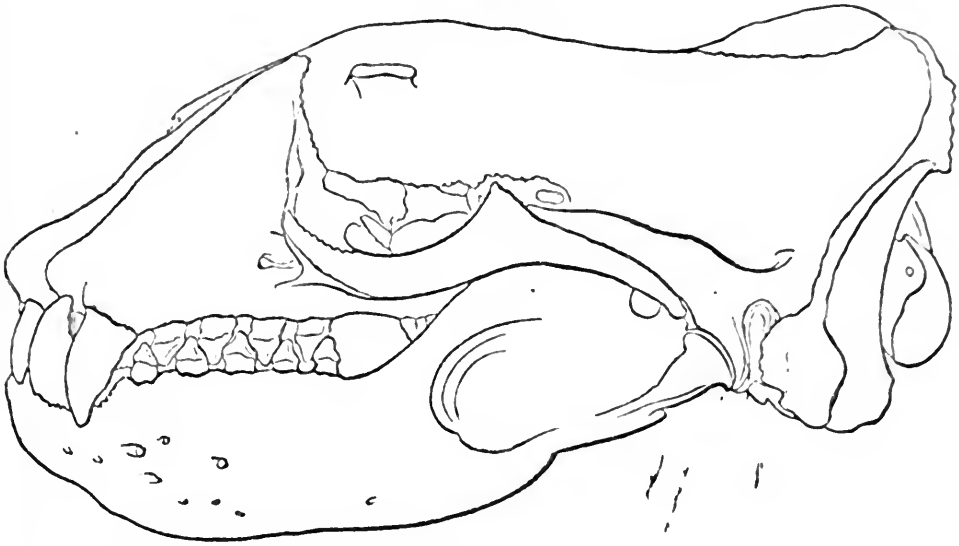
* Fig. 1, anterior portion of the skull of No. 2920 (left side), showing the form of the nasals, the zygomatic and postorbital processes, and the posterior outline of the inter-maxillaries, seen from above.

† Fig. 2, same of No. 2921.

‡ Fig. 3, skull of No. 2921, seen in profile.

quite distinct species. In the anterior portion of the skull the differences are nearly as great as in the posterior portion. In the older skull the ratio of the height of the skull at the base of the second molar to its height at the base of the fourth is as 81 to 100; the corresponding ratio

Fig. 4.*



in the younger skull is as 74 to 100. It may be added that the same ratio in Dr. Gray's figure of the skull of *Zalophus Gillespii* † is as 70 to 100, showing that the younger skull in this character more resembles the *Z. Gillespii*, — which different writers have spoken of as remarkable for the great declination of the face, — than it does the older skull of the same species. There are also great differences in the relative length and shape of the nasal bones, and in the form of the posterior outline of the intermaxillaries (Figs. 1 and 2). In the younger specimen they extend further back than in the older, further even than the end of the nasals, while in the older the nasals extend beyond the intermaxillaries.

In respect to the posterior aspect of the skull (Figs. 2 and 4, Plate I), the differences are no less great. The height of the occipital bone is about fifteen per cent greater in the young skull (Fig. 2, Pl. I), which would be much increased by age through the further development of the supraoccipital crest. The breadth of the occiput above is equal in the two; below it is fifteen per cent greater in the older (Fig. 4, Pl. I).

In the lower surface of the skull (Figs. 1 and 3, Plate I) other considerable differences are observable, and of such a nature that they cannot be regarded as resulting from age. In the older skull, as previously remarked, the bones are in general much thicker than in the younger; but in re-

* Fig. 4, skull of No. 2920, same view.

† Proc. London Zoöl. Society, 1859, Pl. LXX.

spect to the hamuli pterygoidei, the younger skull has these processes longer and stouter than they are in the older. The posterior nares are narrower and higher in the younger, — a difference correlating with the general differences in form of the skull in the two specimens, the nares in the younger being relatively narrow and high as compared with those of the other. The comparative measurements of these skulls already given (p. 49) show definitely the amount of these differences. The palatine surface of the intermaxillaries is *less* depressed in the older skull.

In respect to other portions of the skeleton, considerable differences other than those obviously resulting from age are met with. The smaller and younger specimen, which has a girth in the mounted skin (as it doubtless had in life) one fourth greater than the other, has ribs as long as the other. The number of segments in the sternum varies in the two, through the intercalation in the younger specimen of a short cartilaginous one between the eighth and ninth, to which the ninth pair of ribs is attached, instead of both the eighth and ninth pairs being attached to the eighth segment, as is usually the case.

In color, contrary to what would result from age, the younger specimen is much the lighter.

Asymmetry. — A small amount of asymmetry has now come to be recognized as normally occurring in many groups of mammals, from which even the highest are not free. It is most marked, however, in the lower types, and especially in the cetaceans, where it is usually too great to escape the notice of the most cursory observer. The eared seals also exhibit an unusually great degree of asymmetry. This absence of symmetry doubtless indicates a tendency to a greater than the ordinary degree of individual variation. In the skull of the older specimen of *Eumetopias* now before me, the asymmetry is very striking, the preponderance of size being on the left side of the skull, which is not only broader, but appreciably longer. Besides the asymmetry of size, there is an asymmetry in the position of the different parts, those on one side being in advance of their homologues on the other side.* The following measurements indicate the extent of the asymmetry in size, the measurements being taken from the (homologically) median line outwards at four different points : —

Right side, ...	48	57	34	111
Left side, ...	53	63	39	113

* This one-sidedness is still more strikingly seen in the above-mentioned female skull of *Otaria jubata*, especially in regard to the size and position of the postorbital processes. Dr. G. A. Maack informs me that in the specimens of the *O. jubata* collected by him on the coast of Buenos Ayres the asymmetry was astonishingly great. On the contrary, he found no asymmetry in the skull of the *Arctocephalus falklandicus*.

The palatine bones seem to be particularly liable to vary in length and form on the two sides of the same skull, as does also the position of the last molar tooth. On the left side the distance between the fourth and fifth molars in the older skull is 35 mm., on the right side 26 mm.

In the younger skull the left side is also just appreciably more developed than the right. In the older individual the asymmetry is readily traceable throughout the skeleton, in the hind feet especially, the one being much larger than the other.

General Remarks. — The northern sea lion was first described by Steller in 1751, who, under the name of *Leo marinus*, gave a somewhat detailed account of its habits and its geographical range, so far as known to him. His description of the animal, however, is quite unsatisfactory. Steller's *Leo marinus*, in size, general form and color, closely resembles the southern sea lion (*Otaria jubata*), with which Steller's animal was confounded by Pennant, Buffon and nearly all subsequent writers for nearly a century. Péron, in 1816, first distinctly affirmed the northern and southern sea lions to be specifically distinct. Lesson, in 1828, gave it the specific name it now bears, in honor of Steller, its first describer. The following year Fischer, on the authority of Lesson, also recognized its distinctness from the southern species. Nilsson, in 1840, in his celebrated monograph of the seals, reunited them. Müller, however, in an appendix to Dr. W. Peters's translation of Nilsson's essay, published in the Archiv für Naturgeschichte for 1841, separated it again, and pointed out some of the differences in the skulls that serve to distinguish the two species. Gray, in his Catalogue of the Seals published in 1850, also regarded it as distinct. But one is led to infer that he had not yet seen specimens of it, and that he rested his belief in the existence of such a species mainly on Steller's account of it, as he himself expressly states in his later papers. The skull received subsequently at the British Museum from Monterey, California, and figured and described by Gray as a new species, under the name of *Arctocephalus monteriensis*, proved, however, to be of this species, as first affirmed by Dr. Gill, and later by Professor Peters and Gray himself. With the exception of the figures of an imperfect skull of Steller's sea lion from Kamtchatka, given by Pander and D'Alton in 1826, Dr. Gray's excellent figure (a view in profile) is the only one of its skull hitherto published. The only specimens of the animal extant, up to a recent date, in the European museums, seem to have consisted of the two skulls and a stuffed skin in

the Berlin Museum mentioned by Peters, and the skull in the British Museum figured and described by Gray.

With the Monterey skull above mentioned, Dr. Gray received another very young skull, and the skin of a fur seal, both of which were said to have belonged to one animal, and which he hesitatingly referred to his *Arctocephalus monteriensis.** Later, however, he regarded them as representing a new species,† which he called *Arctocephalus californianus.* Still later he again seems to refer them to his *Eumetopias Stelleri* ‡ (=*Arctocephalus monteriensis* Gray, of earlier date). Concerning this skin he remarked at one time as follows: "If the skin sent last year by Mr. Taylor to Mr. Gurney, and by that gentleman presented to the Museum, is the young of this species [*A. monteriensis*], the young animal is blackish, silvered by the short white tips to the short black hairs; those on the nape and hinder parts of the body with longer white tips, making those parts whiter and more silvery. The under-fur is very abundant, reaching nearly to the end of the hair. The end of the nose and sides of the face are whitish. The whiskers are elongated, rigid, smooth, and white. The hind feet are elongate, with rather long flaps to the toes. The skull is small for the size of the skin, and I should have doubted its belonging to the skin if it were not accompanied by the following label: 'Skull of the fur seal I sent last year. It is very imperfect, from my forgetting where I had put it; but it must do until accident throws another in the way; the other bones were lost. — A. S. T.'" §

As Dr. Gray seems to have finally become settled in his opinion that this skin is identical with his *A. monteriensis*, afterwards called by him *Eumetopias Stelleri*, this may account for the statement (already referred to in my "Résumé,") recently made by him ‖ and subsequently reiterated,¶ that the *Eumetopias Stelleri* is a species in which "the fur is very dense, standing nearly erect from the skin, forming a very soft, elastic coat, as in *O. falklandica* and *O. Stelleri*, which," he erroneously says, "are the only seals that have a close, soft, elastic fur." From his description of this young skull it is apparently refer-

* Proc. Lond. Zoöl. Soc., 1859, p. 358.

† Cat. Seals and Whales, 1866, p. 49.

‡ Ann. and Mag. Nat. Hist., 3d Series, 1866, Vol. XVIII, p. 233.

§ Proc. Lond. Zoöl. Soc., 1859, p. 358.

‖ Ann. and Mag. Nat. Hist., 4th Series, 1866, Vol. I, p. 101.

¶ Ibid., p. 215.

able to *E. Stelleri*; but the skin is unquestionably that of the *Callorhinus ursinus*. Nothing can be more sure than that it cannot belong to the *E. Stelleri*, *which is completely destitute of soft fur*, as proved by the specimens before me, and the description given by Professor Peters of the one in the Berlin Museum.

Lesson gave the name *Otaria californiana* to a supposed species of eared seal based solely on the "Jeune lion marin de la Californie" of Choris.* The figure given by Choris is too poorly drawn to be recognizable as that of one species of eared seal rather than of another. The following is the only allusion Choris makes to this animal in his text: "Les rochers, dans le voisinage de la baie San-Francisco sont ordinairement couverts de lions marins. Pl. XI." From the locality, which is the only possible guide, it was doubtless the *E. Stelleri*, but it may have been the *Zalophus Gillespii*. Dr. Gill in his "Prodrome," adopted provisionally Lesson's name (*californiana*) for the present species, but at the same time suggested its probable identity with the so-called *Otaria Stelleri* of Müller. Peters, a few months later, confirmed Gill's suggestion, since which time the name *Stelleri* has been universally adopted for the larger northern hair seal. The *Otaria Stelleri* of Schlegel,† formerly supposed by Gray ‡ and also by Peters § to include both the Australian eared seals (viz. *Arctocephalus cinereus* and *Zalophus lobatus*), has finally been referred by the latter, after an examination of the original specimens in the Leyden Museum, to the *Zalophus Gillespii*.‖ I am now convinced of the correctness of this determination, though for a time I suspected the skull of the young female figured in Fauna Japonica (Pl. XXII, Figs. 5 and 6) to belong to some species of fur seal. It certainly differs greatly in proportions, as well as in dentition, from the other skulls figured in this work (same plate), and called *O. Stelleri*.

The northern sea lion having become generally recognized as specifically distinct from the sea lion of the southern seas, Dr. Gill, in 1866, separated the two generically. This had indeed already been done practically by Dr. Gray, inasmuch as he placed his *A. monteriensis* (=*O.*

* Voyage Pittoresque, Pl. XI, of the chapter entitled "Port San-Francisco et ses habitants." (The date of this work is 1822.)

† Fauna Japonica, Mam. marine, p. 10.

‡ Ann. and Mag. Nat. Hist., 3d Series, 1866, Vol. XVIII, p. 229.

§ Monatsberichte Akad. Berlin, 1866, pp. 272, 276.

‖ Ibid., p. 669.

Stelleri auct.) in the genus *Arctocephalus*, and the southern sea lion in *Otaria*, with which he nominally associated the *O. Stelleri*. He failed, however, to recognize the identity of his *A. monteriensis* with the *O. Stelleri*, and hence the entire generic diversity of the northern and southern sea lions seems to have escaped his observation. The latter fact was first pointed out by Dr. Gill in his "Prodrome," as above stated.

Comparison with OTARIA JUBATA. — Having only male specimens of the *Eumetopias Stelleri*, and only skulls of the female of *Otaria jubata*, I am unable to make a detailed comparison of these two strictly geographically representative species. The following measurements of a female *O. jubata*, taken from the animal itself (at Cabo Corrientes, Buenos Ayres), by Dr. G. A. Maack, are here introduced for future reference, since they are more detailed than any hitherto published: —

"*Measurements of* OTARIA JUBATA (*adult*).

"Total length to end of tail	1,750 mm.
" " " " " outstretched hind limbs	2,070 "
Greatest circumference of the body	1,050 "
Circumference of the body in front of fore limbs	970 "
" " " hind limbs	860 "
" of the neck	620 "
Length of left fore fin	700 "
" " palm	500 "
" " hind fin (sole)	430 "

"The general color is brown; iris, coffee-brown; barbules, dark yellow."

Of the large collection of skins and skeletons of the *Otaria jubata* received by the London Zoölogical Society in 1868, we as yet have no very detailed account. The measurements of one of the adult females given by Dr. Murie * are as follows: "Greatest length of skin, including hind extremities, 80½ inches [2,045 mm.]; from muzzle to end of tail, 66½ inches [1,702 mm.]; tip to tip of fore limbs outspread, 58 inches [1,473 mm.]" It hence agrees very nearly in size with that measured by Dr. Maack.

The measurements of a male specimen of *O. jubata* — belonging to the same collection as the female — given by Dr. Murie, indicate that it was not nearly full grown. The few reliable facts we have in

* Proc. Zoöl. Soc. 1869, p. 102.

respect to the size of the male are sufficient to show that in this respect, as well as in general external features, the *O. jubata* differs markedly in no way from the *Eumetopias Stelleri*, although they differ widely in the form of the skull and in dentition.

Geographical Distribution. — According to Steller, this species existed in his time along nearly the whole eastern coast of Kamtchatka and southwards to the Kurile Islands. He also met with it on Behring's Island and on the American coast. Both Captain Bryant and Mr. Dall report it as abundant at the Pribyloff Islands, and it has been received by Dr. Gray, and also, as Dr. Gill informs me, at the Smithsonian Institution, from California. The sea lions of the Farallone Islands and other parts of the California coast, especially those that have of late attracted so much attention in the harbor of San Francisco, are probably the present species. The *E. Stelleri* hence doubtless ranges along the American coast, in greater or less abundance, from California to Behring's Strait, and down the Asiatic coast to the Kurile Islands.

Habits. — The habits of this species have not yet been minutely described. Steller gave a very full account of those of the sea bear (*Callorhinus ursinus*), and remarked that, with some few exceptions (which he specifies), those of the sea lion closely resemble those of that animal. Captain Bryant has also been far more minute in his account of the sea bear; but in the subjoined notes respecting the sea lion he presents interesting information regarding the latter species. The Plates of Choris (Nos. XIV and XV of the chapter on the Aleutian Islands) doubtless give a very good idea of the appearance of these animals and the sea bears when assembled on the land. He has also contributed a few interesting facts concerning their habits. The following are the remarks of Captain Bryant: —

"The sea lion visits St. Paul's Island in considerable numbers to rear its young. It is one of the largest of the seal family, the male frequently measuring thirteen feet in length, and weighing from fifteen to eighteen hundred pounds. Its habits are the same as those of the fur seal. When roused to anger it has a very marked resemblance, through the form of its head and neck, to the animal from which it is named, and its voice, when roaring, can be heard to a great distance. Its body is thickly covered with fine, short, dark [?] brown hair, without any fur. Its skin is of considerable value as an article of commerce in the territory, it being used in making all kinds of boats, from a one-man

canoe to a lighter of twenty tons' burden. The natives of all the Aleutian Islands and of the coast as far east as Sitka, beside those of many ports on the mainland to the north, rely on this island for a supply of the skins of this animal. The rookery is on the northeast end of the island, and the animals have to be driven ten or eleven miles to the village to bring their skins to the drying-frames. It sometimes requires five days to make the journey, as at frequent intervals they have to be allowed to rest. It is a somewhat dangerous animal, and the men frequently get seriously hurt by it in driving and killing it. They are driven together in the same manner as the fur seals are; and while impeding each other by treading upon each other's flippers the small ones are killed with lances, but the larger ones have to be shot.

"This animal is the most completely consumed of any on the island. Their flesh is preferred to that of the seal for drying for winter use. After the skins are taken off (two thousand of which are required annually to supply the trading-posts of the territory), they are spread in piles of twenty-five each, with the flesh side down, and left to heat until the hair is loosened; it is then scraped off, and the skins are stretched on frames to dry. The blubber is removed from the carcass for fuel or oil, and the flesh is cut in strips and dried for winter use. The linings of their throats are saved and tanned for making the legs of boots and shoes, and the skin of the flippers is used for the soles. Their stomachs are turned, cleaned, and dried, and are used to put the oil in when boiled out. The intestines are dressed and sewed together into water-proof frocks, which are worn while hunting and fishing in the boats. The sinews of the back are dried and stripped to make the thread with which to sew together the intestines, and to fasten the skins to the canoe-frames. The natives receive thirty-five cents apiece for the skins when ready for shipment. But these skins are not so much valued by the trader for the profit he makes on their sale, as for the advantage it gives him in bargaining with the hunters, since by buying these they are able to secure a right to the purchase of the hunter's furs on his return, the natives always considering such contracts binding."

Choris, in his description of the "Iles S.-Georges et S.-Paul's," thus speaks of the sea lions that he met with on these islands fifty years ago:—

"Le rivage était couvert de troupes innombrables de lions marins.

L'odeur qu'ils répandent est insupportable. Ces animaux étaient alors dans le temps du rut. L'on voyait de tous côtés les mâles se battre entre eux pour s'enlever les uns aux autres les femelles. Chaque mâle en rassemble de dix à vingt, se montre jaloux, ne souffre aucun autre mâle, et attaque ceux qui tentent de s'approcher ; il les tue par ses morsures ou s'en fait tuer. Dans le premier cas, il s'empare des femelles du vaincu. Nous avons trouvé plusieurs mâles étendus morts sur la plage, des seules blessures qu'ils avaient reçues dans les combats. Quelques femelles avaient déjà des petits. Les Aléoutes en prirent plusieurs douzaines pour nous. L'animal n'est pas dangereux ; il fuit à l'approche de l'homme, excepté depuis la mi-mai jusqu'à la mi-juin, qui est le plus fort temps du rut, et où les femelles mettent bas leur petits ; alors il ne se laisse pas approcher et il attaque même."

"Ces animaux sont aussi très-communs au port de San-Francisco, sur la côte de Californie, où on les voit en nombre prodigieux sur les rochers de la baie. Cette espèce m'a paru se distinguer de ceux qui fréquentent les îles Aléoutiennes; elle a le corps plus fluet et plus allongé, et la tête plus fine: quant à la couleur, elle passe fortement au brun, tandis que ceux des îles Aléoutiennes sont d'une couleur plus grise, ont le corps plus rond, les mouvements plus difficiles, la tête plus grosse et plus épaisse; la couleur du poil des moustaches plus noirâtre que celui des îles Aléoutiennes.

"On trouve les lions marins depuis le 30ème jusqu'au 60ème parallèle nord, dans les îles et sur le continent d'Amérique."

"On y [l'île Saint-Georges] tue une grande quantité de lions marins; mais seulement des mâles, à cause de leur grandeur; on se sert de leur peau pour recouvrir les canots, et des intestins pour faire le *kamleyki*, espèces de blouses que l'on endosse par dessus les autres vêtements lorsqu'il pleut pour ne pas se mouiller. La chair, que l'on fait sécher, est dure ; c'est une bonne nourriture pour l'hiver. . . . . Les jeunes sont très-tendres et ont le goût de poisson." *

The following careful description of their movements on land has been communicated to me by Mr. Theodore Lyman, who has recently observed the sea lions on the "Seal Rocks" near San Francisco: —

"These rocks," he says, "are beset with hundreds of these animals, — some still, some moving, some on the land, and some in the water. As

* Voyage Pittoresque autour du Monde, Chapter "Iles Aléoutiennes," p. 12 - 14.

they approach to effect a landing, the head only appears decidedly above water. This is their familiar element, and they swim with great speed and ease, quite unmindful of the heavy surf and of the breakers on the ledges. In landing, they are apt to take advantage of a heavy wave, which helps them to get the forward flippers on *terra firma*. As the wave retreats, they begin to struggle up the steep rocks, twisting the body from side to side, with a clumsy worm-like motion, and thus alternately work their flippers into positions where they may force the body a little onward. At such times they have a general appearance of *sprawling* over the ground. It is quite astonishing to see how they will go up surfaces having even a greater inclination than 45°, and where a man would have to creep with much exertion. When the surface is nearly horizontal, they go faster, and often proceed by gathering their hind-quarters under them, raising themselves on the edges of their fore-limbs and then giving a push, whereby they make a sort of tumble forwards. In their onward path they are accompanied by the loud barking of all the seals they pass; and these cries may be heard a great distance. Having arrived at a good basking-place, they stretch themselves out in various attitudes, — often on the side, sometimes nearly on the back, but commonly on the belly, with the flippers somewhat extended. They seem much oppressed with *their own weight* (which is usually supported by the water), and it seemed an exertion for them even to raise the head, though it is often kept up for a long time. They play among themselves continually by rolling on each other and feigning to bite. Often, too, they will amuse themselves by pushing off those that are trying to land. All this is done in a very cumbrous manner, and is accompanied by incessant barking. As they issue from the water, their fur is dark and shining; but, as it dries, it becomes of a yellowish brown. Then they appear to feel either too dry or too hot, for they move to the nearest point from which they may tumble into the sea. I saw many roll off a ledge at least twenty feet high, and fall, like so many huge brown sacks, into the water, dashing up showers of spray."

From the accounts given by various observers, the sea lions evidently move with much less facility on land than do the fur seals. Captain Bryant states that the fur seals may be driven at the rate of a mile and a half per hour, while he asserts that the sea lions can be driven with safety only about two miles a day.

Genus Zalophus *Gill.*

Zalophus Gill, Proc. Essex Institute, 1866, V, 7, 11. Type *Otaria Gillespii* McBain.

Zalophus Peters, Monatsb. Akad. Berlin, 1866, 275, 671.

Neophoca Gray, Ann. and Mag. Nat. Hist., 3d Series, 1866, XVIII, 231. Type *Arctocephalus lobatus* Gray.

Size medium. Molars approximated, last under the hinder edge of the zygomatic process. Muzzle narrow. Superior profile, from the postorbital process anteriorly, gently declined. Bony palate moderately contracted posteriorly, and but slightly depressed. Hinder edge of the palatals deeply concave. Pterygoid hooks slender. Posterior nares broader than high; anterior higher than broad. Postorbital cylinder narrow and elongate. The postorbital constriction of the skull is deep and abrupt, giving a quadrate or subquadrate form to the brain-box, which varies to triangular through the varying degree of prominence of its latero-anterior angles. The postorbital processes are triangular, developed latero-posteriorly into a rather slender point. The sagittal crest forms a remarkably high, thin bony plate, unparalleled in its great development in any other genus of the family. The general form of the skull is rather narrow, much more so than in *Eumetopias*, and nearly as much so as in *Arctocephalus;* the breadth to length being as 60 to 100.

Zalophus, so far as the skull is concerned, is the most distinct generic form of the family *Otariadæ*, it being thoroughly distinct from all the others. It differs from *Otaria* in having one less pair of upper molars, in the less depression of the bony palate, the less extension posteriorly of the palatines, the much narrower muzzle, the much less abrupt declination of the facial profile, its much higher sagittal crest, and in its narrower and more elongated form.

Zalophus differs from *Eumetopias*, as already pointed out, in having all the upper molars closely approximated, in the concave outline of the posterior border of the palatines, and otherwise much as it differs from *Otaria*.

Zalophus differs from *Callorhinus* in its less number of upper molars, its high sagittal crest, and in the more declined profile of the face. It differs in a nearly similar manner from *Arctocephalus*, but more resembles this genus in the general form and proportions of the skull than any other. But in the nature of its pelage, and in other external features, it is radically distinct from the whole group of fur seals, as it is also in its high sagittal crest.

Zalophus Gillespii *Gill.* GILLESPIE'S HAIR SEAL.

Otaria Gillespii McBAIN, Proc. Edinb. Roy. Phys. Soc., I, 422, 1858.
Arctocephalus Gillespii GRAY, Proc. Lond. Zoöl. Soc., 1859, 110, 360, Pl. LXX; Cat. Seals and Whales, 1866, p. 55.
Zalophus Gillespii GILL, Proc. Essex Inst., V, 13, 1866.
Otaria (Zalophus) Gillespii PETERS, Monatsb. Akad. Berlin, 1866, 275, 671.
Zalophus Gillespii GRAY, Ann. and Mag. Nat. Hist., 3d Series, 1866, XVIII, 231.
Otaria Stelleri SCHLEGEL, Fauna Japonica, Mam. marin, 10, Pl. XXI, (animal), Pl. XXII, Figs. 1–4, and 5–6 (skulls), Pl. XXIII, Figs. 1–9 (skeleton and teeth), 1842.
"*Otaria japonica* SCHLEGEL, MS." Peters.

Color. — In color, as well as in general form, this species is similar to *E. Stelleri*, but in size it is much smaller. Being without skins of this species, I borrow the following from Schlegel's description in the Fauna Japonica. In describing Japan specimens (under the name *Otaria Stelleri*) he says the tints of the upper parts are "d'un gris jaunâtre, un peu nuancé de noir sur le dos et sur la tête. Sur les parties inférieures et sur les extrémités, la teinte générale dont nous parlons, passe insensiblement au brun-roux; mais cette couleur est très-peu marquée sur le dessous du cou, tandis qu'elle devient très-foncée vers l'extrémité des pieds, qui sont d'un brun-roux noir assez profond." "Les poils," he adds, "sont en général courts, puisqu'ils ne portent guère que trois à quatre lignes en longueur sur le cou ou sur le dos, un peu raides et assez touffus. Ils sont, sur les parties supérieures, bruns à la base et noirs au milieu, mais leur pointe offre toujours des couleurs plus claires, qui forment les teintes générales de l'animal." The specimen above described he states is a female, and remarks that another female he possessed differs from it in color only in being generally darker or more deeply colored.

Size. — The mounted skin of an adult male preserved in the Museum of the Pays-Bas, he says, is "six pieds et deux pouces en longueur totale, mesuré depuis le nez jusqu'à l'extrémité de la queue." It differs from a female specimen, he says, only in being larger and darker colored and in having the hairs longer.

The only specimens of this species I have been able to examine are two skulls, one of which was kindly loaned me by the Chicago Academy of Sciences, and the other by the Smithsonian Institution. The former belongs to a mounted skeleton, collected, as Dr. Stimpson informs me, by Professor W. P. Trowbridge, formerly Lieutenant of United States Engineers, somewhere between Puget Sound and San Francisco. The skeleton, without the atlas and skull, Dr. Stimpson writes me, measures six feet; adding the length of the latter gives a little less than seven feet as the whole length of

the skeleton. The sex of neither of these specimens was recorded, but there seems to be little doubt of their being both males. Both are very old individuals. They differ considerably in size, however, as will be seen by the accompanying table of measurements, the Chicago Academy specimen being the larger.

Measurements of the Skull.

	♂ *	♂ †
Length	330	290
Breadth	180	170
Dist. from ant. edge of intermaxillaries to hamuli pterygoidei	190	180
" " " " " last molar .	100	·97
" " " " " front edge of orbit	95	90
" " " " " post. " "	160	150
" " " " " auditory orifice .	245	220
Length of left palatine bone (inner edge)	35	34
" " right " " "	—	36
Breadth of left " " (anteriorly)	21	19
" " right " " "	—	18
Dist. from post. edge of palatals to end of hamuli pteryg.	55	48
" " last molar to end of hamuli pteryg.	90	80
Depression of palate below alveoli of canines	10	07
" " " " 3d molar	09	08
" " " " last molar	—	10
Length of the nasals (outer edge)	61	56
" " " (inner edge)	49	38
Breadth of both nasals together (anteriorly)	30	27
" " " " (posteriorly)	28	20
" of the skull at the canines	70	60
" " " " postorbital process . . .	83	66
" " " " middle of the orbits	145	130
" " " " maxillary condyles . . .	190	170
" " " " paroccipital process	165	163
Diameter " anterior nares (vertical)	32	30
" " " " (transverse)	34	29
" " posterior nares (vertical)	30	23
" " " " (transverse)	28	26
Length of the zygomatic foramen	117	82
Breadth " " "	65	55
Diameter of foramen magnum (antero-posterior) . . .	24	25
" " " (laterally)	25	23
Height of the skull (end of parac. proc. to top of occip. crest)	150	120
" " " (occip. condyle to top of occip. crest) .	130	97
" " " (end of ham. pteryg. to top of sag. crest)	140	125
Length of sagittal crest	157	145
Greatest height of crest	38	29
Length of the lower jaw	240	200
Breadth posteriorly	170	155
" at last molar	75	75
" posterior edge of symphysis	53	64
" of each condyle	55	47
Height of lower jaw at coronoid process	90	75
" " " symphysis	45	37

* Received from the Chicago Academy of Sciences.

† Received from the Smithsonian Institution (S. I. No. 261).

According to Peters, the length of the skull of *O. Gillespii* is 295 mm.; of one of the skulls of *O. japonica* (Schlegel MS. = *O. Stelleri* of the Fauna Japonica) is 270 mm. and of the other 310 mm., which would indicate an animal of about three fourths the size of *E. Stelleri*.

If we can assume that the California "lion marin" of Choris * is this species, which we can hardly do with certainty, it differs from the *E. Stelleri* in being browner and smaller, with a more delicately shaped head and darker mustaches. The latter, however, are variable in color, in other species, in specimens specifically the same.

Individual Variation. — The two male skulls of *Zalophus Gillespii* before me differ from each other very remarkably in various points. Besides the general difference in size indicated in the above table of measurements, there are other and more radical differences in proportions and form. In the specimen received from the Chicago Academy, the general form is much more elongated than in the other, especially the facial portion of the skull and the postorbital cylinder. The nasals are especially longer, and the expanded interorbital space shorter, with the postorbital processes much more heavily developed. The brain-box, seen from above, through the gradually sloping postorbital constriction, is *triangular*, whilst in the other, through the abruptness of the postorbital constriction, it is *quadrate*. Hence in the latter the brain-box has distinct latero-anterior angles, whilst in the other the lateral walls of the brain-box gradually and regularly converge anteriorly. The differences in these respects are far greater than exist between the two male skulls of *Callorhinus ursinus* represented in Plate II. The following proportions indicate the extent of the differences seen in the form of the postorbital cylinder.

The diameter of this part, at its point of greatest constriction, in the specimen received from the Smithsonian Institution is 23 mm.; do. of the specimen received from the Chicago Academy of Sciences, 35 mm. The length of the postorbital cylinder in the first is 43 mm.; in the latter, 69 mm., or *nearly one and a half times longer than in the other*; whilst the difference in the whole length of the skull in the two specimens is less than *one seventh* of the length of the smaller specimen. Species, and even genera, have been based on differences of less importance than these.

General Remarks. — Schlegel, in the work above cited, gave the first and thus far the fullest account we possess of this species. He also gave figures of several skulls, of a skeleton, and of a middle-aged female. He failed, however, to distinguish this species from the *Z. lobatus* and the *Eumetopias Stelleri*, but confounded the three under the name *Otaria*

* Voyage Pittoresque (Iles Aléoutiennes, p. 13).

Stelleri. He also omitted to state distinctly the localities at which the specimens figured were obtained, though they were doubtless from Japan.

As already remarked under *Eumetopias Stelleri*, naturalists for a long time referred the specimens figured by Schlegel under the name *Otaria Stelleri* to two widely distinct species, namely, *O. lobata* (*Zalophus lobatus*) and *O. cinerea* (*Arctocephalus cinereus*). It was only four years since that Professor Peters, after examining the specimens figured in the Fauna Japonica, was able to determine the real character of Schlegel's *O. Stelleri*, which he found referable to the *O. Gillespii* McBain. As previously stated, I see no reason to question the correctness of this identification. The skull represented in Figures 5 and 6, Plate XXII, is said to be that of a young female; the great proportional differences apparent between this and the other specimens figured are only such as might result from age.

The references to this species are very few. The first, aside from Schlegel's above-cited work, is the description of a skull from California by McBain, in which the animal in question was first indicated as a distinct species. This skull was described in 1858, and was the basis of McBain's species *O. Gillespii.* In the following year Dr. Gray published a figure of a cast of this skull, and re-described the species from the cast, under the generic name of *Arctocephalus.* Dr. Gill having seen other skulls, and noticing the striking differences existing between this and the other forms, in his "Prodrome" he proposed for this species the generic name of *Zalophus.*

The only species with which *Zalophus Gillespii* seems to be at all closely related is its congener the *Z. lobatus*, with which, as stated above, it was supposed by Schlegel to be identical, and to which it was in part or wholly referred by later writers. The two are of nearly the same size, and seem to have, in general, similar external features. According to Peters and Gray they differ, however, in the form of the teeth and in respect to some of the features of the skull.

Distribution and Habits. — The only localities from which this species is at present certainly known, are California and Japan, but it doubtless inhabits the intermediate shores of the Pacific. Mr. W. H. Dall informs me, however, that he is confident that there is only one species of "eared sea lion in Behring's Sea." He affirms most positively that "there is no *Zalophus* there, or at San Francisco," the species frequenting the rocks in the harbor of that name being the *Eu-*

metopias Stelleri. Captain Bryant writes me that he feels quite sure two species of sea lions inhabit the coast of California and the other Pacific States, but he has not yet had an opportunity of carefully examining them. The three specimens from the west coast of the United States already in collections, — that described by Dr. McBain, the one in the Museum of the Smithsonian Institution, and that in the Museum of the Chicago Academy, — sufficiently establish its occurrence on the California coast. There seems to be nothing known, or at least on record, concerning its habits.

SUBFAMILY II. — OULOPHOCINÆ.

With thick under-fur; size smaller, form slenderer, and the ears relatively much longer than in *Trichophocinæ*. Digital swimming flaps of the hind feet very long. Molars $\frac{6}{5} - \frac{6}{5} = \frac{12}{10}$.*

Genus CALLORHINUS Gray.

Callorhinus GRAY, Proc. Lond. Zoöl. Soc., 1859, 359. Type "*Arctocephalus ursinus* Gray," = *Phoca ursina* Linné.

Arctocephalus GILL, Proc. Essex Inst., V, 7, 1866. Same type; not *Arctocephalus* F. Cuvier.

Facial portion of the skull broad and greatly produced. Otherwise essentially the same as in *Arctocephalus*.

Callorhinus and *Arctocephalus* are sufficiently distinguished from the hair seals by the character of the pelage, as well as by the other characters given above in the diagnoses of the two groups of hair and fur seals. *Callorhinus* differs apparently from *Arctocephalus* mainly, if not almost solely, in the greater prominence of the facial portion of the skull. Between these two groups there are not such radical differences in the form of the skull as are met with in the several genera of the hair seals, by means of which *Otaria*, *Eumetopias*, and *Zalophus* are so trenchantly separated from each other. *Callorhinus* and *Arctocephalus*, though closely allied forms, are probably generically separable.

Callorhinus ursinus GRAY. NORTHERN SEA BEAR.

Ursus marinus STELLER, Nov. Comm. Academ. Petrop., II, 331, Pl. XV, 1751.
Phoca ursina LINNÉ, Syst. Nat., I, 37, 1758. (From Steller.)
"*Phoca ursina* SCHREBER, Saugeth., III, 289, 1758. (From Steller.)"
Phoca ursina SHAW, Gen. Zoöl., I, 265, Pl. LXII, 1800.
" " FISCHER, Synop. Mam., 231, 1829.
" " PALLAS, Zoog. Rosso-Asiat., I, 102, 1831.

* For a more extended comparison of *Oulophocinæ* with *Trichophocinæ*, see above, pp. 21–23.

Phoca nigra Pallas, Zoog. Rosso-Asiat., I, 107. (Young.)
Otaria ursina Péron, Voy. Terr. Austr., II, 41, 1816.
" " Desmarest, Nouv. Dict. Hist. Nat., XXV, 595, 1817.
" " Desmarest, Mam., I, 249, 1820.
" " Gray, Griffith's An. Kingd., V, 182, 1827.
" " Nilsson, Archiv f. Naturgesch. 1841 (in part).
" " J. Müller, Ibid., 333.
" " A. Wagner, Ibid., 1849, 39.
Otaria Kraschenninikowii Lesson, Dict. Class. Hist. Nat., XIII, 419, 1826.
Otaria Fabricii Lesson, Ibid , 420.
Otaria (Callorhinus) ursinus Peters, Monatsb. Akad. Berlin, 1866, 373, 672.
Arctocephalus ursinus Gray, Cat. Phocidæ, 41, 1850; not *A. ursinus* F. Cuv., or only in part.
" " Gray, Proc. Lond. Zoöl. Soc., 1859, 103, 107, Pl. LXXIII, skull.
" " Gill, Proc. Essex Inst., V, 13, 1866.
Callorhinus ursinus Gray, Proc. Lond. Zoöl. Soc., 1859, 359.
" " Gray, Cat. Seals and Whales, 44, 1866.
" " Gray, Ann. and Mag. Nat. Hist., 3d Ser., XVIII, 234, 1866.
Arctocephalus monteriensis Gray, Proc. Lond. Zoöl. Soc., 1857, 360 (in part).
Arctocephalus californianus Gray, Cat. Seals and Whales, 51, 1866 (in part).
Sea Cat, Kraschenninikow, Hist. Kamt., 306, 1764.
Ours Marin, Buffon, Hist. Nat., Suppl., VI, 336, Pl. XLVII, 1782 (in part).
Ursine Seal, Pennant, Hist. Quad., I, 526, 531, 1792 (in part).

Color. — (*Male.*) General color above, except over the shoulders, nearly black, varying in different individuals of equal age from nearly pure black to rufo-grayish black. Over the shoulders the color is quite gray. The sides of the nose and the lips are brownish, as is a considerable space behind the angle of the mouth, and a small spot behind the ear. The neck in front is more or less gray. The breast and the axillæ are brownish-orange. The limbs are reddish-brown, especially near their junction with the body, as is also the abdomen. The hairs individually vary considerably in color, some being entirely black nearly to their base, and others entirely light yellowish-brown; others are dark in the middle and lighter at each end. The naked skin of the hind limbs, the nose, and the anal region is black.

(*Female.*) The general color of the female is much lighter than that of the male. Above it is nearly uniformly gray, varying to darker or lighter in different individuals and with age. The color about the mouth is brownish, varying to rufous, of which color are the axillæ, the breast, and the abdomen. The sides are brownish-gray. At the base all the hairs are usually brownish, like the under-fur, with a broad subter-

minal bar of black, and tipped for a greater or less distance with gray. The variation in different individuals in the general color results from the varying extent of the gray at the ends of the hairs.

(*Young.*) The general color of the upper surface of the body in the young, previous to the first moult, is uniformly glossy black. The region around the mouth is yellowish-brown. The neck in front is grayish-black. The axillæ are pale yellowish-brown; a somewhat darker shade of the same color extends posteriorly and inward towards the median line of the belly, uniting on the anterior portion of the abdomen. The greater part of the lower surface, however, is dusky brownish-gray, the rest being black, but less intensely so than the back. Specimens of equal age vary much in color, one of the young specimens corresponding nearly with the above description, while the other is much darker.

On the head and sides of the neck a portion of the hairs are found, on close inspection, to be obscurely tipped with gray. After the first moult the pelage becomes gradually lighter, through the extension of the gray at the tips of the hairs, especially in the females, the two sexes being at first alike. Contrary to what has been asserted, the young are provided from birth with a long thick coat of silky under-fur, of a lighter color than the under-fur of the adults

The Hair.—The double pelage consists of an outer covering of long, flattened, moderately coarse hair, beneath which is a dense coat of long fine silky fur, which reaches on most parts of the body nearly to the ends of the hairs. The hairs are thicker towards the ends than at the base, but their clavate form is most distinctly seen in the first pelage of the young. In length the hair varies greatly on the different parts of the body. It is longest on the top of the head, especially in the males, which have a well-marked crest. The hair is much longer on the anterior half of the body than on the posterior half, it being longest on the hinder part of the neck, where in the males it is very coarse. On the crown the hair has a length of 42 mm.; on the hinder part of the neck it reaches a length of 50 to 60 mm. From this point posteriorly it gradually shortens, and near the tail has a length of only 20 mm. It is still shorter on the limbs, the upper side of the digits of the hind limbs being but slightly covered, while the anterior limbs are quite naked as far as the carpus. The males have much longer hair than the females, in which it is much longer than in *Eumetopias Stelleri.**

* From the descriptions of most writers it would seem that the *Otaria jubata* is provided with a conspicuous mane, but in the few accurate descriptions in which the length of the longest hairs is given, the so-called "flowing mane,"—which refers only to the greater length of the hairs on the neck and shoulders as compared with the other regions of the body,—does not appear to be any more truly a mane than in *Eumeto-*

The whiskers are cylindrical, long, slender, and tapering, and vary with age in length and color. In the young they are black; later they are light colored at the base, and dusky at the ends. In mature specimens they are either entirely white, or white at the base and brownish-white towards the tips.

Size. — The length of a full-grown male, according to the present specimens (see the table of measurements on page 77), is between seven and eight feet; and of a full-grown female, about four feet. Captain Bryant states * that the males attain mature size at about the sixth year, when their total length is from seven to eight feet, their girth six to seven feet, and their weight, when in full flesh, from five to seven hundred pounds. The females, he says, are full grown at four years old, when they measure four feet in length, two and a half in girth, and weigh eighty to one hundred pounds. The yearlings, he says, weigh from thirty to forty pounds.

Ears. — The ears (Fig. 12, Pl. II, one half nat. size) are long, narrow, and pointed,† being absolutely longer than those of the *E. Stelleri*, though the latter animal is two or three times the larger.

Fore Limbs. — The hands (Fig. 11, Pl. II, $\frac{1}{20}$th nat. size) are long and narrow, with a broad cartilaginous flap extending beyond the digits, which has a nearly even border. Both surfaces are naked the whole length; not covered above with short hair, as in *Eumetopias* and *Otaria*. The nails are rudimentary, their position being indicated by small circular horny disks, as in all the other eared seals.

Hind Limbs. — The feet (Fig. 12, Pl. II, $\frac{1}{20}$th nat. size) are very long, nearly half their length being formed by the cartilaginous flaps that project beyond the ends of the toes. They widen much less from the tarsus to the ends of the toes than these parts do in *E. Stelleri*, and the length of the toe-flaps is relatively many times greater than in the latter species. The toes of the posterior extremities are of nearly equal length. The outer are slightly shorter than the three middle ones. The nails of the outer toes are rudimentary and scarcely visible; — those of the middle toes are strong and well-developed.

pias Stelleri, *Callorhinus ursinus*, *Arctocephalus cinereus*, or *A. falklandicus*. All the sea bears and sea lions, according to authors, have the hair much longer on the anterior than on the posterior half of the body; and in the hair seals it is not longer than in the fur seals. The resemblance to the mane of the lion, with which in several species this longer hair has been compared, is doubtless partly imaginary and partly due to the loose skin on the neck and shoulders being thrown into thick folds when these animals erect the head. I have not, however, seen the distinct crest formed by the long hairs on the crown of the male of *C. ursinus* mentioned as occurring in the other species, unless it is alluded to in the specific name *coronata*, given by Blainville to a South American specimen of fur seal. It is certainly not possessed by the *E. Stelleri*.

* See beyond, p. 95.

† They are accidentally represented too broad in the figure.

External Measurements.

	No. 2922, Adult ♂		No. 2923, Adult ♂	No. 2924, Adult ♀	No. 2925, Adult ♀		No. 2926, Young ♀ (35 days old).	No. 2927, Young ♀ (35 days old).	Young ♂	Adult ♀ ("6 y'rs old").	Young ♂ *Arctocephalus falklandicus.*
	Unmounted.	Mounted.	Mounted.	Mounted.	Unmounted.	Mounted.	Mounted.	Mounted.	Animal.	Animal.	Animal.
Length of body	2,311	2,390	2,470	1,350	1,118	1,160	840	860	1,270	1,092	1,180
" " tail	—	53	47	54	—	50	15	18	26	50	—
" from nose to end of outstretched hind limbs	2,472	2,740	2,860	1,790	—	1,750	1,015	1,020	—	—	—
" of fore limb	452	470	460	320	317	315	170	190	357	357	550
Breadth of hand	229	225	220	140	—	130	75	85	135	101	—
Length of hind limb	—	515	500	400	432	390	175	200	406	357	450
Breadth of foot at tarsus	—	145	135	78	—	80	55	57	75	76	—
" " ends of toes	—	250	210	150	—	130	110	120	127	101	—
Length of toe-flaps of hind feet (average)	—	225	200	190	—	160	80	75	—	—	—
Distance from end of nose to eye . .	96	95	85	75	—	70	50	52	76	62	—
" " " ear . . .	254	255	260	180	—	190	120	130	178	152	—
" between the eyes	127	137	105	78	—	75	53	55	—	—	—
" " " ears	240	360	315	225	—	205	150	156	152	?152	—
Length of the ear	50	44	50	35	—	33	34	33	38	38	—
" " longest barbule . . .	180	180	185	175	—	140	65	65	—	—	—
Distance between the ends of outstretched fore limbs	2,083	—	—	—	1,321	—	—	—	—	—	—
Circumference of body in front of fore limbs	—	1,720	1,650	930	—	900	555	500	914	711	970
" " " hind limbs	—	680	670	410	—	460	260	260	357	266	—
" head at the ears . .	—	770	820	490	—	550	315	330	—	—	—

Measurements. — The preceding table of external measurements indicates the general size of the adult males and females, and the young at thirty-five days old. In some respects the dimensions are only approximately correct, being taken from mounted specimens; in the main, however, they are sufficiently accurate. A few measurements taken from the soft skin are also given; the making of a complete series of measurements of the skins before they were mounted was accidentally omitted. In addition to the six specimens of Captain Bryant's collection, I am indebted to Mr. W. H. Dall for measurements of a male and a female, taken by him * from the animals immediately after they were killed. The female (said by Mr. Dall to be six years old) is evidently adult, but the male, from its but little larger size, seems not to have been fully grown. In the last column of the table a few measurements are given of a male specimen of the *Arctocephalus falklandicus*, taken by Dr. G. A. Maack, from a fresh specimen collected by him at Cabo Corrientes, Buenos Ayres. This specimen appears also to have not been fully grown.

Skull.† — In adult specimens the breadth of the skull is a little more than half its length, the point of greatest breadth being at the posterior end of the zygomatic arch. The muzzle or facial portion is broad and high, or greatly produced, much more so even than in *Eumetopias.* The postorbital processes vary from sub-quadrate to sub-triangular, sometimes produced posteriorly into a latero-posteriorly diverging point, as in *Zalophus.* The postorbital cylinder is broad and moderately elongated. The postorbital constriction is well marked, giving a prominently quadrate form to the brain-case, the latero-anterior angles of which vary somewhat in their sharpness in different specimens. The sagittal and occipital crests are well developed in the old males, nearly as much as in *Eumetopias*, as are also the mastoid processes. The palatine bones terminate midway between the last molar teeth and the pterygoid hamuli; their posterior outline is either slightly concave, or deeply and abruptly so. The palatal surface is flat, but slightly depressed posteriorly, and but moderately so anteriorly. The zygomatic foramens are broad, nearly triangular, and truncate posteriorly. The posterior and anterior nares are of nearly equal size in the males, with their transverse and vertical diameters equal; in the females the posterior nares are depressed, their transverse diameter being greater than the vertical. The nasal bones are much broader in front than behind.

The lower jaw is strongly developed, but relatively less massive than

* At St. George's Island, Alaska, August, 1868.

† See Figs. 1–4, Pl. II (males); Figs. 1–4, Pl. III (females); and Figs. 5, 6, 7, Pl. II, and Fig. 9, Pl. III (young).

in *Eumetopias.* The coronoid processes are high and pointed, but much more developed in the males than in the females. The ramial tuberosities are greatly produced, especially the hinder one (see Figs. 8–10, Pl. II).

Measurements of the Skull.

	Adult ♂ No. 2922.	Adult ♂ No. 2923.	Adult ♀ No. 2924.	Adult ♀ No. 2925.	Young ♀ No. 2926.	Young ♀ No. 2927.
Length	245	275	185	200	133	137
Breadth	145	155	115	117	85	—
Dist. from ant. edge of intermax. to end of ham. pteryg.	140	165	120	124	68	—
" " " last molar	88	97	63	75	45	—
" " " auditory opening	180	205	135	145	83	92
" " " edge of max. condyle	153	165	120	135	75	83
" palato-max suture to end of ham. pteryg.	68	75	58	58	33	—
Length of left palatine bone	36	37	25	25	15	—
Breadth of left palatine bone opposite last molar	15	13	10	10	5	—
Length of left nasal bone	40	46	—	33	—	17
Breadth of left nasal bone (anteriorly)	16	20	—	11	—	7
" " " (posteriorly)	10	11	—	6	—	5
Breadth of skull at canines	51	56	34	33	21	26
" " " postorbital processes	64	67	42	40	35	36
" " " paroccipital "	130	148	91	95	70	74
" posterior nares (vertical)	23	24	15	13	10	—
" " " (transverse)	23	24	20	21	12	—
" anterior nares (vertical)	36	34	—	23	14	20
" " " (transverse)	35	38	—	23	16	—
Length of zygomatic foramen	77	84	64	68	31	—
Breadth of " "	48	52	40	41	30	—
Greatest height of skull (mast. proc. to top of occip. crest)	110	115	75	76	61	64
Height of skull at hamulus pterygoideus	95	108	—	75	57	—
Length of postorbital cylinder	44	56	29	30	10	6
" brain-case	86	84	80	76	72	75
" the lower jaw	160	176	120	126	—	75
Breadth of lower jaw at its condyles	135	114	90	93	—	—
" " " last molar	52	54	33	35	—	—
" " " symphysis	39	45	24	24	—	—
Height " " coronoid process	60	65	35	37	—	21
" " " symphysis	34	40	23	21	—	12

Teeth. — The molars are closely set in a continuous row. The canines (Fig. 7 *c* and 7 *c′*, Pl. II, upper canines) are large and sharply pointed, the lower slightly curved. The outer upper incisors (Figs. 6 *a* and 7 *a*, Pl. II) are much larger than the others, but relatively smaller than in *Eumetopias.* The middle incisors are flattened antero-posteriorly, and in youth and middle age have their crowns transversely divided (Figs. 6 *a* and 7 *a*, Pl II, upper incisors seen from the side). The lower incisors (Fig. 6 *d*, Pl. II) are similarly divided and are quite small. The crowns of the mo-

lars are sharply conical, with no accessory cusp, or occasionally exceedingly slight ones. All the molars are simple rooted in the specimens I have been able to examine. Some of them have deep median grooves either on the inside or outside of the fangs, or on both sides, which seem to indicate that the fangs are made up of two connate roots. The distinctness of these grooves varies in different specimens (compare Figs. 6 *b* with 7 *c*, Pl. II) and in the corresponding teeth of the two sides of the mouth in the same specimen. Hence it is not improbable that specimens may be found in which the grooves of the fangs may be entirely obsolete, or so deep as to nearly or quite divide the fang into two distinct roots. The roots of the molars are very short, and but partially fill their alveoli; hence when the periosteum is removed they fit so loosely that they require to be cemented in with wax or other substance to prevent their constantly falling out whenever the skull is handled. The canines and the incisors have much longer roots, which more nearly fill their sockets. The roots of the molars are comparatively much shorter and thicker than in *Eumetopias*,[1] and club-shaped, whereas in the latter they are slender and tapering. They are a little shorter than in *Zalophus Gillespii*, which has also short-rooted, loosely fitting teeth.*

Skeleton. — Vertebral formula: Cervical vertebræ, 7; dorsal, 15; lumbar, 5; caudal (including the 4 sacral), 13 to 14 in the males, and 14 to 15 in the females.

The skeleton in its general features resembles that of *Eumetopias Stelleri*, already described. The bones of *C. ursinus* are, however, all slenderer, or smaller in proportion to their length, than in that species, the general form of the body being more elongated. The scapulæ are shorter and broader than in *E. Stelleri*, the proportion of breadth to length being in the one as 11 to 10 and in the other as 13 to 10. The pelvis is more contracted opposite the acetabula in *C. ursinus* than in *E. Stelleri*, and the last segment of the sternum is also longer and narrower. The differences in the skull of the two forms have already been pointed out in the generic comparisons. In proportions, the principal difference, aside from that already mentioned as existing in the form of the scapula, consists in the longer neck and longer hind feet in the *C. ursinus;* the ratio of the length of the cervical vertebræ to the whole length of the skeleton being as 15 to 100 in *E. Stelleri*, and as 23 to 100 in *C. ursinus;* and the ratio of the length of the foot to the tibia being in the former as 13 to 10, and in the other as 16 to 10. The following measurements indicate the length of the principal bones, and of the different vertebral regions.

* Figures of the teeth of this species are given in the Fauna Japonica, Mammals, Pl. XXIII, Figs. 4–9.

Measurements of the Skeleton.

	Adult ♂ No. 2022.	Adult ♂ No. 2023.	Adult ♀ No. 2025	Adult ♀ No. 2024
Whole length of skeleton (including skull) .	2,040	1,840	1,370	1,215
Length of skull	275	245	200	185
" " cervical vertebræ	430	360	200	172
" " dorsal "	770	680	520	470
" " lumbar "	270	245	185	173
" " sacral "	160	145	105	95
" " caudal "	140	145	160	120
" " first rib	212	178	120	110
" " " osseous portion . .	112	105	55	55
" " " cartilaginous portion .	100	73	65	55
" " third rib	395	370	205	175
" " " osseous portion . .	265	210	140	115
" " " cartilaginous portion .	130	90	65	60
" " sixth rib	465	400	323	265
" " " osseous portion . .	350	295	230	190
" " " cartilaginous portion .	115	105	93	75
" " tenth rib	590	—	405	335
" " " osseous portion . .	360	340	265	215
" " " cartilaginous portion .	230	—	140	120
" " twelfth rib, osseous portion only	345	320	210	200
" " fifteenth rib " " "	210	205	150	130
" " sternum	640	590	385	370
" " " 1st segment . .	135	127	76	73
" " " 2d " . .	68	54	37	34
" " " 3d " . .	65	57	39	36
" " " 4th " . .	65	55	40	36
" " " 5th " . .	60	57	40	37
" " " 6th " . .	58	55	40	36
" " " 7th " . .	63	57	43	40
" " " 8th " . .	115	110	70	70
" " scapula	250	217	140	120
Breadth of "	295	285	170	160
Greatest height of its spine	35	27	14	12
Length of humerus	220	220	130	130
" " radius	205	195	128	128
" " ulna	243	223	160	157
" " carpus	55	55	35	35
Breadth " "	100	80	60	55
Length of 1st digit* and its metacarpal bone	250	250	180	177
" " 2d " " " "	245	235	178	—
" " 3d " " " "	215	195	155	—
" " 4th " " " "	170	150	125	—
" " 5th " " " "	127	115	100	—
" " femur	150	135	82	85
" " tibia	250	225	167	157
" " fibula	230	210	145	150
" " tarsus	87	84	57	60
Breadth " "	67	65	40	37
Length of 1st digit† and its metatarsal bone	270	260	200	—
" " 2d " " " "	265	260	—	—
" " 3d " " " "	265	260	—	—
" " 4th " " " "	264	255	—	—
" " 5th " " " "	290	280	—	—

* Fore limb. † Hind limb.

	Adult ♂ No. 2922.	Adult ♂ No. 2923	Adult ♀ No. 2925.	Adult ♀ No. 2924.
Length of innominate bone . . .	234	210	145	140
Greatest (external) width of pelvis anteriorly	115	110	70	75
Width of posterior end of pubic bones .	17	14	30	25
Length of ilium	100	95	60	60
" " ischio-pubic bones . . .	134	110	75	73
" " thyroid foramen . . .	67	63	45	45
Breadth " " " . . .	34	25	20	20

Sexual Differences. — The sexes differ in color, as already stated, in the females being much lighter than the males, or grayer. In respect to the skeleton they differ extraordinarily in the form of the pelvis, as already described,* all the parts of which in the female are greatly reduced in size, and instead of the pubic bones meeting each other posteriorly, as they do in the males, they are widely separated. The innominate bones are also much further apart in the females, and the bones forming the front edge of the pelvis are less developed, so that the pelvis in the female is entirely open in front. In consequence of the remarkable narrowness of the pelvis in the male, the form of this portion of the skeleton is necessarily varied in the female, to permit of the passage of the fœtus in parturition. As already remarked, no such sexual differences are seen in the *Phocidæ*.

In respect to other parts of the skeleton, the absence of the great development of the sagittal and occipital crests seen in the males has already been noticed. The bones of all parts of the skull are much smaller and weaker, especially the lower jaw and the teeth. The attachments for the muscles are correspondingly less developed throughout the skeleton. The most striking sexual difference, however, is that of size; the weight of the full-grown females, according to Captain Bryant, being *less than* ONE SIXTH that of the full-grown males.

Differences resulting from Age.— The differences in color between the young and the adult consist, as already stated, in the young of both sexes during the first three or four months of their lives being glossy black, and gradually afterwards acquiring the color characteristic respectively of the adult males and females. In respect to the differences in the skeleton that distinguish the young, I can only speak of the skull. In regard to this a most striking difference is seen in the relative development of its different regions, as compared with the adult of either sex. The two young skulls before me, said to be from specimens thirty-five days

* In the comparison of the skeleton of the eared seals with that of *Phoca vitulina* (above, p. 25 *et seq.*).

old, are both females, but at this age the sexes probably differ but little in osteological features, especially in those of the skull. In these specimens the anterior or facial portion of the skull is but little developed in comparison with the size of the brain-case. The muzzle is not only excessively short (see Figs. 5–7, Pl. II), but the orbital space is small, and the postorbital cylinder is reduced almost to zero, the postorbital processes being close to the brain-case. The zygomatic arch is hence very short; the zygomatic foramen is as broad as long, instead of being nearly twice as long as broad, as in the adult. On the other hand, the brain-case is exceedingly large, the greatest breadth of the skull being at the middle of the brain-case instead of at the posterior end of the zygomatic arch. As will be seen by the table of measurements of the skull already given, *the brain-case is nearly as large as in the adults*, and the bones being thinner, it must have a capacity about as great as that of the skulls of the adult males and females, there being, in respect to this point, *but slight difference in the sexes.* As the young advance in age, the anterior portion of the skull, or that part in advance of the brain-case, greatly elongates, especially the postorbital cylinder, and increases also in breadth, the skull in a great measure losing the triangular form and the narrow peaked muzzle characteristic of the young. The postorbital processes also greatly change their form as they further develop, as shown in the figures of Plate II.

The limbs are also relatively much larger than in the adult, as mentioned by Quoy and Gaimard in respect to the *Arctocephalus cinereus* of Australia,* which enables them to move on land with greater facility than the adult, as the above-mentioned authors have stated to be the case in the Australian species.

It is not true, however, that the young of *C. ursinus* are devoid of under-fur, as has been by some writers incorrectly stated.†

Individual Variation. — The two males were both not only full-grown, but quite advanced in age, though in all probability the crests of even the older skull (No. 2922) would have been still further developed. The other male (No. 2923) was somewhat younger, but already had the sagittal crest

* Voyage de l'Astrolabe, Zoologie, Tom. I, p. 89.

† It may be added that the young specimens above described had not fully shed their milk teeth. The incisors appear to have been renewed, but both the first and second sets of canines were still present (as shown in Fig. 5, Pl. III, natural size), the permanent ones being in front of the others. The three pre-molars of the first set have been replaced by the permanent ones, the first and second of which are already quite large. The hinder or true molars are in one of the specimens but just in sight, and doubtless had not cut through the gum. In the other specimen they are a little more advanced. The middle one is quite prominent; the first is much smaller, while the last or third true molar is far behind either of the others in development.

considerably produced; the teeth, however, were but moderately worn, the incisors still retaining the groove dividing the surface of the crowns. In the younger male skull the posterior outline of the palatines is but slightly concave, whereas in the other it is deeply and abruptly emarginate in the middle, — as deeply so as in the young (one month old) skulls; — showing that differences in this respect do not necessarily depend upon differences in age. They also differ in the form of the postorbital processes, in the younger they having nearly the same form as in *Eumetopias*, whereas in the older nearly that seen in *Zalophus*. The postorbital cylinder is also much shorter in the younger, though these two skulls do not present nearly the great difference in this respect exhibited by the two very old male skulls of *Zalophus* already described. Another difference is seen in the parieto-maxillary suture. In the younger specimen it is nearly straight and directed forwards, the nasals extending considerably beyond it. In the other it curves at first moderately backwards, and then abruptly in the same direction; the maxillaries extending in this case slightly beyond the nasals, instead of ending considerably in front of the end of the latter. The nasals themselves are much narrower in the younger specimen, especially anteriorly, and hence have very different forms in the two specimens.

In respect to the teeth, it may be added that the older skull has *seven* upper molars on one side and *six* on the other, the normal number being six on each side. The form of the molar teeth, especially of the fangs, differ markedly in the two skulls; those of the younger having the longitudinal grooves of the fangs of nearly all the teeth almost wholly obsolete, while in the other specimen the roots of nearly all the molars are more or less strongly grooved.

Of the two female skulls one is very aged,* as shown by the closed sutures and the greatly worn and defective teeth. The younger, however, is also quite advanced in years. Differences of a similar character to those seen in the males also occur between these, but they are less marked.

There are also considerable variations in color. Not only is one of the young females much darker below and about the face than the other, but one

* Respecting the age of these specimens of fur seals, Captain Bryant has responded to my inquiries as follows: "The grown females (the mothers of the pups) were average specimens. The only means I had of determining their age was by the evidences afforded by dissection. These were that the older female had given birth to seven young, and the other to five, which would make their ages respectively ten and eight years. The two grown males were also selected as average specimens in size and color. Judging from their general appearance and color, I estimated them to be ten years old. The two pups were thirty-five days old, and in that time had doubled their size from birth. They were both females."

of the old females is much darker than the other, while similar variations are seen in the males.

General Remarks. — The northern sea bear (*Callorhinus ursinus*) was first made known by Steller in 1751, under the name of *Ursus marinus.* On his visit to Kamtchatka and its neighboring islands, in 1742, he met with these animals in great numbers at Behring's Island, where he spent several weeks among them, and carefully studied their habits and anatomy. On his return to St. Petersburg he published a detailed and accurate description of them in his valuable essay entitled *De Bestiis Marinis*, in the Transactions of the St. Petersburg Academy for the year 1749.* This valuable memoir has furnished nearly all the information concerning the northern sea bears we have hitherto had. Steller's account, occupying twenty-eight quarto pages, gave not only a detailed description of its anatomy, with an extensive table of measurements, but also of its remarkable habits, and figures of the animals. His description of its habits has been largely quoted by Buffon and Pennant, and by Hamilton, in his history of the "Marine Amphibia."† Kraschenninikow, in his History of Kamtchatka, ‡ under the name of the "sea cat," also gave a lengthy account of its habits, apparently mainly from Steller's notes; but it embraces a few particulars not given in the *De Bestiis Marinis.* Buffon, followed by Pennant, and most general writers for half a century, confounded the northern sea bear with the southern sea bear, they combining the history of the two as that of one species. When specimens of both the northern and southern fur seals had been compared in Europe, their specific distinctness became fully recognized, and in 1859 they were even generically separated by Dr. J. E. Gray, since which time they have been generally recognized as belonging to different genera. In color, size, and the character of the pelage they are undoubtedly closely related, as they seem to be also in habits, but they differ greatly in the form of the facial portion of the skull, and hence in physiognomy, through the much greater breadth of the muzzle in the northern species, and its abruptly rising and convex nose.

* Novi Commentariæ Academiæ Petropolitanæ, Vol. XI, pp. 331–359, pl. xv. 1751.

† Naturalist's Library, Mammalia, Vol. VIII, 1839.

‡ History of Kamtchatka (English edition), translated from the Russian by James Grieve, M. D., pp. 125–130, 1764.

Steller's figures were the only original ones of this species that had been published up to a recent date, which, with modifications, have been frequently copied. Those given by Hamilton (Plate XXI of his work above cited) are among the best, and are quite accurate in general form, but erroneous in details, especially in respect to the feet. Choris, in 1822, gave a plate purporting to represent a group of sea bears, as they appear when assembled on the rocks at their breeding-places. Though doubtless giving a good idea of their attitudes at such times, as the other plate in his chapter on the Aleutian Islands, purporting to represent the sea lions, does of those animals; but they are not sufficiently detailed to be of further value. Mr. Dall, in his book on "Alaska and its Resources" (previously cited), has published a figure from nature of this species, which, while doubtless generally correct, gives a somewhat erroneous impression in regard to the character of the hind feet, since the upper surface is represented as being strongly ridged and furrowed, the ridges extending to the ends of the flaps, which are really flat.*

The first and only specimen of the *skull* hitherto figured is that of a male, represented in profile, published by Dr. Gray in the Proceedings of the Zoölogical Society for 1859 (Plate LXVIII).

As already remarked, the sea bears of the North were for a long time confounded with the southern sea bears, they collectively bearing the name of either *Phoca* or *Otaria ursina*. This name was originally, however, applied by Schreber and Linné to the *Ursus marinus* of Steller, to which animal the name *ursina* is hence exclusively applicable.

Forster and Cook, and other voyagers, subsequently described the southern sea bears, so far as respects their general habits, size, and abundance. Most of these writers seem to have regarded these animals as the same as the northern sea bear, and, as already stated,

* It is remarkable how few correct figures have been published of the eared seals, even those in scientific works being palpably erroneous, and contradictory of the characters given in the descriptions accompanying them. In nearly all cases the feet are represented as covered with hair, as in the common seals, and similarly provided with well-developed nails on both the fore and hind limbs. In this respect even the figures given by Quoy and Gaimard, in the Zoölogy of the *Voyage de l'Astrolabe*, are faulty, not corresponding at all in this regard with the accompanying descriptions of the animals. The figures of the *Otaria jubata*, published in the Proceedings of the London Zoölogical Society (1866, p. 80, woodcut; 1869, Pl. VII) seem to be those most nearly approaching accuracy.

naturalists for a long time generally confounded them. Péron, in 1816, first claimed that they were distinct, but no specimens seem to have reached European museums till some years later. Dr. Gray, writing in 1859, remarks as follows: "I had not been able to see a specimen of this species in any of the museums which I examined on the Continent or in England, or to find a skull of the genus [*Arctocephalus*] from the North Pacific Ocean, yet I felt so assured, from Steller's description and the geographical position, that it must be distinct from the eared fur seals from the Antarctic Ocean and Australia, with which it had usually been confounded, that in my 'Catalogue of Seals in the Collection of the British Museum' [1850] I regarded it as a distinct species, under the name of *Arctocephalus ursinus*, giving an abridgment of Steller's description as its specific character." "The British Museum," he adds, "has just received, under the name *Otaria leonina*, from Amsterdam, a specimen [skull and skin] of the sea bear from Behring's Straits, which was obtained from St. Petersburg"*; which is the specimen already spoken of as figured by Dr. Gray. From the great differences existing between this skull and those of the southern sea bears, Dr. Gray separated the northern species from the genus *Arctocephalus*, under the name *Callorhinus*.†

Although there were two skulls of Steller's sea bear in the Berlin Museum as early as 1841,‡ and three skeletons of the same species in the Museum of Munich in 1849,§ Dr. Gray seems to have been the first naturalist who was able to compare this animal with its southern relatives, and hence to positively decide its affinities.

Misled by a label accompanying specimens of eared seals received at the British Museum from California, a skin of the *Callorhinus ursinus* was doubtfully described by this author, in the paper in which the name *Callorhinus* was proposed, as that of his *Arctocephalus monteriensis*, which is a hair seal. This skin was accompanied by a young skull, purporting, by the label it bore, to belong to it, but Dr. Gray observes that otherwise he should have thought it too small to have belonged to the same animal. Seven years later,‖ however, he described the

* Proc. London Zoöl. Soc., 1859, p. 102.

† Ibid., p. 359.

‡ Archiv für Naturgeschichte, etc., 1841, p. 334.

§ Ibid., 1849, p. 39.

‖ Cat. Seals and Whales, 1866, p. 51.

skull as that of a new species (*Arctocephalus californianus*), still associating with it, however, the skin of the *Callorhinus ursinus*. The skull he subsequently considered as that of a young *A. monteriensis* (= *Eumetopias Stelleri*); and referring his *A. californianus* to that species, he was consequently led into the double error of regarding the *Eumetopias Stelleri* as a fur seal (as already explained under that species and elsewhere in the present paper), and of excluding the *Callorhinus ursinus* from the list of fur seals.

Geographical Distribution. — The northern fur seal seems to be nowhere so numerous at present as at the St. Paul's and St. George's Islands, off the coast of Alaska. They seem to still occur, however, in considerable numbers at a few of the islands to the northward and westward, especially at St. Matthew's and Behring's Islands. They appear never to have landed on the Asiatic shores to any great extent, and I have found no report of their occurrence to the southward of the Kuriles on that coast. On the American side they were formerly numerous from Sitka to the southern coast of California. At Point Conception, Captain Bryant informs me, large numbers were formerly taken, but that they are now rare on the California coast, and are only seen there in the winter season. "The present year," he writes me,* "unusually large numbers have been seen off the coasts of Oregon, Washington Territory, and British Columbia, and many skins have been taken and brought to San Francisco. They were mostly of very young seals, none appearing to be over a year old. Formerly in March and April the natives of Puget Sound took large numbers of pregnant females, but no places where they have resorted to breed seem to be known off this coast. Neither can I ascertain that any rookeries of the hair seals, or sea lions, are known to exist here; but I think it probable that both species occupy the rocky ledges off the shore, which are rarely visited by boats."

The northern fur seals seem to require a moderately cool and humid climate, since they do not readily bear the heat of the sun. These conditions apparently existing in an eminent degree at the Pribyloff Islands, these islands, as Captain Bryant remarks beyond, are eminently suited to the wants of these animals, which, according to his computation, resort there in summer to the number of more than a million.

* Under date of June 14, 1870, from the United States revenue cutter "Lincoln," *en route* for the Seal Islands of Alaska.

At Behring's and the Pribyloff Islands the fur seals are reported to make their appearance from the southward late in spring, and that they only resort to these islands for the purposes of reproduction, and leave them early in the autumn. Their haunts at other seasons seem not to be well known, but it is evident that their winter quarters must be to the southward of these islands. That there is a southward migration of these animals in winter is evident from their reported greater frequency at that season on the Pacific coast of the United States.

Habits. — The very full account of the habits of this species, contained in the following communication of Captain Bryant, together with the accompanying notes, require nothing to be added on this point in the present connection.

II.

On the Habits of the Northern Fur Seal (Callorhinus ursinus *Gray*), *with a Description of the Pribyloff Group of Islands. By* Captain Charles Bryant, *with Notes by* J. A. Allen.

Description of the Pribyloff Group of Islands.

Discovery. — The group of several small islands, known as the Pribyloff Group, were discovered under the following circumstances. Captain Pribyloff, who in 1781 took charge of the Russian trading factory at Ounalaska, observed during his voyages among the islands to the westward of Ounalaska numbers of fur seals going north in spring and returning in autumn. Believing that there must be unknown land to the northward to which these animals resorted, he fitted out an expedition for the purpose of discovering it, and in June, 1785, while cruising for that purpose, discovered an island. He took possession of this island, colonized it, and called it St. George's, from the vessel in which the discovery was made. On a clear day, during the following year, these colonists saw another island to the northward of the first, and visiting it in their canoes, proceeded to occupy it. The island was called St. Paul's, from its discovery being made on St. Paul's day.

St. Paul's Island. — St. Paul's Island, of which I append an outline sketch (Fig. 5) is nearly triangular, and sixteen miles in length. Its northern side is a little concave. Its greatest breadth is four miles, at

Fig. 5.

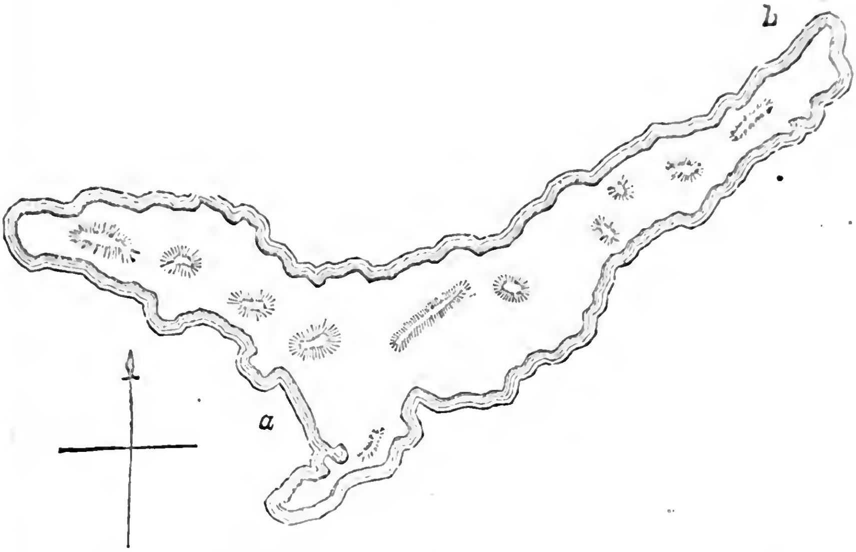


Diagram of St. Paul's Island: *a*, harbor and native village; *b*, sea-lion rookery

a point one third its length from the west end. From this point a narrow peninsula, half a mile wide and two and a half miles long, extends in a southwest direction from the main island. The island is of volcanic origin, and consists of a cluster of flattened cones. The central cones of the island have an elevation of from two to three hundred feet, and a diameter of from half a mile to one mile and a half. Those on the outside, which form the shore line, are much smaller, they being only from one eighth to half a mile in diameter, and from fifty to sixty feet in height. Their bases touch those of the central higher cones. Between the chains of cones are narrow valleys, raised but little above the sea level. The border cones are composed entirely of clinkstone, and their surfaces appear to have undergone no change other than that resulting from the original fissuring, and the subsequent action of frost. Where these cones extend into the water they form rounded points with gently sloping shores. There is a belt of loose rocks, varying from five to forty rods in width, between the base of the outer cones and the water. The coves formed between these points have shores of loose lava sand.

The peninsula is formed by two of these cones, one of which is one half and the other two and a half miles distant from the main island, with which they have been recently connected by the deposition of loose sand thrown up by the action of the waves. The connecting

necks of land thus formed have a height of only six or eight feet above the tide level.

The cones of the peninsula differ from those of the main island in being elongated instead of circular, and in having their surfaces covered with a layer of pitchstones, several inches in thickness, above the clinkstones.

On the cone in the centre of the peninsula there is a bed of volcanic ashes and cinders, which shows by its loose mixed condition that it fell there after the elevation and cooling of the rock above water. Opposite the junction of the peninsula with the main island is a cliff, facing the southeast, sixty feet high. Its composition of alternate layers of cinders and ashes indicates that it was deposited under water, and subsequently elevated to its present position. This cliff has been worn into by the waves, and portions of it continually falling down furnish material for the increase of the sand belt, along the southeast shore of the island. A seam or stratum two feet in thickness, composed mainly of volcanic ashes, and containing lumps of calcined sea mud and petrified shells, extends the whole length of the cliff, parallel with its surface curves, and situated at about midway its height. These shells differ from any now found on the island.

The distance from the point where the peninsula joins the island to the west end of the island is about eight miles, and the general trend of the shore is northwest. The peninsula itself extends two miles and a half in a southwesterly direction, with a reef continuing to the westward a mile farther. Within the angle formed by these two shores is an open harbor, with anchorage of from nine to thirteen fathoms of water, half a mile to three miles off shore.

A vessel lying here is sheltered from winds blowing from any northerly point between northwest and east; with the wind more to the southward, a heavy swell rolls over the reef, making it very rough. At the head of the cove is located the trading-post of the former Russian company and the native village. This portion of the island is undergoing great changes, from the filling in of sand from deep water. At no very remote period there existed a spacious harbor within the cove now filled with sand; and there are people living on the island who remember when the peninsula itself was an island. In this cove last year a vessel drawing six feet of water lay and swung at her anchor where it is now dry at low tide. The sand is brought up by the action of

the tides from deep water, and being thrown on the shores soon becomes dry and light, and is blown by the high winds into the valleys and over the slopes of the hills, filling up the cracks in the rocks. The climate being moist, the soil thus thrown up is rapidly overspread with a luxuriant growth of grass, conspicuous among which is the redtop and other common grasses of the New England States; at a lower level on the made land a grass grows which, when young, resembles oats, but later it heads out like rye, and bears a small black seed which resembles the latter grain when shrunken in ripening. These grass-heads in winter furnish rich forage for the cattle and other stock living on the island. Among the profusion of wild flowers are the dandelion, buttercup, wild pea and bean, yarrow, wormwood, and other weeds; also the cow-parsnip or wild celery. The latter the natives consider a great luxury, they eating the seed stalks when green and tender with great relish.

The northeast point of the island is formed by a cone two miles in diameter and a hundred feet in height. It was once two and a half miles distant from the main island, but is now connected with it. The action of the tide ebbing and flowing has formed bars of sand on the two outer sides; they thus have extended until they have united the two islands, enclosing between them a long narrow lake. This lake is now rapidly filling with sand, and being only a mile long it has become quite fresh by the annual melting of snow in it.

The southeast shore of the island has also a belt of sand, which is in many places half a mile wide, and is constantly increasing. In many places the sand is drifted to the height of fifty feet, which shows that at some period of the year the island is subject to very high winds.

On one of the largest cones near the centre of the island is the rim of an extinct volcano, with a crater thirty rods in diameter. This rises to a height of two hundred feet above the surrounding plain of clinkstones. Its walls are of red tufa, much crumbled and broken, the *débris* of which fills the opening in the centre.

Around its base are several fissures communicating with dark caves. Three fourths of a mile west is a still larger crater, but of less elevation. The surface of this portion of the island is covered with broken clinkstones, and is either entirely bare of vegetation or only covered with moss.

Otter Island. — Four miles southwest, and in line with the peninsula, is a small rocky island, half a mile in its longest diameter, one fourth of

a mile wide, and about forty feet high, with a sloping shore on one side. It is a part of a cone which has been broken off on three sides, and the other part submerged. This is called Otter Island, and has on it a small fur seal rookery, yielding three thousand skins annually.

Mosrovia, or Walrus Island. — East-southeast from the east end of St. Paul's Island, eight miles distant, is a rock rising on all sides to a height of thirty-five feet, half a mile long by one eighth wide. It has around its base at the water line several ledges or shelves, on which the walruses come to lie after feeding on the banks east of the island. These animals frequent the island during the summer in large numbers, and are killed by the natives for their ivory. On the island is also a small sea lion rookery. It is also the breeding-place of immense flocks of sea-fowl, and the natives of St. Paul hence visit it in the laying season for the purpose of obtaining eggs.

St. George's Island. — This island lies forty miles to the southeast of St. Paul's, and is nearly triangular in form (Fig. 6); its greatest

Fig. 6.

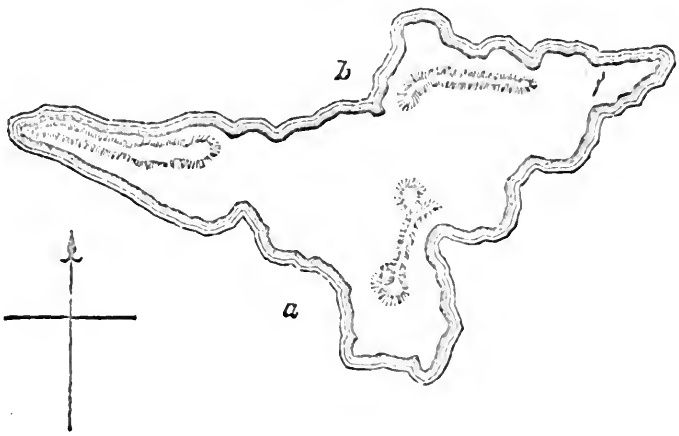


Diagram of St. George's Island: *a*, principal seal rookery; *b*, harbor and settlement.

length is twelve miles in an east and west direction. The greatest width of the island, which is near its centre, is four miles. Its northern shore has an indentation near its centre of three fourths of a mile in depth, with a bank in front. Within this cove vessels may anchor in ten fathoms of water, one half a mile off shore. It is at this point that the settlement is situated. The southeast and southwest sides are very irregular, with indentations on each side where vessels may anchor in from ten to sixteen fathoms, one fourth of a mile from

shore, but with poor holding-ground, and no shelter except when the wind is from the land.

This island is of similar origin to St. Paul's, but differs from it in outline. A mountain ridge nearly one thousand feet high traverses the southeast part of the island parallel to the shore, and forms a perpendicular sea front, from two to six hundred feet high. West of the ridge the island is intersected by a valley three miles wide, descending gradually on either side to the shores, where it terminates in low broken cliffs. To the westward of the valley the surface rises again rapidly, and ends in a narrow perpendicular headland six or seven hundred feet high.

The whole appearance of the island indicates that it was originally much larger than it is at present, and that the outer portion has been broken off and submerged, leaving the sides perpendicular. It is only on the sloping shores near the middle of the island that the seals can obtain a footing. On all the other sides the surf breaks against the base of the cliffs. Broken clinkstones cover most of the surface of the island, upon the lower parts of which a thin soil of decayed vegetable matter has accumulated. Owing to the springy, oozy nature of the ground, the houses are all built above-ground, and not partially below the surface as on St. Paul's. The island has one hundred and sixty Aleutian inhabitants, similar to those of St. Paul's.

The island of St. George is estimated to yield one half as many seals as St. Paul's, but owing to the poor anchorage and the difficulty of loading the vessels with the skins, the seals have been less disturbed.

The Climate.—No record of the temperature at these islands had been kept previous to my arrival. My observations at St. Paul's give the mean temperature of June as 48° F.; of July, 51°; a part of August, 60°. These are the three warmest months of the year. I was told that the mercury froze twice during the previous winter.

Snow falls on these islands from October to April, but except in sheltered spots it does not attain any great depth, blowing off as fast as it falls.

From the middle of March to the latter part of May the great body of floating ice comes down from the north, and passes by the east end of the island to the southwest. At this time the weather is very severe, this being the most stormy period of the year. This body of ice seldom extends as far south as St. George's, forty miles distant. During my

residence at St. Paul's there was very little fog on the island, though it could be seen resting on the water ten or fifteen miles off shore, forming clouds which obscured the sun during the greater part of the time. The climate is not favorable to agriculture, but there is at least a thousand acres of first-class grazing land along the southeast shore and in the vicinity of the village.

Last year a horse and four neat cattle were brought to the island. Directions had been given to prepare hay for them, but owing to the dampness of the atmosphere it was not done, so that when the cattle were landed there were only such supplies of food for them as the island naturally afforded. They therefore had to subsist on the dry grass of the flats, on which they wintered in good condition, the cows giving a good supply of milk. The wild rye-heads proved nutritious food, of which the supply was abundant. The horse also came through in excellent condition, though having no grain. Goats and sheep have been added to the stock on the island during the past season. They have all bred and are doing well. I have been thus minute in these details, because I have often heard it asserted that these islands are barren rocks, without vegetation.

The Habits of the Fur Seal.

The fur seals resort to the Pribyloff Islands during the summer months for the sole purpose of reproduction. Those sharing in these duties necessarily remain on or near the shore until the young are able to take to the water. During this considerable period the old seals are not known to take any food. In order to speak intelligibly of the duties of the several classes of seals at this important season, it is necessary at this point to describe the animals.

The male fur seal does not attain mature size until about the sixth year. He then measures in total length from seven to eight feet, and six to seven in girth. His color is then dark brown, with gray over-hair on the neck and shoulders. When in full flesh his weight varies from five to seven hundred pounds. These and no others occupy the rookeries (or breeding-grounds) with the females.

A full-grown female measures four feet in length and two and a half around the body, and differs from the male in form by having a somewhat longer head, shorter neck, and a greater fulness of body posteriorly. She usually weighs from eighty to a hundred pounds. Her

color when she first leaves the water is a dark steel-mixed on the back, the sides and breast being white; but she gradually changes somewhat, and in eight or ten days after landing becomes dark brown on the back, and bright orange on the breast, sides, and throat. Hence it is easy to distinguish those that have just arrived from those that have been several days on the shore. The female breeds the third year, and is full-grown at four years.

The yearlings weigh from forty to fifty pounds, and are dark brown with a lighter shade on the throat and breast. The ages of those between one and six years old are easily distinguished by the differences in size and state of development of the animals. The reproductive organs of the male are fully developed the fourth year, and it is mainly by males of this age that the fertilization of the females is effected. Copulation, described more fully later, usually takes place in the water.

The breeding-rookeries, which are frequented exclusively by the old males and females with their pups, occupy the belt of loose rocks along the shores between the high-water line and the base of the cliffs or uplands, and vary in width from five to forty rods. The sand beaches are used only as temporary resting-places, and for play-grounds by the younger seals; these beaches being neutral ground, where the old and infirm or the wounded may lay undisturbed.

The old male appears to return each year to the same rock so long as he is able to maintain his position. The native chiefs affirm that one seal, known by his having lost one of his flippers, came seventeen successive years to the same rock.*

Those under six years are never allowed by the old ones on these places. They usually swim in the water along shore all day, and at night go on the upland above the rookeries and spread themselves out, like flocks of sheep, to rest.

* Dr. Newberry states (United States Pacific Railroad Surveys and Explorations, Vol. VI, Zoölogy, p. 50, 1857) that Dr. William O. Ayres of San Francisco presented a skull of a "sea lion" to the California Academy of Science, obtained by him during a visit to the Farallone Islands in June, 1855, concerning which he made the following remarks, which tend to corroborate Captain Bryant's opinion that the seals return year after year to the same breeding-grounds. Dr. Ayres observes: "The specimen is of interest as illustrating, in one particular, the habits of these animals. The left zygomatic arch has been perforated by a bullet, and the lower part of the left inferior maxillary bone by another; both these injuries having been received so long since that the action

Wherever a long continuous shore line is occupied as a breeding-rookery, neutral passages are set apart at convenient distances through which the younger seals may pass from the water to the upland and return unmolested. Often a continuous line moving in single file may be seen for hours together going from the water to the upland, or the reverse, as the case may be. When suddenly disturbed while sleeping on the upland by an attempt of an animal to cross the rookery at any other place, a general engagement ensues, which often results in the death or serious crippling of the combatants. After the females have arrived at the rookeries, many of them, as well as their pups, are trampled to death in these struggles.

Constant care is also necessary lest thoughtless persons incautiously approach the breeding-grounds, as the stampede of the seals that would result therefrom always destroys many of the young.

The old males are denominated by the natives *Seacutch* (married seals). These welcome the females on their arrival, and watch over and protect them and their young until the latter are large enough to be left to the care of their mothers and the younger males.

Those under six years old are not able to maintain a place on the rookery, or to keep a harem, and these are denominated *Holluschuck* (bachelors). These two classes of males, with the full-grown females, termed *Motku* (mothers), form the three classes that participate in the duties of reproduction.

By the first to the middle of April the snow has melted from the shore and the drift ice from the north has all passed. Soon after this period, a few old veteran male seals make their appearance in the water near the island, and after two or three days' reconnoissance venture on to the shore and examine the rookeries, carefully smelling them. If the examination is satisfactory, after a day or two a few climb the slopes and lay with their heads erect listening. At this time, if the wind blows from the village towards the rookeries, all fires are extinguished and

of the absorbents has almost smoothed the splintered edges of the bones. Inside of the wound of the zygoma was found the piece of lead which had caused it, and which was at once recognized, from certain peculiarities of form, as one which had been fired, without fatal effect, at a sea lion, on the same rocks, in the summer of 1854. We have thus a demonstration," Dr Ayres continues, "that these huge seals return, in some instances at least, year after year, to the same localities. They leave the Farallones in November and return in May, being absent about six months. How far they migrate during that interval we have at present no means of determining." — J. A. A.

all unnecessary noises avoided. These scouts then depart and in a few days after small numbers of male seals of all ages begin to arrive. The old patriarchs soon take their places on the rookeries and prevent the younger males from landing. They thus compel them to either stay in the water or go to the upland above.

In locating, each old male reserves a little more than a square rod of space to himself. For this proceeding they evidently have two reasons. First, from the constant liability to surprise from their rear, which is their weakest point, they require room enough to make one leap in turning before being able to defend themselves or to attack their enemies. Their eyes being adapted to seeing in the water, their vision is feeble when they are out of that element. Consequently they have to rely mainly on the senses of hearing and smell for warning of danger; hence while dozing on the rocks every movement or sound in their vicinity keeps them constantly turning towards the direction from which it proceeds. A second reason is that each requires that amount of space for the reception of his ten or fifteen wives.*

Male seals continue to arrive in small numbers daily, a few of which are yearlings; those two, three, four, and five years old arrive in about equal proportions. Those older than this are more numerous than the younger, each one of which fights his way to his old place on the rookery,† or, taking a new one, prepares to contend for it in case the owner comes to take it. As they acknowledge no right but that of might, the later comer has to select again. The growling and fighting are constant, so that day and night the aggregated sound is like that of an approaching railway train.

About the 15th of June the males have all assembled, the ground being then fully occupied by them, as they lay waiting for the females to come. These appear in small numbers at first, but increase as the season advances till the middle of July, when the rookeries are all full, the females often overlapping each other.

* Steller gives the number of females to each male as eight to fifteen or even fifty. ("Mares polygami sunt, unus sæpi 8, 15, ad 50 fœmellas habet, quas anxie æmulabundus custodit, et vel alio tantillium appropinquante, in furorem agitur.") Several of the earless seals, as well as all the species of eared seals, are well known to be polygamous. The seraglios of the male sea elephant, whose habits are better known than those of any other of the group, are said to embrace frequently from fifteen to twenty females. — J. A. A.

† Steller remarks that the males sometimes become so attached to their stations that they prefer death to the loss of them. — J. A. A.

Many of the females on their arrival appear desirous of returning to some particular male, and frequently climb the outlying rocks to overlook the rookeries, calling out and listening as if for a familiar voice. Then changing to another place they do the same again, until some "bachelor" seal swimming in the water approaches and drives her on shore, often compelling her to land against her will. Here comes in the duty of the "bachelor" seals. They swim all day along the shore escorting and driving the females on to the rocks as fast as they arrive. As soon as a female reaches the shore, the nearest male goes down to meet her, making meanwhile a noise like the clucking of a hen to her chickens. He bows to her and coaxes her until he gets between her and the water so that she cannot escape him. Then his manner changes, and with a harsh growl he drives her to a place in his harem. This continues until the lower row of harems is nearly full. Then the males higher up select the time when their more fortunate neighbors are off their guard to steal their wives. This they do by taking them in their mouths and lifting them over the heads of the other females, and carefully placing them in their own harem, carrying them as cats do their kittens. Those still higher up pursue the same method until the whole space is occupied. Frequently a struggle ensues between two males for possession of the same female, and both seizing her at once pull her in two or terribly lacerate her with their teeth. When the space is all filled, the old male walks around complaisantly reviewing his family, scolding those who crowd or disturb the others, and fiercely driving off all intruders. This surveillance always keeps him actively occupied.

In two or three days after landing, the females give birth to one pup each,* weighing about six pounds. It is entirely black, and remains of this color the whole season. The young are quite vigorous, even at birth, nursing very soon after they are born. The mother manifests a strong attachment for her own young, and distinguishes its cry among thousands. The voice of the female is like the bleating of a sheep, and the cry of the pup resembles that of a lamb.†

* A single young at a birth seems to be the general rule in this family; cases where two are produced seeming to be, so far as known, exceptional. The period of gestation is stated by different authors as being nine to twelve months, varying in the differing species, from twelve in the fur seals to nine or ten in the hair seals. — J. A. A.

† By several different writers the voice of the male is compared to the roaring of the lion; that of the female to the bleating of a sheep; and that of the young to the cry of a lamb, not only in the case of the present species, but also of their southern allies.

In a few days after the birth of the young the female is ready for intercourse with the male. She now becomes solicitous of his attentions, and extends herself on the rocks before him. Owing to the position of the genital organs, however, coition on land seems to be not the natural method, and only rarely, perhaps in three cases out of ten, is the attempt to copulate under such circumstances effectual. In the mean time the four and five year old males are in attendance along the shore. When their jealous lord is off his guard, or engaged in driving away a rival, the females slip into the water, when an attentive "bachelor" seal follows her to a distance from shore. Then, breast to breast, they embrace each other, turning alternately for each other to breathe, the act of copulation sometimes continuing from five to eight minutes.* When the female again returns to the shore she is treated with in-

Kraschennimkow, apparently quoting from Steller, thus quaintly describes their voice as heard under different circumstances. "When this animal lies upon the shore and diverts himself, his lowing is like that of a cow; when he fights he growls like a bear; when he has conquered his enemy he chirps like a cricket." — *Hist. of Kamtsch.*, p. 228. Mr. Dall observes that they have "a kind of piping whistle which they use when tired or hot." — J. A. A.

* Other accounts somewhat vary from this. Steller's remarks on this point are as follows: "Concubitum exercent more hominum ita ut mas incubus fœmella succuba sit, præcipue autem circa vesperam veneris exercitiis inhiant: horam antea tam mas quam fœmella in mare se recipiunt, una placide natant, dein una reuertuntur, fœmella supina in dorso jacet, mas vero e mari superueuit, anterioribus pedibus innixus, maximo feruore libidinem exercet, et sub hoc lusu fœmellam ita premit et pondere suo in arenam demergit, ut nihil nisi caput emineat, ipse vero pedibus anterioribus adeo in arenam descendit, ut tandem toto ventre fœmellam premat et contingat. Locum eligunt ipsum litus arenosum, qua undis hunedum alluitur, adeo intenti et obliuiosi sui ipsius sunt, ut plusquam per quadrantem horæ scortanti abstarem, antequam me obseruaret, nec obseruasset, nisi manu colapham impegissem, ex quo adeo iratus maximo fremitu me lacessiuit, ut ægre me surriperem, ille vero nihilominus me eminus vidente, quod cœperat, absoluit opus per integrm quadrantem horæ."

Mr. W. H. Dall, in August, 1868, spent some time at St. George's Island, and in some valuable notes on the natural history of this island, which he has kindly placed at my disposal, I find the following remarks, which, it will be seen, are quite confirmatory of Steller's account: "They [the females] sleep in the water, lying on their sides, with the two flippers [of the upper side] out of the water, and receive the male in the same position. They sometimes remain *in copula* for upwards of an hour." While these statements are doubtless quite true, at least in numerous instances, the more favorable opportunities for observation Captain Bryant has had, leave little reason to suppose he has, through any inattention, been deceived in the matter.

I have been thus lengthy in these comments from the fact that this mode of coitus has not been supposed to occur among the lower mammalia. — J. A. A.

difference by all the males. She now roams at will about the rookery, whereas before she was not allowed to go to the relief of her young when in distress and crying for her. By the middle of August the young are all born, and the females are again pregnant. The old males having occupied their stations constantly for four months, without food, now resign their charge to the younger males, and go to some distance from shore to feed.

The fact of their remaining without food seems so contrary to nature, that it seems to me proper to state some of the evidences of it. Having been assured by the natives that such was the fact, I deemed it of sufficient importance to test it by all the means available. Accordingly I took special pains to examine daily a large extent of the rookery and note carefully the results of my observations. The rocks on the rookery are worn smooth and washed clean by the spring tides, and any discharge of excrement could not fail to be detected. I found, in a few instances, where newly arrived seals had made a single discharge of red-colored excrement, but nothing was seen afterwards to show that such discharges were continued, or any evidence that the animals had partaken of food. They never left the rocks, except when compelled by the heat of the sun to seek the water to cool themselves. They are then absent from the land for but a short time. I also examined the stomachs of several hundred young ones, killed by the natives for eating, and always without finding any traces of food in them. The same was true of the few nursing females killed for dissection.* On their arrival in the

* Steller states that, in the numerous specimens he dissected, he always found the stomachs empty, and remarks that they take no food during the several weeks they remain on land. Mr. Dall confirms the same statement in respect to the present species, and Captains Cook, Weddel, and others, who have had opportunities of observing the different southern species, affirm the same fact in respect to the latter. Lord Shuldham long since stated that the walrus had the same habit, though its annual fast seems somewhat shorter than those of the eared seals. In the London Philosophical Transactions for the year 1775 (p. 249), in briefly describing the droves of walruses that at that time frequented the Magdalen and other islands in the Gulf of St. Lawrence, he says that they crawl upon the land in great numbers, at convenient landing-places, "and sometimes remain for fourteen days together without food, when the weather is fair; but on the approach of rain they immediately retreat to the water with great precipitation."

This singular phenomenon of a protracted annual fast during the period of parturition and the nursing of the young — the season when most mammals require the most ample sustenance — seems not wholly confined to the walruses and the eared seals. So far as known, however, it is limited to the Pinnipedes; and, excepting in the case of a single

spring they are very fat and unwieldy, but when they leave, after their four months' fast, they are very thin, being reduced to one half their former weight.

The female has four teats, two on each side, equidistant, and in line between the fore and hind flippers. Their milk is of a yellowish color, composed of water and caseine, very insipid, and containing no sugar. The pups nurse but seldom, and when separated from the mother for thirty-six hours and returned to her again, they seem in no haste to do so, and in some cases did not for several hours afterwards.

About the 20th of July the great body of the previous year's pups arrive and occupy the slopes with the younger class of males, and they continue to be mixed together during the remainder of the season. The two-years-old females, which pair with the young males in the water near the island, also now associate with the other females.

The pups are five weeks old when the old females go off to feed; they go with the mothers to the upland, but keep by themselves. The pups born on the lower edge of the rookery, where the surf breaks over them occasionally, learn to swim early, but the larger portion of them do not take to the water until later, and many have to be forced in by the parent.* Once in, however, they soon love to sport in it. The young are taught to swim by the old males on their return from feeding.

By the last of October the seals begin to leave the islands in small companies, the males going last and by themselves. In November the

member, the sea elephant (*Macrorhinus elephantinus*), to the two above-named families. By some of the old writers the sea elephant was said to feed sparingly, at this time, on the grasses and sea-weeds that grew in the vicinity of its breeding-places, but the weight of the evidence in respect to this point seems to indicate that this species fasts similarly to the eared seals and walruses, during the period it resorts to the land to bring forth its young. Regarding the period of abstinence of the sea elephants and its effect upon the animals, Weddel observes as follows: "The circumstance of these animals living on shore for a period not less than two months, apparently without taking food of any description, may certainly be considered a remarkable phenomenon in natural economy. That they live by absorption is evident; that is, by consuming the substance of their own bodies; because, when they come first on shore they are excessively fat, and when they return to the sea they are very lean" (*Voyage towards the South Pole*, p. 136).

It may be that other species of the earless seals undergo similar fasts, but if so I have as yet seen no record of the fact. — J. A. A.

* A dislike or fear of the water on the part of the young of other species of fur and hair seals has been reported by other observers. — J. A. A.

young seals (as I was informed by the natives, my own observations ending in August) stop to rest a few days on the Aleutian Islands, and at Ounalaska the natives obtain several hundred skins annually.*

* The following remarks, quoted from Captain Weddel's "Voyage towards the South Pole" (p. 137, August, 1827), show how closely the southern fur seal (*Arctocephalus falklandicus*) resembles the northern fur seal in habits and general economy: —

"Nothing in this class of animals [the seals], and more particularly in the fur seal of Shetland, is more astonishing than the disproportion in the size of the male and female. A large grown male, from the tip of the nose to the extremity of the tail, is six feet nine inches, whilst the female is not more than three feet and a half. This class of males is not, however, the most numerous; but being physically the most powerful, they keep possession of the females, to the exclusion of the younger branches; hence, at the time of parturition, the males may be computed to be as one to twenty [females], which shows this to be, perhaps, the most polygamous of large animals.

"They are in their nature completely gregarious; but they flock together and assemble on the coast at different periods and in distinct classes. The males of the largest size go on shore about the middle of November to wait the arrival of the females, which of necessity must soon follow, for the purpose of bringing forth their young. These, in the early part of December, begin to land; and they are no sooner out of the water than they are taken possession of by the males, who have many serious battles with each other in procuring their respective seraglios; and by a peculiar instinct they carefully protect the females under their charge during the whole period of gestation.

"By the end of December, all the female seals have accomplished the purpose of their landing. The time of gestation may be considered twelve months, and they seldom have more than one at a time, which they suckle and rear apparently with great affection. By the middle of February the young are able to take to the water; and after being *taught to swim by the mother*, they abandon them on shore, where they remain till their coats of fur and hair are completed. During the latter end of February, what are called the dog-seals go on shore: these are the young seals of the two preceding years, and such males as, from their want of age and strength, are not allowed to attend the pregnant females. These young seals come on shore for the purpose of renewing their annual coats, which being done by the end of April, they take to the water, and scarcely any are seen on shore again till the end of June, when some young males come up and go off alternately. They continue to do this for six or seven weeks, and the shores are then abandoned till the end of August, when a herd of small, young seals of both sexes come on shore for about five or six weeks; soon after they retire to the water. The large male seals take up their places on shore, as has been before described, which completes the intercourse all classes have with the shore during the whole year.

"The young are at first black; in a few weeks they become gray, and soon after obtain their coat of hair and fur. . . . . I have estimated the female seal to be, in general, at its full growth within four years, but possibly the male seal is much longer, very likely five or six years; and some which I have contrasted with others of the same size could not, from their very old appearance, be less than thirty years"

[For further information in respect to the habits of the Pinnipedes in general, the reader is referred to Dr. Robert Hamilton's "Natural History of the Amphibious Carnivora," etc. (1839), which forms the eighth volume of the Mammalia of Jardine's "Nat-

Manner of Killing the Seals. — It will be recollected that I have described the younger seals as spreading out on the slopes above the rookeries to rest at night. A party of men approach these places armed with clubs of hard wood, and quietly creep between the seals and the shore. When ready the men start up with a shout at a given signal, and drive the seals inland in a body. When at a sufficient distance from the rookery, they halt to screen the flock of as many as possible that are too old for killing, only those that are two and three years old yielding prime skins; the fur of those older is too coarse to be marketable. The screening is done by driving the seals slowly forward in a curve; the older, sullenly holding back, force the more timid forward, when the men opening their ranks let them pass through and return to the shore. The remainder of the flock is then driven to the killing-ground, though still containing many too old to be of value.

It is necessary to drive the flock some distance from the feeding ground, as the smell of the blood and the carcasses disturbs the seals. Another object is to make the seal carry his own skin to the salt-house, and it is hence sometimes necessary to drive them six or seven miles. The driving has to be conducted with great care, as the violent exertion causes the seals to heat rapidly, and if heated beyond a certain degree the fur is loosened and the skin becomes valueless. In a cool day they may be driven one mile and a half per hour with safety. They travel by lifting themselves from the ground on their fore legs, and hitching their body after them with a kind of sideways, loping gallop. When arrived at the killing-ground a few boys are employed to keep them from straggling, and they are thus left to rest and cool. Then a small number, from seventy to one hundred, are separated from the flock, surrounded and driven on each other, so that they confine themselves by treading on each other's flippers. Those desired for killing are then easily selected and quickly killed by a light blow on the nose from a hard wooden club. When these are killed, those left as unfit are allowed to go to the nearest water, whence they immediately return to the place from which they were driven. This operation is repeated until the whole flock is disposed of, providing there is time to skin and take care of them all before putrefaction

uralist's Library," — an excellent compilation from previous authors. The more important of the recent papers treating of the habits and other characters of the eared seals have already been cited in the historical "Résumé" of the present paper. — J. A. A.]

would begin. The work of skinning is performed by all the men on the island, and every one participating in it is allowed to share in the proceeds.

As the seals are not wholly at rest until the females arrive, great care is necessary in selecting the time and place from which to drive. These points are determined by a head man, who assumes the whole control of this part of the business. In the month of May only the small number required by the natives for food are driven. In June, when the seals are more numerous, they are driven and killed for their skins, although the percentage of prime skins is at this time very small, often not twenty per cent of the whole flock driven. About the middle of July the females go off into the water, and there is a period of general rest among all the seals, during which time the natives desist entirely from killing for from ten to fourteen days. At the close of this period the great body of yearling seals arrive. These, mixing with the younger class of males, spread over the uplands and greatly increase the proportion of prime skins, but also greatly increase the difficulty of killing properly. Up to this time, there having been no females with the seals driven up for killing, it was only necessary to distinguish ages; this the difference in size enables them to do very easily. Now, however, nearly one half are females, and the slight difference between these and the younger males renders it necessary for the head man to see every seal killed, and only a strong interest in the preservation of the stock can insure the proper care. September and October are considered the best months for taking the seals.

Besides the skin, each seal will yield one gallon and a half of oil, and the linings of all the throats are saved and salted as an article of trade to other ports in the Territory, these being used by the natives for making water-proof frocks to wear in their skin canoes when hunting the sea otter or fishing. These parts have no very great commercial value, though they are considered by the natives as indispensable to them.

It will be seen by the foregoing description of the habits of the fur seal, that the conditions necessary for their preservation and increase are very simple. The first is that they be not unnecessarily disturbed during the period of their arrival on the island. Second, that care be taken in killing to kill only males, and to reserve enough of these for breeding purposes. If these precautions are taken, they increase faster

than if left to themselves; for when the number of males is in excess, the continual fighting on the rookeries destroys many of both females and young, which get trampled to death.*

Mode of Curing the Skins. — The skins are all taken to the salt-houses and are salted in kenches or square bins, the skins being spread down flesh side up, and a quantity of loose salt profusely scattered over them. They remain thus packed for thirty or forty days, when they are taken from the bins; the loose salt is removed, and the skins are folded together, the flesh side in, and sprinkled as they are folded with a small quantity of clean salt. They are then ready for shipment, only requiring a small additional quantity of salt whenever removed.

Number of Seals frequenting the Island. — There are at least twelve miles of shore line on the island of St. Paul's occupied by the seals as breeding-grounds, with an average width of fifteen rods. There being about twenty seals to the square rod, gives one million one hundred and fifty-two thousand as the whole number of breeding males and females. Deducting one tenth for males leaves one million thirty-seven thousand and eight hundred breeding females. Allowing one half of the present year's pups to be females, this will add half a million of breeding females to the rookeries of 1872, in addition to those now there, while the young of last year and the year before are also to be added. This estimate does not include the males under six years of age, these not

* The almost total extermination at some points of some of the various seals formerly extensively hunted for their skins or their oil on the islands and coast of Southern South America is well known. Weddel states (in his "Voyage," already cited) that the number of fur seals taken off the Shetland Islands, during the years 1821 and 1822, may be computed at 320,000. "This valuable animal," he adds, "might, by a law similar to that which restrains fishermen in the size of the mesh of their net, have been spared to render annually 100,000 furs for many years to come. This would have followed from not killing the mothers till the young were able to take to 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 [1839] practised at the river of Plata. The island of Lobos, in the mouth of that river, contains a quantity of seals, and is farmed by the Governor of Monte Video, under certain restrictions, that the hunters shall not take them but at stated periods, in order to prevent the animals from being exterminated. The system of extermination was practised, however, at Shetland; 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 animals became nearly extinct; the young losing their mothers when only three or four days old, of course all died, which, at the lowest calculation, exceeded 100,000." J. A. A.

being allowed on the rookeries by the older males, nor the yearlings. If we now add those frequenting St. George's Island, which number half as many, and make a very liberal discount for those that may be destroyed before reaching maturity, the number is still enormous. It will also be seen that the great importance of the seal fishery is not to be calculated from the basis of its present yield, since each year adds to its extent, as with proper care the number can be increased until both islands are fully occupied by these valuable animals.*

Peculiar situation of the Pribyloff Island. — These islands are situated immediately between the northern edge of the great warm oceanic current, — which, passing into Behring's Sea west of the Aleutian Islands and flowing east through Ounimak Straits, enters the Gulf of Alaska at that point, — and the edge of the rotary cold current which flows from the Gulf of Anadir east through Norton Sound, returning westward to this point again. These currents furnish the necessary climatic conditions of a cool uniform temperature and humid atmosphere necessary to these animals, while their position is just far enough south to escape being visited by the polar bears floating on the ice, as is not the case with the island of St. Matthew's, the nearest land on the north. There are no other islands possessing these advantages in an equal degree. Behring's and Copper Islands, further westward, in Russian waters, approach it nearest.

Prices paid for the Skins at the Islands, and their Value in Europe. — The Russian company allowed the natives the value of ten cents per skin. This was the pay they received for the labor of killing, curing the skins, and delivering them alongside the vessel ready for shipment, the company finding salt and magazines in which to salt them.

The parties who took advantage of the interval between the transfer of the Territory and the enacting and enforcement of the law of the 27th of July, 1868, to kill and purchase of the natives, paid twenty-seven cents per skin, and had they been allowed to trade the present

* It may be added that the United States government has already taken measures to prevent an undue decrease of the fur seals of the Pribyloff Islands, in the amendment to the bill for the preservation of the fur-bearing animals of Alaska, which was passed by Congress early in July of the present year, and that private parties have interested themselves in the preservation of the sea lions that frequent portions of the California coast. — J. A. A.

year would have bidden forty cents apiece for them. To this is to be added the cost of salt, buildings, and the expense of the agency on shore. Their market value was at that time five dollars, so that, after a liberal allowance for incidental expenses, the profit must be very large.

Previous to 1866 these skins were worth only three dollars each, but owing to recent improvements in their manufacture they have become fashionable for ladies' wear, and soon after the transfer of the Territory to the United States the price rose to seven dollars. At this time the Russians had one hundred thousand on hand, which were forwarded to London, the only market for seal-skins in the raw state, and the only place where they are dressed. The different parties who sealed on the islands in the summer following the purchase took two hundred thousand, which so overstocked the market that they are now worth only three or four dollars.

The agents of the Russian Fur Company aimed to control this branch of the fur trade in Europe by regulating the supply. To do this they sent orders a year in advance to have such a number killed as in their judgment the market might need, always keeping at the same time one year's supply on hand. At the time of the sale of the Territory the annual yield was estimated at eighty thousand skins. The opinion of the men who have the special care of the seals is that it has reached one hundred thousand, and that the killing yearly of this number will in no way check their increase. As I have elsewhere explained, to kill a proper number of males annually tends to a general increase in the whole number of seals.

Use of the Flesh by the Natives. — The flesh of the seal constitutes the principal food of the inhabitants, they killing from time to time such numbers as are necessary for that purpose. Before the seals leave in autumn a number are killed sufficient for their winter's supply. The carcasses are allowed to freeze, and in this state they keep them until the return of the seals in the spring. The flesh of the yearling seal is somewhat darker than beef; it is juicy and tender, but lacks the sweetness and flavor of beef, and is less firm and nutritious. In highly seasoned dishes it is relished by nearly all who partake of it. The soldiers on the island preferred it to salt rations. A five weeks' old pup roasted is esteemed a great luxury. The sea lion also constitutes a part of the natural food of the natives.

CAMBRIDGE, August, 1870.

No. 2. — *Preliminary Report on the Crustacea dredged in the Gulf Stream in the Straits of Florida, by* L. F. DE POURTALES, Assist. U. S. Coast Survey. Part I. BRACHYURA. *Prepared by* DR. WILLIAM STIMPSON.

(COMMUNICATED BY THE SUPERINTENDENT OF THE U. S. COAST SURVEY.)

THE crustacea collected by M. Pourtales are very numerous in species, and among them there is an unusually large proportion of new forms; so that their investigation has occupied more time than was anticipated. To avoid delay in publishing a portion at least of the results, it is thought best to give at once that part of the work which has been done thus far, reserving the completion for a second part, in which the general considerations derived from the entire study will also be given.

To preserve accuracy in the statements of localities and depths, and to insure the correction of any errors which may have occurred, all the details on the labels of each species are given below, arranged in the order of depths of water.

MAIOIDEA.

FAMILY MAIIDAE.

SUBFAMILY LEPTOPINAE.

The group typified by the genus *Leptopus* Lamarck (*Egeria* Latr.) should be separated from the Inachinae of Dana on account of the broad and somewhat heart-shaped meros-joint of the external maxillipeds, which in *Inachus* is simply ovate and elongated, with the palpus articulated at the small extremity.

Pyromaia nov. gen.

Carapax somewhat pyriform, convex; rostrum simple, slender, of moderate length, acute; transorbital breadth small; præorbital spine short, almost erect; postorbital tooth rather large, pointing forwards. Meros-joint of the external maxillipeds short and broad, deeply and broadly notched for the reception of the palpus, and with the inner lobe strongly projecting and the outer lobe angular. Ambulatory feet long; those of the first pair three times as long as the post-frontal portion of the carapax.

This genus approaches nearest to *Microrhynchus* Bell, but differs in its more elongated and pyriform carapax, larger rostrum, and prominent, angular external lobe of the meros-joint of the outer maxillipeds. From *Leptopus* it differs in its simple rostrum.

Pyromaia cuspidata nov. sp.

Body and feet naked. Carapax granulated, with the regions well defined, tumid, and armed with short spines. Rostrum trigonal, with the three edges (the superior and two lateral) armed with minute spines. Basal joint of external antennæ with a slender spine in front, and a smaller one beneath; the latter pointing directly downward. Chelipeds with the meros-joint spinous below and with a spine at the summit; carpus with one spine on the outer side at the articulation of the hand; hand inconspicuously spinulose, fingers longer than the palm, not gaping, serrated, and acuminate. Ambulatory feet with cylindrical joints; in the adult female smooth and naked; in the young male sparsely and inconspicuously hairy; dactyli two thirds as long as the penult joint, and flattened toward the extremities.

The dimensions of the largest specimen, a female, are as follows: Length of the carapax, 1.2 inch; greatest breadth, 0.94 inch; proportion of breadth to length, 1 : 1.28. Length of ambulatory feet of the first pair, 3.05 inch.

This species lives in deep water, with a range of from 82 to 125 fathoms, as shown by the following table of localities, etc., taken from the notes of the expedition.

Off Sand Key,	May 11, 1868.	Cast No. 5.	82	fathoms.
Off Alligator Reef,	May 8, 1869.	Cast No. 6.	88	"
Off the Samboes,	May 9, 1868.	Cast No. 6.	93	"
Off the Samboes,	May 9, 1868.	Cast No. 1.	121	"
S. W. of Sand Key,	February 17, 1869.	Cast No. 2.	125	"

Subfamily PISINAE.

Pisa antilocapra nov. sp.

Carapax subovate, rather narrow, pubescent, and spinous, with a strong, acute spine on the hepatic region, seven to ten smaller, subequal ones on the branchial, and four, forming a rhomb, on the intestinal region. A few sharp tubercles on the cardiac and gastric regions. Rostrum horizontal, equalling in length more than one third the post-frontal length of the carapax; horns diverging from the basal third, rather slender, acute, and straight, or slightly curved inward near the extremities. Præorbital spine slender, less than one third as long as the rostrum. On the superior margin of the orbit there are two spiniform teeth between the base of the præorbital spine and the external angle, which is also acute. Spine of the basal joint of the external antennæ much smaller than the præorbital spine. Feet pubescent, with the meros-joints sparsely spinose above. Dactyli of the ambulatory feet unarmed on the inferior edge.

Dimensions of a male: Total length of carapax, 1.22; breadth, excluding the spines, 0.65; length of ambulatory foot of the first pair, 1.30 inch.

It is a more elongated species than any of the three *Pisae* described by Desbonne and Schramm, which are the only ones as yet indicated as inhabiting the West Indian seas, if, indeed, these species truly belong to the genus.

The specimens occurred at the following localities and depths: —

Off Carysfort Reef, March 31, 1869.	Cast No. 1.	52 fathoms.
Off Carysfort Reef, March 31, 1869.	Cast No. 5.	60 "
Off Alligator Reef, May 8, 1869.	Cast No. 10.	118 "

Pisa praelonga nov. sp.

Carapax long and narrow, the width across the branchial regions being very little greater than that between the orbits. It is sparsely hairy, and armed with a few very small spines on the sides. Surface beneath the hairs smooth. Rostrum large, as long as one third the post-frontal length of the carapax; horns slender, acute, divergent. Præorbital spine slender, acute. Orbit large, with one sharp tooth on the upper margin, near the base of the post-orbital tooth. Basal joint of external antennæ with a spine in front (smaller than the præorbital spine), and another on the o ter side near the base.

Dimensions of a male: Length of carapax, rostrum included, 0.39; length to the base of horns of rostrum, 0.30; breadth, 0.19 inch.

It differs from all species of the genus hitherto known in the narrowness of the carapax.

Off Alligator Reef, May 8, 1869.	Cast No. 10.	118 fathoms.
Off Tennessee Reef, May 7, 1869.	Cast No. 7.	124 "

Milnia bicornuta Stm.

Pisa bicornuta Latreille, Encyc. Méth., X, 141.

Pericera bicorna H. Milne-Edwards, Hist. Nat. des Crust., I, 337.

Pisa bicorna Gibbes, Proc. Am. Assoc. Adv. Sci., 1850, p. 170.

Pericera bicornis Saussure, Crust. Nouv. du Mexique et des Antilles, p. 12; pl. i, fig. 3.

Milnia bicornuta Stimpson, Notes on North American Crustacea, p. 52. Smith, Trans. Connecticut Acad. of Arts and Sciences, II, 1.

Found at low-water mark at the Tortugas, and dredged at Key West in 2 to 5 fathoms.

The generic name *Milnia* is preoccupied, having been used by Haime for an Echinoid, but it seems scarcely necessary to change it.

Subfamily PERICERINAE.

Milne-Edwards, Dana, and authors generally, speak of the eyes of *Pericera* as being non-retractile, having probably studied the genus by means of dried specimens only. In fact, however, the eyes in this group are more perfectly retractile than in any other crustacea; so much so that they may be entirely concealed in their orbits, which form a capacious cavity with a small, round external orifice. In this cavity the peduncle of the eye, the inner half of which is not indurated, becomes bent to a right angle when retracted.

Pericera trispinosa H. M.-Edw.

Pisa trispinosa Latreille, Encyc. Méth., X, 142.

Pericera trispinosa H. M.-Edwards, Hist. Nat. des Crust., I, 336 Guerin, Iconog. du Règne Anim., Crust., pl. viii, fig. 3. Gibbes, Proc. Am. Assoc. Adv. Sci., 1850, p. 172.

Dredged at Key West in from 2 to 5 fathoms, and found at the Tortugas at low-water mark.

Pericera camptocera nov. sp.

Allied to *P. trispinosa*, but differs as follows: The carapax is narrower and more sparsely pubescent. The four tubercles at the summit of the gastric region are more prominent, forming erect spines. The posterior spine and the lateral spines are longer and more curved. The rostrum is longer, and its horns are regularly divergent from the base. The orbital tubes are more protuberant, and the præocular and postocular teeth longer. The movable part of the antennæ is both longer and stouter. Finally the carpal joint of the ambulatory feet is narrower and not tuberculated.

Measurements of a male: Total length of carapax, 0.92; length of rostrum, from base of orbital tubes, 0.25; breadth, between the tips of the lateral spines, 0.70; between the bases of these spines, 0.48 inch.

One male and one female specimen were taken near Key West in from 2 to 5 fathoms.

Pericera eutheca nov. sp.

Carapax subtrapezoidal, constricted anteriorly behind the orbits, and broadly rounded behind. Frontal and hepatic regions concave; gastric, cardiac, intestinal, and branchial regions moderately prominent and each bearing a slender spine. Rostrum very small, forming about one sixth the length of the carapax, nearly horizontal, and consisting of two slender, acute, parallel horns. Orbits very strongly prominent, projecting forward and outward far beyond the antero-lateral margins, forming sheaths longer than the rostrum, and each occupying nearly one third the interorbital width of the carapax. The distance between their extremities equals four fifths of the greatest width of the carapax. The extremity of the orbital sheath is armed with two spines, one before and one behind the eye. The spine of the basal joint of the external antennæ is rather small and slender, and about one third as long as the rostrum. The ambulatory feet are very slender.

The measurements of a female specimen are: Total length of carapax, 0.90; breadth, excluding the spines, 0.65; length of first pair of ambulatory feet, 0.75 inch.

It may be distinguished from all the species hitherto known by the great size and prominence of the orbital sheaths.

Off French Reef, April 3, 1869. Cast No. 1. 15 fathoms.
West of Tortugas, Jan. 16, 1869. Cast No. 9. 37 fathoms.

Pericera septemspinosa nov. sp.

Carapax oblong, strongly convex, pubescent; antero-lateral and postero-lateral sides concave. Dorsal surface armed with seven prominent spines, one on the gastric, one on the cardiac, one on the intestinal, and two on each branchial region. Rostrum about one fourth as long as the post-frontal portion of the carapax, deflexed; horns subtriangular, acute, diverging, curved, pointing outward. Orbits projecting, with a prominent, acute præocular and postocular spine. On the suborbital and subhepatic region there are three spines, the posterior one of which is longest. There is a small, slender, acute spine on the basal joint of the antennæ. Feet unarmed. The pubescence of the body adheres strongly to rough objects brought in contact with it, and notably to that of other specimens of the same crab.

Measurements of a male: Length of carapax, 0.33; breadth, excluding the spines, 0.25 inch.

It differs from *P. eutheca* in its broader rostrum and less prominent orbital sheaths; also in the spines on the subhepatic region, etc.

West of Tortugas, January 16, 1869. Cast No. 4. 36 fathoms.

Pericera cornuta H. M.-Edw.

Cancer cornuta Herbst, Naturg. d. Krabben u. Krebse, pl. lix, fig. 6.
Maia taurus Lamarck, Animaux sans Vert., V, 242.
Pericera cornuta H. Milne-Edwards, Hist. Nat. des. Crust., I, 335; pl. xiv bis, fig. 5. Illust. Cuv. Règne Anim., pl. xxx, fig. 1. Gibbes, Proc. Am. Assoc. Adv. Sci. 1850, p. 172. Stimpson, Notes on N. American Crust., p. 55.

A young example, one inch long, of this well-known species, occurred in rather deep water. It had previously been found only about low-water mark. In the young, the horns of the rostrum are more divergent than in the adult, and the anterior branchial spine is smaller. The feet are provided with a few long, thick hairs not found in the adult.

Off the Quicksands, January 23, 1869. Cast No. 1. 34 fathoms.

Tiarinia setirostris nov. sp.

Carapax narrow, with perpendicular sides. The greatest breadth, which is at the posterior fourth of the post-frontal length, is only one fourth greater than the transorbital breadth. The upper surface is naked, and bears a few small tubercles, of which three, in a median line on the posterior half of the carapax, are larger than the others. The posterior tubercle, on the intestinal region, is spiniform and curved upward. Sides of the carapax somewhat setose. Rostrum half as long as the post-frontal part of the carapax, with the horns slightly gaping near the base, but contiguous for the remainder of their length, very slender, setiform, and setose. External antennæ as long as the rostrum; basal joint concave, without any spine at the antero-external angle; flagellum long, hair-like. Chelipeds in the male large, longer than the carapax including the rostrum; hand somewhat compressed, granulated above; fingers very short, widely gaping. Ambulatory feet long, slender, and smooth; those of the first pair nearly as long as the chelipeds.

Dimensions of a male specimen: Length of carapax, 0.82; breadth, 0.35 inch.

This species differs much from the typical *Tiariniae* in the great length, slenderness, and smoothness of its ambulatory feet, and future investigations, on more abundant materials than those at present available, may prove it to be generically distinct; in which case I would propose for it the name *Leptopisa*.

The *Tiariniae* hitherto described all belong to the Indo-Pacific fauna, living chiefly in the southern part of the Japanese Archipelago, in the seas of Sulu and the Philippines, Nicobar, etc. Of these species our Florida form approaches nearest to *T. angusta* Dana, which it resembles in the narrowness of the carapax, but from which it is at once distinguished by the less tuberculated carapax and slender feet.

It was taken at the following points:—

Key West, 2 to 5 fathoms.
Near the Tortugas, 9 fathoms.
On the Fishing Banks, S. W. of Loggerhead Key.

Subfamily NAXIINAE.

The characters of the orbital region in *Chorinus* are so different from those of *Naxia* and its allies as to forbid its being placed in the same subfamily with the latter group, for which the name *Naxiinae* is here proposed. The deep notch on the upper side of the orbit is here a constant character.

Scyra umbonata nov. sp.

Carapax triangular, with six large flat-topped protuberances on the upper surface; one on the posterior part of the gastric region, one on the cardiac, and two on each branchial region. On the outer side of the branchial region there is also an acute triangular tooth, pointing forward and outward, and of similar character and nearly as large as the other protuberances just described. They are all not only flattened, but somewhat expanded at the top. Their summits are naked, but the deep channels between them are pubescent. Besides the above there are on the carapax three small tubercles on the gastric and a strong erect tooth on each hepatic region. The gastric and the sides of the branchial regions are hairy. The rostrum is rather longer than the interorbital width of the carapax; it is hairy above, and is neither flattened nor expanded. The movable part of the external antennæ has cylindrical joints. The merosjoint of the external maxillipeds is not notched for the reception of the palpus. Abdomen and sternum pubescent. Sternum of the male with deep excavations between the segments, the excavations being broader than the ridges separating them.

Dimensions of a male: Length of carapax, 0.94; breadth, measured between the tips of the branchial teeth, 0.72 inch.

The species of *Scyra* heretofore known are but two in number, and inhabit waters of moderate depth on the shores of the North Pacific Ocean, one on the coast of California and Oregon, the other on that of Japan. The present species was placed in the genus with some doubt, on account of the character of the rostrum, the external antennæ, and the outer maxillipeds, which, as may be noticed by the description, differ somewhat from those of the type, *S. acutifrons*. The resemblance in all other essential characters is, however, very great; and in the present state of our knowledge, the Florida species ought not to be separated as the type of a distinct genus.

It is an inhabitant of deep water, as follows: —

Off Sand Key, May 11, 1868. Cast No. 15. 143 fathoms.

Subfamily OTHONIINAE.

The Othoniinae are characterized by great orbito-frontal breadth, a small, short rostrum, an extremely short epistome, and gaping external maxillipeds. The orbits are tubular like those of the Pericerinae, but are directed forwards instead of outwards.

Othonia aculeata Stm.

Hyas aculeata Gibbes, Proc. Am. Assoc. Adv. Sci., 1850, p. 171.
Othonia aculeata Stimpson, Notes on N. American Crust., p. 3.
Othonia Lherminieri Desbonne et Schramm, Crust. de la Guadeloupe, p. 20.

The specimens in the collection are all young, and occurred as follows: —

At Key West, 2 to 5 fathoms.
At the Tortugas, 5 to 6 fathoms.
Off the Tortugas, January 29, 1868, in 13 fathoms.

Subfamily MITHRACINAE.

Mithrax hispidus H. M.-Edw.

Cancer hispidus Herbst, Naturg. d. Krabben u. Krebse, pl. xviii, fig. 100.
Maia spinicincta Lamarck, Anim. sans Vert., V, 241.
Mithrax spinicinctus Desmarest, Consid. sur les Crust., p. 150; pl. xxiii, figs. 1, 2.
Mithrax hispidus H. Milne-Edwards, Hist. Nat. des Crust., I, 322. Gibbes, Proc. Am. Assoc. Adv. Sci., 1850, p. 172. Stimpson, Notes on N. American Crust., p. 60. Smith, Trans. Connecticut Acad. of Arts and Sciences, II, 2, 32.

This well-known species occurred at Key West, in from 2 to 5 fathoms.

Mithrax pleuracanthus nov. sp.

This is closely allied to *M. hispidus*, but is a smaller species, with a somewhat narrower carapax. The protuberances of the carapax, and the teeth or spines of the orbits and the basal joint of the antennæ, are sharper and more prominent, and there are small tubercles on the intestinal, branchial, and hepatic regions which do not occur in *M. hispidus*. The minute punctures of the surface are less apparent than in that species.

The dimensions of a male specimen are: Length of the carapax, 0.57; breadth, 0.55 inch; proportion of length to breadth, 1 : 0.965.

This species can scarcely be the *M. affinis* of Desbonne and Schramm (Crust de la Guadeloupe, p. 10), the description of which applies to it in most respects, for those authors state that the front, rostrum, and orbits are like those of *Mithraculus sculptus*.

It occurred at Key West in from 2 to 5 fathoms, and at the Tortugas in 5 to 6 fathoms. There is in the Smithsonian Collection a specimen taken at St. Thomas by A. H. Riise, Esq.

Mithrax acuticornis nov. sp.

Carapax much longer than broad, and tuberculated, sparsely on the gastric region but more closely posteriorly and at the sides, the tubercles becoming spiniform toward the margins, which are armed with true spines curving forward at their tips. Rostrum half as long as the interorbital width, and consisting of two rather slender, acute horns. Basal joint of the external antennæ armed with two spines, the anterior one of which is slender, curved, and two thirds as long as the rostrum. The margin of the orbit is armed with six spiniform teeth, not including those of the antennal joint. The feet are strongly spinose above, but the hands are unarmed. The color in wet specimens, and probably in life, is a bright deep red.

Dimensions of a male: Length of carapax, 0.73; breadth, 0.55 inch; proportion, 1 : 0.753.

This species approaches *Schizophrys* in the shape of its carapax, which is much more oblong than in other species of the genus in which I have placed it; but the rostrum is simply two-horned, and the orbits are similar to those of the typical forms of *Mithrax.*

Off the Quicksands,	January 23, 1869.	Cast No. 1.	34 fathoms.
West of the Tortugas,	January 16, 1869.	Cast No. 8.	37 "
West of the Tortugas,	January 16, 1869.	Cast No. 12.	42 "

Mithrax Holderi nov. sp.

This species resembles *M. acuticornis* in the characters of the front, but the carapax is broader and more strongly and closely tuberculated, the tubercles occupying nearly the whole upper surface, causing it to resemble that of *Tiarinia cornigera.* There is a small spine on the hepatic region and one at the lateral extremity of the branchial region. The anterior spine of the basal joint of the antennæ is nearly as long as the rostrum, and there is another spine, very small, at the insertion of the movable part of the antenna. The ambulatory feet are flattened above, giving the joints a somewhat trigonal form, and both margins of their upper surface are spinulose and ciliated.

Dimensions of a male: Length of the carapax, 0.55; breadth, 0.48 inch; proportion, 1 : 0.872.

This species occurred at the Tortugas in 7 fathoms. It is named in compliment to Dr. J. B. Holder, who found it, also at the Tortugas, and I believe at low-water mark, several years ago. Dr. Holder's specimen is in the Museum of the Smithsonian Institution.

Mithraculus sculptus Stm.

Maia sculpta Lamarck, Anim. sans Vert., V, 242.

Mithrax sculptus H. Milne-Edwards, Hist. Nat. des Crust., I, 322. Gibbes, Proc. Am. Assoc. Adv. Sci., 1850, p. 172. Desbonne et Schramm, Crust. de la Guadeloupe, p. 9.

Mithraculus sculptus Stimpson, Notes on N. American Crust., p. 58.

Key West,	2 to 5 fathoms.
Tortugas,	5 to 6 "
? Off the Samboes,	123 "

This well-known species is found throughout the West Indian seas, and is very abundant on the reefs at and above low-water mark. I have queried the depth 123 fathoms, fearing that some accidental transposition of labels has taken place, as the *Mithraculi* are eminently littoral in their habits, and the specimen so labelled is a full-grown male, similar in all respects to those found on the shores.

Mithraculus ruber nov. sp.

Carapax subtriangular, one fifth broader than long. Surface naked, polished, and uneven, but with the protuberances less numerous and smaller than in *M. sculptus* and *M. coronatus*. These protuberances are also rounded, and not elongated as in the allied species, and some of them are sparsely tuberculated. Antero-lateral margin armed with three teeth, besides the angle of the orbit, the posterior tooth being sharp, spiniform, and curving forward, the other two teeth tuberculiform; the middle tooth is composed of two tubercles, and there is a small tubercle between it and the posterior tooth. Behind the posterior tooth there is a small sharp tubercle on the postero-lateral margin. The meros-joint of the outer maxillipeds is slightly sinuous in front, showing a faint indication of a notch. Chelipeds rather long and slender; meros armed above with six small, conical, equal tubercles; carpus and hand smooth. Ambulatory feet cylindrical, densely short-hairy above (hairs simple); they are also spinulose above, the spines being scattered in two rows. Color of the carapax chestnut red, with some bluish posteriorly.

Dimensions of a male: Length of the carapax, 0.48; breadth, 0.60 inch; proportion, 1 : 1.25.

It differs from *M. sculptus*, *M. cinctimanus*, and *M. minutus* in its broader carapax, etc., and from *M. coronatus* in its spiniform lateral tooth and in the character of the surface of the carapax.

Found on the reef at Cruz del Padre, Cuba.

Mithraculus coronatus Stm.

Cancer coronatus Herbst, Naturg. d. Krabben und Krebse, I. 184; pl. xi, fig. 63 (?).

Mithraculus coronatus White, Brit. Mus. Cat. Crust., p. 7 (? partim). Stimpson, Notes on N. American Crust., p. 58. Smith, Trans. Conn. Acad. of Arts and Sciences, II, 2.

It is somewhat doubtful whether this is really the *Cancer coronatus* of

Herbst. He refers to Seba, pl xxii, fig. 6. Seba's fig. 22 of pl. xix is a better representation of the species under consideration.

Littoral on the reef at Eastern Dry Rocks.
Reef at Cruz del Padre, Cuba.
Key West, in 2 to 5 fathoms.

Family TYCHIDAE.

Subfamily TYCHINAE.

Tyche emarginata White.

Tyche emarginata White, Annals and Magazine of Natural History, First Series, Vol. XX, p. 206.

Platyrinchus trituberculatus Desbonne et Schramm, Crust. de la Guadeloupe p. 3; pl. iii, figs. 7 and 8.

The curious genus *Tyche* is so little known that a short description of the crab under consideration may not be out of place here. The carapax is flattened and partly concave above, and has laminiform expansions in front and behind. The frontal region is very broad, the transorbital width nearly equalling that across the branchial regions. The hepatic region is concave. Rostrum rather long, forked from the base; horns widely divergent. Præorbital spines very long, and somewhat divergent, thus, with the rostrum, giving the entire front a four-horned form. External antennæ concealed beneath the rostrum. Eyes long, but reaching scarcely beyond the edge of the expanded orbital margin, which is entire, without notch or tooth.

The external maxillipeds are very remarkable in form, the exognath having a hook-shaped process at the base, which overlaps the base of the ischium-joint of the endognath. The meros-joint of the endognath has a posterior lobe which projects far into the anterior extremity of the ischium.

This crab was found by the expedition at Key West in 2 to 5 fathoms, and at the Tortugas in 7 fathoms.

Family EURYPODIIDAE.

Among the general characters of this family, the existence of a distinct orbital arch over the base of the eye, and of a postocular spine, seem to be the most important.

Subfamily COLLODINAE.

This name is proposed for a group of genera of Eurypodiidae characterized by the extreme shortness of the rostrum, which group is, as far as known, peculiar to the tropical parts of the American seas, and occurs on both sides of the continent.

Collodes trispinosus nov. sp.

Carapax ovate-triangular, hairy, and everywhere covered with small granulated tubercles, except on the front and the anterior portion of the gastric region. There is an erect, capitate spine on the gastric, one on the cardiac region, and one of equal size on the basal joint of the abdomen. Rostrum with two minute horns. Four minute spines on the basal joint of the antennæ, the anterior one of which is placed nearly on a level with the horns of the rostrum. Ambulatory feet long, and provided with long stiff hairs; hairs of the penult joint below straight and above hook-like and often serrated on the inner side near the tip. Dactyli of the ambulatory feet about as long as the penult joint.

In the male of this species the carapax is somewhat more elongated and depressed than in the female; the hands are of moderate size only, and much curved inward; fingers nearly as long as palm and gaping, with a tooth inside on the middle of the thumb. Abdomen of the male elongate triangular; intromittent organs nearly straight, simple, reaching nearly to the extremity of the abdomen.

All the specimens examined were covered with a thick coating of mud, held by the setæ.

The dimensions of a female specimen are: Length of the carapax, 0.41; breadth, 0.32 inch.

The only species hitherto known of this genus is the *C. granosus* of the west coast of North America, described by me in "Notes on North American Crustacea," page 66 (Annals of the New York Lyceum of Natural History, Vol. VII, p. 194), from which the species under consideration differs in its more elongated carapax, which is more completely covered with granulated tubercles, and in the somewhat greater length of the rostral horns and the spines on the basal joint of the antennæ. It is proper to state that of *C. granosus* only a single (female) specimen is as yet known.

The species occurred as follows: —

Off the Quicksands,	January 23, 1869.	Cast No. 1.	34 fathoms.
Off Carysfort Reef,	March 21, 1869.	Cast No. 8.	35 "
Off Carysfort Reef,	March 21, 1869.	Cast No. 7.	40 "
Off French Reef,	April 3, 1869.	Cast No. 4.	50 "

Collodes nudus nov. sp.

Allied to *C. granosus* and *C. trispinosus*, having three spines on the back similar in shape and position to those of those species. It differs from them, however, in its naked carapax and feet, and in the less numerous and prominent granulated tubercles of the dorsal surface. The carapax is also much broader anteriorly.

The ambulatory feet of the second pair are rather longer than those of the first pair. The dactyli of the ambulatory feet are armed with spines along the inner edge.

The dimensions of the single specimen found, a male, are as follows: Length of carapax, 0.24; breadth, 0.18; length of ambulatory foot of the first pair, 0.45 inch.

Off Carysfort Reef, March 21, 1869. Cast No. 7. 40 fathoms.

Arachnopsis nov. gen.

Carapax oblong, narrow, and somewhat truncated in front. Rostrum short, bifid. Orbital arch high, protuberant. Postocular spine long, and separated from the orbital arch by a deep, narrow fissure. Eye long, considerably overreaching the tip of the postocular spine, but capable of being drawn back beneath it. Basal joint of the external antennæ with a small, sharp spine at the extremity, pointing obliquely forward and outward, between which and the rostrum the movable part of the antenna is exposed, and with a spinulous crest on the inferior surface extending back to the angle of the buccal area. Meros-joint of the external maxillipeds broader than long, and with sharply prominent external and internal anterior angles. Ambulatory feet long, filiform; those of the second pair longest; dactyli straight, acute, and nearly as long as the penult joint.

This genus differs from *Collodes* in its filiform ambulatory feet and long eye peduncles.

Arachnopsis filipes nov. sp.

Body armed above with three erect, slender, blunt spines, one on the gastric region, one on the cardiac region, and one on the basal joint of the abdomen. Abdominal spine small; cardiac and gastric spines equal and about as long as the distance between the orbital arches. Carapax convex anteriorly, and flattened posteriorly. Surface of carapax smooth and glossy, naked, except for a few hairs on the anterior part of the branchial, the sides of the gastric, and the frontal region. Beneath, the subhepatic and pterygostomian regions are armed with spiniform granules. Chelipeds in the male as long as the carapax and much curved; edges of meros and carpus spinulose; hand nearly smooth; fingers as long as the palm. Ambulatory feet spinulose along the lower edges of all the joints, except the dactyli; those of the second pair more than twice as long as the carapax. Sternum, abdomen, and external maxillipeds tuberculated.

Dimensions of a male: Length of carapax, 0.25; breadth, 0.18; length of ambulatory foot of first pair, 0.5 inch.

Off Conch Reef,	May 11, 1869.	Cast No. 2.	34 fathoms.
Off Carysfort Reef,	March 21, 1869.	Cast No. 7.	40 "
Off French Reef,	March 21, 1869.	Cast No. 2.	45 "

Batrachonotus nov. gen.

Carapax triangular, broadly expanded behind; surface rough with granulations; gastric, cardiac, and branchial regions strongly protuberant; cervical depressions deep and broad, giving the carapax a superior outline much like that of a frog's back. Rostrum very short, not extending beyond the walls of the antennulary fossæ, rounded in outline, and slightly emarginated at the middle. Basal joint of the external antennæ with a small tooth or spine on the outer margin, but none at the anterior extremity. No spine on the orbital arch. Post-ocular spine minute. Meros-joint of the external maxillipeds broad, with prominent external and internal anterior angles. Ambulatory feet simple; those of the first pair disproportionately long, nearly twice as long as those of the second pair; those of the posterior pairs very short. Dactyli of ambulatory feet rather long. Abdomen very narrow at base.

It differs from the other genera of Collodinae, among other characters, in the want of a terminal spine on the basal joint of the antennæ, and in its very long anterior and short posterior ambulatory feet.

Batrachonotus fragosus nov. sp.

The following description is that of a male. Body and feet naked. On each of the protuberant regions of the carapax there are one or two large and many smaller rounded tubercles or granules. A strong tubercle on the basal joint of the abdomen. A sharp tubercle on the subhepatic, and one on the pterygostomian region. Sternum regularly granulated. Chelipeds as long as the carapax, and sparsely granulated within; ischium with an erect spine at the summit; hand unarmed; fingers toothed and slightly gaping. Ambulatory feet of the first pair about three times as long as the carapax.

Color of the body in the alcoholic specimen whitish, or pale flesh-color, variegated with purplish.

Of this species we find in the collection only one specimen, a male, the dimensions of which are: Length of the carapax, 0.28; breadth, 0.245; length of ambulatory feet of the first pair, 0.80 inch.

The specimen was taken in N. Lat. 24° 36′ 40″, W. Long. 83° 2′ 20″, on the 22d of January, 1868. Cast No. 3. Depth 16 fathoms.

Euprognatha nov. gen.

Carapax pyriform. Rostrum short, trifid, the median horn being the interantennular spine, which points forward and downward at a much lower level than that of the other two horns, which are minute and divergent.

Basal joint of the external antennæ armed at the anterior extremity with a slender spine reaching forward as far as do the rostral horns; movable part of the antennæ exposed from its insertion. An erect spine on the orbital arch. Eye large; peduncle short. Post-ocular spine reaching beyond the extremity of the eye. Meros-joint of the external maxillipeds somewhat L-shaped, strongly produced beyond the insertion of the palpus in front and at the postero-interior angle. Feet long and slender. Penult joint of the ambulatory feet of the first pair more than twice as long as the dactyli, and three times as long as the antepenult joint.

This genus differs from all the other genera of Collodinae in its interantenular spine and the spine on the orbital arch, and especially in the shape of the meros-joint of the external maxillipeds.

Euprognatha rastellifera nov. sp.

The following description is that of a male. Carapax naked, with the regions well defined, and minutely and irregularly granulated. There is a single, erect, blunt, almost capitate spine on the gastric, the cardiac, and each branchial region, making four in all, and there are a few smaller spines on the sides of the branchial, and on the hepatic and pterygostomian regions. There is also a small spine on the basal joint of the abdomen. The interantennular spine projects somewhat beyond the other four spines of the front, which reach to the same vertical plane. The chelipeds are large, nearly twice as long as the carapax; hand swollen; fingers not gaping. Ambulatory feet of the first pair nearly one third longer than the chelipeds. The ambulatory feet are naked (except in bearing a few minute curled setæ above), and rough with minute spines. The sternum is regularly granulated, except on the concave portion between the chelipeds.

Dimensions: Length of carapax, 0.32; breadth, 0.23; length of ambulatory foot of the first pair, 0.76 inch.

This crab is an inhabitant of deep water, ranging from 80 to 138 fathoms, and occurred in considerable abundance, as follows:—

Off the Samboes,	May 9.	Cast No. 5.	80 fathoms.
Off Alligator Reef,	May 8, 1869.	Cast No. 6.	88 "
Off Sand Key,	May 16, 1868.	Cast No. 2.	120 "
Off the Samboes,	May 9, 1868.	Cast No. 12.	123 "
S. W. of Sand Key,	February 17, 1869.	Cast No. 2.	125 "
Off Boca Grande,	February 15, 1869.	Cast No. 5.	125 "
Off Sand Key,	May 11, 1868.	Cast No. 11.	128 "
S. W. of Sand Key,	February 17, 1869.	Cast No. 3.	138 "

Subfamily AMATHIINAE.

The only species of this group hitherto known is the *Amathia Rissoana* of the Mediterranean Sea. Two species are now added, as follows: —

Amathia hystrix nov. sp.

This species has a close resemblance to *A. Rissoana*, but differs in having four instead of three spines on the gastric region.

The dimensions of a male specimen are as follows: Length of carapax, including the rostrum, 1.23; excluding rostrum, 0.71; breadth, including lateral spines, 0.95; excluding these spines, 0.48 inch.

Off Sand Key, May 11, 1869. Cast No. 16. 138 fathoms.

Amathia modesta nov. sp.

Carapax armed with twelve spines shorter than in the other species of the genus, the two on the gastric region being in fact only spiniform tubercles. The lateral and posterior spines are longest, that on the outer extremity of the branchial region equalling in length one fifth the width of the carapax. Rostrum nearly as long as the post-frontal part of the carapax; horns rather stout, divergent, and curving outward at the tips. The spine before the eye is small, and that behind still smaller. No trace of a spine at the anterior angles of the buccal area. Feet somewhat shorter than in the other two species, and with no trace of a spine at the summit of the meros-joint.

Dimensions of a male: Length of carapax, rostrum and posterior spine included, 0.84; from base of rostral horns to tip of posterior spine, 0.54; breadth of carapax, including spines, 0.50; excluding spines, 0.36; length of ambulatory foot of the first pair, 0.95 inch.

Taken off Sand Key in 120 fathoms.

Subfamily ANOMALOPINAE.

This group is indicated for the reception of the genus *Anomalopus*, now for the first time described, with a single species. The crab differs from all other Maioids in its elongated, subcylindrical carapax, and in the character of its ambulatory feet; those of the posterior pair being larger than those of the penult pair. The orbital arch is less distinct than in other Eurypodiidae, and the post-ocular spine much smaller.

Anomalopus nov. gen.

Carapax very much elongated, almost subcylindrical; rostrum very long, slender, bifid. Eyes without orbits; præorbital spine small, acute; postocular spine minute. External antennæ exposed from above; basal joint narrow. Antennulary fossæ large. Epistome two thirds as long as it is broad. Meros-joint of the external maxillipeds without any notch at the interior angle where the palpus is inserted; external angle sharply prominent. Chelipeds in the female shorter than the carapax. Ambulatory feet of the first pair very long, twice as long as the carapax, with the dactylus nearly straight, and three fourths as long as the penult joint. Ambulatory feet of the posterior two pairs shorter and stouter than those of the anterior two, and with prehensile extremities; those of the penult pair shorter than those of the last pair.

Anomalopus furcillatus nov. sp.

Carapax minutely pubescent, unarmed except in front, regions scarcely defined. Rostrum equalling in length two thirds that of the post-frontal part of the carapax, forked in the terminal half of its length; horns but slightly divergent. External antennæ much shorter than the rostrum; flagellum as long as the two joints preceding it taken together. Antennulæ reaching to the extremity of the peduncle of the antennæ. Chelipeds with a small spine on the outer side of the carpus; hand very small; fingers half as long as the palm and much gaping.

Dimensions of a female: Length of carapax 0.67; breadth 0.25; length of ambulatory foot of the first pair, 1.50; of the third pair, 0.48; of the fourth pair, 0.82 inch.

Of this species I find but one specimen in the collection, a female, which was taken at the depth of 123 fathoms off "The Samboes."

Family LEPTOPODIIDAE.

This family is characterized by an entire want of orbits and of a true post-ocular spine, and by the great length of the feet.

Subfamily LEPTOPODIINAE.

Leptopodia sagittaria Leach.

Cancer sagittarius Fabricius, Ent. Syst., II, 442.
Inachus sagittarius Fabricius, Suppl. Ent. Syst., p. 359.
Cancer seticornis Herbst, Naturg. d. Krabben u. Krebse, III, pl. lv, fig. 2.
Leptopodia sagittaria Leach, Zoöl. Misc., II, pl. lxvii. Latreille, Encyc. Méth. pl. ccxcix, fig. 1. Desmarest, Consid. sur les Crust., pl. xvi, fig. 2. Guerin, Iconographie du Règne Anim., Crust., pl. xi, fig. 4. H. Milne-Edwards, Hist. Nat. des Crust., I, 276; pl. xv, fig. 14. Illust. Cuv. Règne Anim., Crust., pl. xxxvi. Gibbes, Proc. Am. Assoc., 1850, p. 169. Desbonne et Schramm, Crust. de la Guadeloupe, p. 1.

This crab, which has hitherto been found in shallow waters, but never, as far as I am aware, above low-water mark, occurred to the expedition at the following points and depths: —

South of the Tortugas,	January 15, 1869.	Cast No. 3.	17 fathoms.
Off Conch Reef,	May 11, 1869.	Cast No. 1.	30 "
Santarem Channel, at the edge of Bahama Bank.		Cast No –.	35 "
Off French Reef,	March 21, 1869.	Cast No. 2.	45 "

SUBFAMILY ACHAEINAE.

Podochela macrodera STM.

Podochela macrodera STIMPSON, Notes on N. American Crust., p. 68.

Found at Key West, in from 2 to 5 fathoms

Podochela gracilipes nov. sp.

Closely allied to *P. macrodera*, but differs in its narrower body, longer and more acute rostrum, and longer and much more slender feet. The dactylus of the first pair of ambulatory feet is exceedingly slender and longer than in either of the two species hitherto known, being more than one third as long as the penult joint. The process of the penult joint in the other ambulatory feet is almost entirely obsolete.

Dimensions of a female: Length of carapax, 0.35; breadth, 0.24 inch.

Only female specimens occur in the collection.

West of Tortugas,	January 16, 1867.	Cast No. 5.	36 fathoms.
Off Pacific Reef,	May 13, 1869.	Cast No. 2.	49 "
Off Carysfort Reef,	March 31, 1869.	Cast No. 1.	52 "
Off Carysfort Reef,	March 21, 1869.	Cast No. 5.	60 "

Podonema nov. gen.

The species of this genus I formerly included under *Podochela* (Notes on N. American Crust., p. 69), but the study of several species which have since become known to me has led me to consider it distinct in the hood-shaped rostrum, and in the existence of lamelliform ridges on the pterygostomian regions, defining the afferent channels. Like *Podochela*, this genus has a concave posterior margin of the carapax.

Podonema Riisei STM.

Podochela Riisei STIMPSON, Notes on N. American Crust., p. 69.

A female specimen of this species was taken in 13 fathoms, off the Tortugas.

Podonema lamelligera nov. sp.

The following description is that of a female, the only specimen as yet found. Carapax similar to that of *P. Riisei*, except that there is a spiniform tubercle, curving backward at the tip, on the gastric region, and that the rostrum is smaller and more pointed. The two marginal lamellæ of the basal joint of the external antennæ are strongly prominent, joining each other in front, and curving outward at the posterior extremity On the ischium-joint of the external maxillipeds there is a smooth longitudinal channel, defined exteriorly by a ciliated ridge. On either side of the buccal area there are four laminiform crests; one at the antero-exterior angle of the area, one on the hepatic, and two on the pterygostomian region. The sternum, where not covered by the abdomen, and the bases of all the feet, are ornamented with cavities, the surface of each joint being concave and surrounded by a laminiform expansion.

Dimensions of the female specimen: Length of carapax, 0.44; breadth, 0.37 inch.

It was taken at the depth of 21 fathoms, off Tennessee Reef, on the 7th of May, 1869.

Podonema hypoglypha nov. sp.

The following description is that of a male. Gastric, cardiac, and branchial protuberances low and rounded. Rostrum slightly curved upward, and triangular in outline when seen from in front and below, but with the lateral expansions well developed. The basal joint of the external antennæ is greatly elongated, and the laminiform expansions of the margins slight. Hepatic tooth and pterygostomian ridges moderately developed. Sternum with deep and broad channels separating the segments, which have each a corresponding flattened ridge as broad as the channel.

Dimensions of a male specimen: Length of carapax, 0.63; breadth, 0.48 inch.

It differs from *P. Riisei* in the shape of the rostrum, and from both *Riisei* and *lamelligera* in the elongated basal joint of the external antennæ.

No female specimen occurs in the collection.

Key West, in 4 to 5 fathoms.

S. W. of Loggerhead Key, in 9 fathoms.

Family ACANTHONYCHIDAE.

In this group the eye is short, in some genera scarcely movable, and in others somewhat retractile, or rather capable of being moved in a horizontal plane. There are no true orbits, but in many genera the eye lies beneath the expanded orbital margin of the carapax, which has frequently two teeth, one before and one behind the position of the eye. The eye is, however, never concealed by these expansions. The carapax is generally flattened, angular, and naked, instead of subpyriform and spinous as in the majority of Maioids. The feet are usually short.

It is necessary to reject the name *Periceridae*, which was applied to this group by Dana, for in the genus *Pericera* the eyes are completely retractile, as stated on a previous page. The genus *Acanthonyx* seems the most typical of the group, and from this is taken the name adopted above.

Subfamily EPIALTINAE.

Epialtus longirostris Stm.

Epialtus longirostris Stimpson, Notes on N. American Crust., p. 71.

Found at Key West. in from 2 to 5 fathoms.

Epialtus affinis Stm.

Epialtus affinis Stimpson, Notes on N. American Crust., p. 3.

Found on the Reef at Cruz del Padre, Cuba.

Mocosoa nov. gen.

Carapax subpentagonal, tumid; rostrum subtriangular, entire, obtuse, excavated below; eyes large, immovable. External antennæ concealed beneath the rostrum and not reaching to its tip; basal joint triangular, unarmed in front. External maxillipeds very broad; meros-joint particularly short and broad, with the outer angle much projecting outward, and the inner one a right angle, not at all notched for the reception of the palpus.

This genus differs from *Epialtus* in its immovable eyes, which resemble those of *Huenia*. From *Huenia* it differs in the character of the rostrum. The name adopted for the genus is that of one of the Florida Caciques encountered by De Soto in his march.

Mocosoa crebripunctata nov. sp.

Upper surface of carapax everywhere uniformly punctate, the minute pits being equal in size and wider than the interspaces. Carapax naked and protuberant, there being two prominences between the eyes, three on the gastric region, one large one on the cardiac, and three on each branchial region. Of the three branchial protuberances one is situated at the middle of the region, and two on the outer margin, the posterior one being smallest and bearing a minute blunt spine. Feet short and armed with a few short, blunt spines, chiefly on the meros-joint.

Body of a strawberry color; upper surface of carapax iridescent.

Of this species there is but one specimen in the collection, an immature female, the dimensions of which are: Length of carapax, 0.20; breadth, 0.17 inch.

It was taken in 15 fathoms, off French Reef, April 3, 1869.

FAMILY PARTHENOPIDAE.

SUBFAMILY PARTHENOPINAE.

Lambrus crenulatus SAUSS.

Lambrus crenulatus DE SAUSSURE, Crust. Nouv. du Mexique et des Antilles, p. 13; pl. i, fig. 4. STIMPSON, Notes on N. American Crust., p. 73. DESBONNE et SCHRAMM, Crust. de la Guadeloupe, p. 21.

This species is remarkable for its depressed form and the excavation of the pterygostomian and subhepatic regions, which excavation extends to the infero-exterior margin of the orbit, forming, when the chelipeds are retracted, covered afferent passages, the external apertures of which are seen between the base of the finger of the cheliped and the margin of the orbit. This arrangement would indicate that the crab habitually conceals itself in the sand, with the rostrum, eyes, and afferent apertures only exposed.

Lambrus laciniatus De Haan exhibits the same features in a less marked degree, and the two species, with three or four similar forms, comprise a group which future studies may prove to be distinct from the triangular *Lambri*, and for which the name *Platylambrus* would be appropriate.

Lambrus crenulatus was taken near the Tortugas in from 5 to 7 fathoms, and off Loggerhead Key in 13 fathoms.

Lambrus Pourtalesii nov. sp.

Carapax considerably broader than long, with a median row of four spiniform tubercles, of which one is placed upon the gastric and three on the cardiac region. In front of the tubercle on the gastric region there are two much smaller ones in a transverse line. The oblique ridge on the branchial region is armed with three unequal tubercles, and a strong, spiniform, laciniated tooth, with a smaller tooth at its base, at the margin of the carapax. There are a few small, scattering tubercles on the other parts the carapax, particularly in the hollows between the branchial and cardiac regions. The depressions between the branchial, hepatic, and gastric regions are moderately deep. The general surface is pitted and granulated, having a carious appearance. There is a small prominent tooth on the hepatic region. Antero-lateral margin, behind the cervical sulcus, with nine small, slender, laciniated teeth, progressively diminishing in size forwards; posterior tooth only one third the size of the large branchial spine or tooth, which is the largest on the margin of the carapax. There is a prominent tubercle at the summit of the branchial region. Rostrum of moderate size, pointing obliquely downward and forward, and bearing a tooth on each side near the base, and a smaller one near the tip. At the basal tooth the rostrum is abruptly contracted more than one half in width. Chelipeds rather long; margins armed with laciniated teeth; meros convex, with the upper surface granulated and tuberculated, the largest tubercles, those along the middle, being subspiniform; carpus with five large and several small spiniform tubercles above and on the outer side. Upper surface of hand with only two or three tubercles about the middle; teeth of the margins larger and more triangular than those of the margins of the meros; those of the inner broader than those of the outer margin, particularly those toward the fingers, which are not, like those toward the carpus, separated by intervals; inner margin with eight large and three small teeth; outer one with four large and six small teeth. Lower surface of hand punctate, with a regular median row of tubercles. Ambulatory feet somewhat compressed; meros-joint spinulose on both upper and lower edge. The ridges of the abdomen, sternum, and outer maxillipeds are tuberculated.

Dimensions of a male: Length of carapax, 0.47; breadth, lateral teeth included, 0.52 inch; proportion of length to breadth, 1 : 1.106; length of meros-joint of chelipeds, 0.37 inch.

Off Conch Reef,	March 21, 1869.	Cast No. 1.	40 fathoms.
Off French Reef,	March 21, 1869.	Cast No. 2.	45 "
Off American Shoal,	May 6, 1868.	Cast No. 9.	100 "
Off Conch Reef,	May 11, 1869.	Cast No. 6.	117 "

Lambrus fraterculus nov. sp.

Nearly allied to *L. Pourtalesii*, but differing as follows: The carapax is narrower, the proportion of length to breadth being 1 : 1.04 even in the female, while in the male it is longer than broad. The depressions between the branchial and the gastric and hepatic regions are much deeper. In the female the tubercles of the carapax and the teeth of the margins are less spiniform and generally smaller; the tubercles of the branchial and gastric regions are indeed sometimes obsolete or nearly so. In the only male specimen at hand, the median tubercle of the gastric and that of the cardiac region are much taller than in *L. Pourtalesii.* The rostrum is also longer than in that species, with the narrowed extremity much more slender, and the basal teeth more prominent; there is also a small slender spine placed beneath and outside of this basal tooth. The chelipeds are shorter, and the lower surface of the hand is always ornamented with several rows of granulated tubercles. The dactyli of the ambulatory feet are covered with a dense velvet-like pubescence, except at the tips.

Dimensions of a male: Length of carapax, 0.47; breadth, 0.45 inch. Of a female, length of carapax, 0.54; breadth, 0.56; length of meros-joint of cheliped, 0.34 inch.

Off Sand Key,	May 11, 1868.	Cast No. 2.	26 fathoms.
Off Carysfort Reef,	March 21, 1869.	Cast No. 8.	35 "
West of Tortugas,	January 16, 1869.	Cast No. 4.	36 "
Off Conch Reef,	March 21, 1869.	Cast No. 1.	40 "
Off Carysfort Reef,	March 21, 1869.	Cast No. 5.	60 "
West of Tortugas,	January 16, 1869.	Cast No. 13.	68 "

Lambrus agonus nov. sp.

Carapax broader than long, of rounded form, without angles at the sides. Depressions between the regions rather shallow. Surface above everywhere minutely tuberculated and granulated. The larger tubercles are somewhat spiniform, and are arranged as follows: Five on the gastric region, of which four are placed in a transverse line across the middle, and one, larger than the others, on the median line behind them; three in a longitudinal row on the cardiac region; one each side of the intestinal, far apart; five on each branchial, and one on the hepatic region. From the central cardiac, and from each hepatic tubercle, proceeds on each side a row of granules, forming a V. Antero-lateral margin behind the hepatic region armed with six very small teeth, beneath and behind the posterior one of which there is a short tooth-like crest. The rostrum, though smaller in size, resembles that of *L. Pourtalesii* in having a slender extremity, but instead of two denticles near the tip, it has two or three denticles near the basal teeth. There are two prominent teeth on the outer side of the orbit, and a minute spine at the summit of the eye. On the sternum, near the base of the chelipeds, there is a conical tubercle on each side. Tooth of the basal joint of the cheliped acutely triangular. On the second joint of the abdomen there is a sharply prominent, bluntly triangular transverse crest, and a tooth on each side; and on the penult joint there is a crest like that of the second joint, but smaller.

The chelipeds are very long and slender; upper surface minutely scabrous, and with an irregular row of tooth-like tubercles which is median on the meros and carpus, but approaches the outer margin in the hand. Edges of the meros and carpus with numerous small irregular teeth. On the inner (superior) edge of the hand there are nineteen teeth, increasing somewhat regularly in size to a point near the anterior extremity, where they gradually diminish again. On the outer edge of the hand there are four or five large and about eleven small teeth alternating by threes with the larger ones. The fingers are white in color, and not so much bent downwards as is usual in the genus. Ambulatory feet long, slender, naked, and unarmed, or with only obscure indications of teeth on the meros-joint.

Dimensions of a male: Length of carapax, 0.45; breadth, 0.50; proportion, 1 : 1.11; length of meros-joint of cheliped, 0.55 inch.

In a male specimen of what is probably a variety of this species, dredged off Conch Reef, the hands are shorter than in the typical form, and the rostrum is not narrowed toward the extremity, and is devoid of marginal teeth. These differences are certainly important ones, but the specimen accords so well with the type in all other characters that I can scarcely believe it to be distinct.

The species has some resemblance to *L. mediterraneus* Roux, but differs in the smaller and less numerous marginal teeth of the carapax, and in the unarmed ambulatory feet.

Off the Marquesas,	February 10, 1869.	Cast No. 3.	40 fathoms.
Off Carysfort Reef,	March 21, 1869.	Cast No. 7.	40 "
Off Conch Reef,	March 21, 1869.	Cast No. 1.	40 "
Off Conch Reef,	May 11, 1869.	Cast No. 3.	49 "

Solenolambrus nov. gen.

This name is proposed for a well-defined group of Parthenopidae, allied to *Lambrus*, of which I have before me three species, the only ones as yet known, all of which are new to science.

The carapax is pentagonal, and more or less broader than long. The posterior side of the pentagon is much the shortest, and the other four sides are about equal. The margin is acute on all sides, forming a slight crest. The upper surface is naked, glossy, strongly convex, and bears four protuberances, one gastric, one cardiac, and two branchial. The gastric and cardiac protuberances are more or less triangularly pyramidal, and the branchial protuberance is armed with an acute ridge, running obliquely to the postero-lateral margin of the carapax. The frontal region is slightly convex, and there is no protuberance on the orbital region. The rostrum is short and blunt, or faintly tridentate. The orbits are round, with the upper margin entire and smooth. The basal joint of the external antennæ is about as long as the next joint; it may be either longer or shorter. The epistome is concave. From the antero-external angle of the buccal area a sharp, elevated, crenulated ridge extends to the outer base of the cheliped, separating the concave pterygostomian from the subhepatic region, which is also concave and channel like. When retracted, the extremity of the hand of the cheliped covers the pterygostomian region, forming the afferent passage. The external maxillipeds fit accurately the buccal area, and closely against each other within, and the exognath is concave, forming part of the wall of the afferent channel, which is defined within by a slight elevated ridge on the outer side of the ischium of the endognath; the meros-joint has a prominent antero-external angle, and its surface is concave toward the antero-interior angle, and there is no notch for the insertion of the palpus, which, except at its origin, is concealed beneath the other joints of the endognath. The chelipeds resemble those of *Lambrus*, except that the fingers are very small, and the dactylus is generally at right angles with the palm when retracted. The terminal joints of the ambulatory feet are acuminate. The third, fourth, and fifth joints of the male abdomen are soldered together.

This genus differs from *Parthenope* and *Lambrus* in its naked, polished carapax, in the distinct definition of the afferent channels, and in the want of a notch in the meros-joint of the external maxillipeds for the reception of the palpus. As far as known, it is peculiar to the tropical portions of the American seas, species being found on both the east and the west coasts of the continent.

Solenolambrus typicus nov. sp.

Carapax one eighth broader than long; posterior side considerably produced. Surface punctate. Protuberances of the gastric and cardiac regions triangularly pyramidal, and acute, with the ridges forming the angles crenulated; one of the ridges, the posterior, is in the median line of the carapax, and the other two diverge from each other in front. The cardiac pyramid is symmetrical, each of its triangular sides being equal; while the gastric protuberance is not symmetical, the posterior ridge being a short, steep slope, and the two anterior ridges being long, and enclosing a gradual, somewhat convex slope toward the front. The ridge of the branchial region is also crenulated, and is bent at the middle at an obtuse angle, almost a right angle. In the male each of the protuberances of the carapax is surmounted by an acute spine, while in the female the apical angles are not thus acute. The margin of the carapax is more or less distinctly crenulated, especially the antero-lateral margin, at the outer or posterior end of which there are three small but distinct teeth. The antero-lateral margin is concave anteriorly and convex posteriorly. The posterior margin is straight, with the lateral angles sharply defined, and even spiniform in the male. Eyes rather large, with a minute tubercle on the anterior side of the extremity. Basal joint of the external antennæ somewhat longer than the next joint.

Epistome of moderate length. On the subhepatic region, near the afferent ridge, and parallel to it, there is a slight supplementary ridge. External maxillipeds naked; ischium with the outer ridge tuberculated, and a few tubercles on the surface near the extremity; external angle of meros very strongly prominent. On the sternum between the bases of the chelipeds there are two small tubercles, one on either side of the median line. Chelipeds long, naked, with the exception of some inconspicuous setæ on the crest of the hand; meros with denticulated margins, and with the surface smooth and glossy above, except at the inner or posterior extremity, where there are three or four small tubercles, and at the outer extremity, where there is a granulated protuberance; carpus with five denticulated crests; hand trigonous, with ten strong, regular, equal teeth on the superior crest, twelve small, granulated teeth on the outer margin, and fifteen teeth, increasing regularly in size toward the extremity, on the lower margin; upper surface of the hand with two rows of tubercles and two or three scattered ones between the rows; lower surface with three rows of tubercles, those of the middle row minute and obsolescent toward the extremity; inner surface glabrous at the middle, and with a row of tubercles close to either margin, and a few scattered ones near the fingers. All the tubercles of the surfaces of the hand are ornamented with granules, from two to five in number. Fingers very small and slender, one fifth as long as the palm; dactylus when retracted placed almost at a right angle with the palm. Ambulatory feet compressed, naked, polished, with a laminiform crest above; the meros of the posterior pair having a crest below also, which has a lobe-like expansion at the inner extremity. Abdomen tuberculated on the sides; that of the male not narrowed at the third joint and very little tapering.

Dimensions of a female specimen: Length of carapax, 0.45; breadth, 0.50 inch; proportion, 1 : 1.11; length of meros-joint of cheliped, 0.41; length of hand, 0.50 inch.

Off the Samboes,	May 9, 1868.	Cast No. 5.	80 fathoms.
Off Alligator Reef,	May 8, 1869.	Cast No. 6.	88
Off Alligator Reef,	May 8, 1869.	Cast No. 8.	110

Solenolambrus tenellus nov. sp.

This species is much smaller than the preceding, and more delicate and fragile in appearance. The carapax is but little shorter than broad, and about equally produced in front and behind beyond the line of the lateral angles. Surface rather coarsely punctate. Protuberances of the carapax much less prominent than in the other species; those of the gastric and cardiac regions obtusely rounded, without angular ridges; ridge of branchial region sufficiently well marked near the postero-lateral margin, but almost obsolete anteriorly. Margins of carapax crenulated, the teeth being most distinct on the flattened, expanded, and broadly rounded lateral angle, where they are about six in number, not crenulated, and but little projecting, being defined chiefly by the impressed lines on the marginal limb. On the hepatic region there are two or three denticulated teeth. Postero-lateral margin slightly concave. Posterior margin convex; its lateral angles obtuse. Rostrum rather prominent and faintly tridentate at the extremity; median tooth smallest and most prominent. External angle of orbit not prominent. Eye large, with a very minute tubercle at the summit. In the external antennæ the basal joint is about equal to the next in length. Subhepatic region less concave than in *S. typicus*, and without any supplementary ridge. External maxillipeds and afferent channels nearly as in *S. typicus*, but with the ridges less strongly tuberculated, and with the outer angle of the meros-joint less acutely prominent. Sternum between the bases of the chelipeds convex on either side, but not tuberculated. Chelipeds very long and slender; edges denticulated, but with the surface between them smooth and polished; meros with about thirteen denticles on either edge, the third denticle from the outer extremity being larger than the others; hand with twelve sharp, forward-curving teeth on the superior edge, the terminal tooth above the finger being spiniform and considerably longer than the others; outer edge of hand with about eleven obtuse, equal, less prominent, minutely crenulated teeth; inner edge with nineteen or twenty very minute teeth. Ambulatory feet naked and compressed, but without laminiform crests; meros-joint of the posterior pair slightly expanded below near the base. In the male the sternum and abdomen are smooth and glabrous; abdomen broad at the base and narrower at the third joint.

Dimensions of a male: Length of the carapax, 0.25; breadth, 0.27 inch; proportion, 1:1.08; length of meros-joint of cheliped, 0.29; length of hand, 0.32 inch.

Off Carysfort Reef,	March 21, 1869.	Cast No. 8.	35 fathoms
Off Carysfort Reef,	March 21, 1869.	Cast No. 7.	40 "
Off Conch Reef,	March 21, 1869.	Cast No. 1.	40 "
Off French Reef,	March 21, 1869.	Cast No. 2.	45 "
Off Carysfort Reef,	March 21, 1869.	Cast No. 6.	48 "
Off Conch Reef,	May 11, 1869.	Cast No. 3.	49 "

Mesorhoea nov. gen.

This genus bears an almost exact resemblance to *Solenolambrus* in the form and armature of the carapax, the character of the feet, and that of the pterygostomian and hepatic channels, except that the latter are deeper. It differs, however, in the very important point that the afferent channels meet at the middle of the endostome, which has there a triangular projection, and a deep notch in its vertical, laminiform wall. The meros-joint of the external maxillipeds is acutely produced forward at its internal angle, and behind it the palpus is entirely concealed. The epistome is very short. The eyes are small, and may be retracted into their deep sockets so as to be almost entirely concealed. The basal joint of the external antennæ is somewhat shorter than the next joint.

The remarkable form of the endostome and external maxillipeds in this genus indicates an approach to the oxystomatous crabs, to which the Parthenopidae show, indeed, considerable resemblance in other respects.

Mesorhoea sexpinosa nov. sp.

Carapax one fifth broader than long, and about equally produced in front and behind beyond the line of the lateral angles. Surface punctate and inconspicuously pubescent. Protuberances of the gastric, cardiac, and branchial regions strongly angular, each surmounted by a three-sided spine, the spine of the branchial region being situated on the postero-lateral margin, of which it forms a projection. The angles or ridges are more or less crenulated. The lateral edges of the gastric protuberance are continued forward nearly to the front, becoming parallel shortly after diverging from the spine. The cardiac spine is more slender than the others, and its posterior edge is nearly vertical. The branchial ridge is nearly straight. Between the protuberances and ridges the surface is more or less regularly concave, the sides of the protuberances being not swollen. The rostrum is short. The margins of the carapax are sublaminiform and almost entire, the normal crenulation being indicated only by faint impressed lines on the limb. Microscopic notches may, however, be detected on the antero-lateral margin, which is slightly convex toward the lateral angle. Postero-lateral margin concave. Posterior margin about half as long as the postero-lateral, convex at the middle, and terminating on either side in a slight tooth. Afferent channels deep, separated from the subhepatic channels by a very thin and sharp, prominent, ciliated lamina, and defined on the inner side by the ciliated outer edge of the ischium of the external maxillipeds. From the anterior angle of the buccal area a short ridge extends to the middle of the inner tooth of the orbit, which ridge separates the concavity of the epistome from that of the subhepatic region. Meros-joint of the external maxillipeds with two tubercles on the surface, one towards the postero-exterior angle, the other close to the antero-exterior angle; anterior margin of the joint deeply concave or notched. Chelipeds short, pubescent, especially on the toothed edges; surface between the edges smooth; on the basal joint below there is a strong, triangular, pyramidal spine, nearly as large as the dorsal spines of the carapax; margins of the meros crenulated with six or seven small teeth on either edge; carpus flattened above, with two strong, crenulated crests, the outer one of which bears a larger, spiniform tooth at the middle; hand with an elevated, nine-toothed superior crest and eleven-toothed outer margin; fingers very small; dactylus at right angles with palm. Ambulatory feet much compressed; antepenult and penult joints with a laminiform crest above; meros-joint of the posterior pair with a slight crest below. Abdomen glabrous.

Of this species there is but one specimen — a female — in the collection; in which the length of the carapax is 0.32; the breadth, 0.39 inch. The length of the hand is 0.28 inch.

The specimen was taken in 11 fathoms, four miles southwest of Loggerhead Key.

Subfamily CRYPTOPODIINAE.

Cryptopodia concava nov. sp.

Carapax subpentagonal, greatly expanded posteriorly, the posterior margin, which is nearly straight, equalling the entire width; lateral margins short; antero-lateral margins slightly convex. Rostrum triangular. The gastric region is protuberant, and from its summit a sharp, crenulated ridge or raised line passes on either side to the postero-lateral angle, enclosing a concave, triangular space. The surface between this ridge and the antero-lateral margin is also concave. The entire upper surface of the carapax, the ridges excepted, is smooth and shining. The margins are crenulated with small teeth, the furrows separating which extend for some little distance inward, giving the indentations the appearance of being much deeper than they really are. The teeth themselves are minutely granulated. External maxillipeds smooth, glabrous; meros-joint triangular, with the external angle very acutely projecting, and the internal angle without a notch for the insertion of the palpus, the first joint of which is indurated, with a projecting tooth at its extremity.

Chelipeds flattened as in *C. fornicata*, but with the meros-joint narrower, the carpus smaller, and the hand convex below; fingers slender, curved. Ambulatory feet crested; crest of meros spinulose above and below. Transverse crest of sternum bilobed, each lobe being three-toothed, and in the same line with a tooth on the basal joint of the cheliped, which belongs also to this crest, which forms the margin of the concave and perpendicular front of the sternum.

The dimensions of the only specimen found — a young female — are as follows: Length of carapax, 0.32; breadth, 0.43; proportion, 1 : 1.34;

length of meros-joint of cheliped, 0.22; length of hand, 0.26; breadth of hand, 0.12 inch.

The specimen was taken off Conch Reef in 34 fathoms.

CANCROIDEA.

Family CANCRIDAE.

Subfamily XANTHINAE.

Actaea nodosa Stm.

Actaea nodosa Stimpson, Notes on N. American Crust., p. 75. Desbonne et Schramm, Crust. de la Guadeloupe, p. 25.

Dredged January 16, 1869, west of the Tortugas, in 35 and 37 fathoms.

Actaea setigera Stm.

Xantho setiger H. Milne-Edwards, Hist. Nat. des Crust., I, 390.
Actaea setigera Stimpson, Notes on N. American Crust., p. 51. A. Milne-Edwards, Nouv. Arch. du Muséum d'Hist. Nat., I, 271; pl. xviii, fig. 2.

Found on the Reef at Cruz del Padre, Cuba.

Carpoporus nov. gen.

Carapax subhexagonal, nearly as long as broad; antero-lateral margin armed with three small teeth (in a line which conducts beneath the orbit anteriorly), and drawn in posteriorly, the greatest breadth of the carapax being at the middle tooth; postero-lateral shorter than the posterior margin; facial region very broad; front prominent. Orbit circular, without teeth below, except two or three minute spiniform denticles on the margin; fissures of outer and inferior margins obsolete. Basal joint of the external antennæ narrowing forwards, reaching the front, and passing well into the hiatus of the orbit, nearly as in *Euxanthus;* movable part of the antennæ very small. Chelipeds, when retracted, having a large hole between the carpus and hand above for the passage of water to the afferent branchial apertures. Third, fourth, and fifth joints of the abdomen in the male soldered together; terminal joint as broad as long.

This genus differs from *Xantho* in its external antennæ; from *Euxanthus* in the narrowness of the carapax; from *Polycremnus* in its five-jointed male abdomen; and from *Halimede* and *Medaeus* in the want of conspicuous fissures and teeth on the margin of the orbit.

It is very peculiar in the perforation of the retracted chelipeds, recalling a similar perforation of the chelipeds of *Echinocerus foraminatus,* in which, however, it occurs between the carpus and meros.

Carpoporus papulosus nov. sp.

Carapax naked above, areolated; areolets protuberant, somewhat wart-like, and granulated; gastric and frontal regions very prominent. Lateral teeth small, spiniform; their interstices armed with denticles, two or three in number. Front strongly projecting at the middle, and bilobed; margin of lobe concave. Peduncle of the eye granulated, and with a few minute spines at the summit. Orbit with the margin minutely crenulated with granules, with a slight fissure near the middle of the superior margin, and with two spiniform teeth below near the outer side. Outer maxillipeds armed in front and along the inner edges with small but strongly prominent tubercles. The carpus and hand of the chelipeds are sculptured externally with granulated protuberances, which on the hand are arranged in four or five longitudinal rows; hand serrated above with four teeth; fingers short, less than half the length of the palm. Ambulatory feet hairy below; penult and antepenult joints armed above with two rows of short, stout spines.

Dimensions of a male: Length of carapax, 0.25; breadth, 0.31 inch; proportion, 1 : 1.24.

S. W. of the Tortugas,	January 18, 1869.	Cast No. 1.	25 fathoms.
Off Carysfort Reef,	March 31, 1869.	Cast No. 1.	52 "

Micropanope nov. gen.

The generic group now for the first time described is nearly allied to *Panopeus*, and also shows some resemblance to *Pilumnus*. As in the latter genus, the species are among the smallest of Cancroid forms, and live in deep or moderately deep water. As far as I am aware they are never truly littoral like the *Panopei*. Species of the genus occur in the warmer seas of both sides of the American continent.

The carapax is rather narrow, with the antero-lateral margin short and the front broad. As in *Panopeus*, there are five teeth on the antero-lateral margin, but the second tooth is coalesced with the scarcely prominent angle of the orbit, and the posterior tooth is minute; so that only two of the teeth are prominent, arming the carapax at its antero-lateral angle. The external hiatus of the orbit is reduced to a simple emargination. The basal joint of the external antennæ is short, but meets a process from the front. The endostome is usually marked on either side by a slight ridge, which does not, however, extend to the anterior margin. The hand in the chelipeds is large, with rather long fingers, bent to an angle with the palm, so that the lower margin of the hand is rather deeply concave.

Micropanope sculptipes nov. sp.

Carapax naked, distinctly areolated; anterior and antero-lateral areolets somewhat roughened in front with small, sharp, tooth-like tubercles. Antero-lateral teeth sharp and denticulated; the posterior one nearly obsolete. Frontal lobes little projecting, but with a convex outline; margin minutely crenulated, and defined by a slight furrow following it above. A small tubercle on the subhepatic region beneath the second antero-lateral tooth. Chelipeds granulated above; carpus with a sharp tooth and denticulated margin within, and with the granules arranged in reticulating lines; hand with a double denticulated crest, and with the minute granules of the outer surface showing a tendency to arrangement in rows; these granules become obsolete toward the base of the thumb or propodal finger. Ambulatory feet armed with minute spines above, which form two rows on the carpal joint.

Dimensions of a male: Length of carapax, 0.13; breadth, 0.17 inch; proportion, 1 : 1.30.

It was taken at the following localities and depths: —

Off the Marquesas,	February 10, 1869.	Cast No. —.	15	fathoms.
Off Carysfort Reef,	March 21, 1869.	Cast No. 8.	35	"
West of the Tortugas,	January 16, 1869.	Cast No. 6.	35	"
West of the Tortugas,	January 16, 1869.	Cast No. 12.	42	"
Off French Reef,	March 21, 1869.	Cast No. 2.	45	"
Off Carysfort Reef,	March 21, 1869.	Cast No. 5.	60	"
West of the Tortugas,	January 16, 1869.	Cast No. 13.	68	"

Chlorodius dispar nov. sp.

Carapax transversely oval, very broad, convex, smooth, polished, sparsely punctate in front, and scarcely at all areolated, the only depressions at all conspicuous being those at the antero-lateral corners of the gastric region, partly defining the protogastric lobes. Antero-lateral margin almost entire, the posterior two of the five normal teeth only being distinguishable. Orbits entire, above and below. Front straight, slightly notched, but not at all prominent at the middle; margin furrowed. Chelipeds very unequal, the right one in both specimens under observation being much larger than the other; they are naked, smooth, and polished; fingers a little more than half as long as the palm, scarcely gaping, and but little excavated at the tips. Ambulatory feet compressed, hairy above.

Colors: Carapax, dark brown; chelipeds, dark reddish; fingers, black; greater hand with one or two white spots on the outer side between the bases of the fingers.

Dimensions of a male: Length of carapax, 0.18; breadth, 0.26 inch; proportion, 1 : 1.44.

This species approaches somewhat *C. levissimus* Dana, of the Sandwich Islands, but differs from that and all other known species in its smooth, oval, convex carapax and the obsolescence of the antero-lateral teeth.

Found on the reef at Cruz del Padre, Cuba; two specimens, a male and a female.

FAMILY ERIPHIIDAE.

SUBFAMILY OZINAE.

Pilumnus aculeatus H. M.-EDW.

Cancer aculeatus SAY, Jour. Acad. Nat. Sci., Philad., I, 449.

Pilumnus aculeatus H. MILNE-EDWARDS, in GUERIN, Iconog. du Règne Anim., Crust., pl. iii, fig. 2; and Hist. Nat. des Crust., I, 420. GIBBES, Proc. Am. Assoc. Adv. Sci., 1850, p. 177.

A young specimen of this species was collected at the Tortugas. I find no note of the depth of water at which it was taken.

Pilumnus caribaeus DESB. et SCHR.

Pilumnus caribaeus DESBONNE et SCHRAMM, Crust. de la Guadaloupe, p. 32.

The specimens which I have referred to the above species differ from *P. aculeatus* in having the anterior spine of the three principal ones of the antero-lateral margin bifid, and in the shorter and more numerous spines of the frontal margin.

Found on the reef at Cruz del Padre, Cuba, and at Key West in from 2 to 5 fathoms.

Pilumnus floridanus nov. sp.

This species belongs to the same group with *P. aculeatus*, and bears a close resemblance to it. It differs in its narrower carapax, which is covered with a dense, short pubescence, with a few longer hairs, a transverse series of which, across the frontal region, forms a somewhat conspicuous feature. Below the ciliated line, the frontal region is naked, and its margin is unarmed; its lobes are not strongly and evenly projecting as in *aculeatus*, but are most prominent within, near the median sinus. The orbits are unarmed above, but have eight or ten spiniform teeth on the margin below, which teeth are far shorter than in *aculeatus*. The subhepatic tooth or tubercle is small and inconspicuous, and the surface of the subhepatic region is not perceptibly granulated. There are no spines on the hepatic region above. In the chelipeds the entire outer surface of the greater hand is tuberculated. The ambulatory feet are armed with spines as in *aculeatus*.

Dimensions of a female specimen: Length of carapax, 0.22; breadth, 0.30 inch; proportion, 1 : 1.36.

Found at the Tortugas.

Pilumnus lacteus nov. sp.

Closely allied to *P. gemmatus* Stm. (Notes on North American Crustacea, p. 86), and like that species covered with a whitish or cream-colored, velvet-like pubescence. It differs in the more spiniform shape of the antero-lateral teeth of the carapax, in the less numerous tubercles on the carapax and chelipeds, in the want of tubercles on the superior margin of the orbit, and in the smooth, glabrous outer surface of the hands, which is light red in color. The lobes of the front also are more triangular and pointed.

Dimensions of a male: Length of carapax, 0.31; breadth, 0.44 inch; proportion, 1 : 1.42.

Found on the reef at Cruz del Padre, Cuba, and at Key West in from 2 to 5 fathoms.

Pilumnus Agassizii nov. sp.

Carapax convex, and with the anterior two thirds deeply areolated; areolets protuberant. Surface pubescent everywhere, except on the anterior and antero-lateral areolets, which are naked and thickly granulated. The depressions between the protuberant areolets are broad, occupying fully as much space as the areolets themselves. Two of the areolets form the lobes of the front, which are as large and prominent as the epigastric lobes, or even larger. The frontal surface is vertical, and not much projecting, but the lobes are deeply separated from each other and from the orbits. Orbital region protuberant and granulated; margin not toothed, but crenulated with granules, and marked by two fissures above and two less conspicuous ones below. The antero-lateral margin behind the orbit is armed with three triangular, acute, equal teeth of moderate size. Subhepatic tooth distinct. Chelipeds stout, short, and thick; carpus covered above with granulated tubercles which are confluent exteriorly, forming transverse ridges; hand covered above and on the outer side with small but prominent mammillary tubercles, having their apices pointing forwards. Ambulatory feet pubescent and hairy; penult and antepenult joints armed with minute spines above.

Dimensions of a male: Length of carapax, 0.65; breadth, 0.83 inch; proportion, 1 : 1.28.

This species has some little resemblance to *P. gemmatus*, but the protuberances of the carapax are densely granulated instead of sparsely tuberculated.

It was taken in from 5 to 7 fathoms between East and Middle Keys, Tortugas, and East of the Tortugas in 13 fathoms.

Pilumnus nudifrons nov. sp.

Body and feet everywhere pubescent above, except on the frontal and orbital regions. Carapax about seven eighths as long as broad, much narrowed posteriorly, convex; regions slightly defined and not protuberant; surface beneath the pubescence punctate and sparsely roughened with scattered tubercles variable in size, and most numerous on the gastric and hepatic regions. Frontal and orbital regions continuous, without any teeth or spines, forming a prominent, wide, naked, minutely granulated anterior border to the carapax, made more distinct by a channel-like depression which separates it from the rest of the surface. On this border there are no sinuses at the junction of the front and orbits, and the median emargination of the straight or slightly convex frontal outline is very slight. At the outer angle of the orbit the border is continued for a short distance posteriorly, on the antero-lateral margin. Beyond this the antero-lateral margin is nearly parallel to the axis of the body, and armed with three small triangular teeth. Orbital margin below entire, and smooth, without fissures or teeth, with the exception of the usual large tooth forming the inner angle. The subhepatic tooth is distinct, forming part of an irregularly denticulated or granulated ridge, which extends from the posterior extremity of the anterior border of the carapax to the anterior angle of the buccal area. The basal joint of the external antennæ is small, and the space between it and the frontal projection is almost equal to its own length. Chelipeds very short and stout, armed above and on the outer side with roughened tubercles like those of the carapax. On the superior margin of the hand there are three strongly projecting teeth.

Dimensions of a female specimen: Length of the carapax, 0.41; breadth, 0.49 inch; proportion, 1 : 1.195.

Only two specimens of this species were taken, both females. They occurred at the depths of 111 and 125 fathoms, off Sombrero Key.

Pilumnus granulimanus nov. sp.

This is a small species, in which the carapax is rather short and broad, naked, areolated and granulated in front, and smooth posteriorly. The granulation is especially conspicuous on the hepatic regions. Antero-lateral margin minutely denticulated, and armed with four small, equal, acute, triangular teeth, besides the angle of the orbit. At the penult tooth a short granulated ridge extends inwards on the surface of the carapax. The antero-lateral margin in these characters resembles that of *Xantho* and *Panopeus* rather than that of the ordinary *Pilumni.* The subhepatic region is granulated, and bears a minute tooth beneath the interval between the angle of the orbit and the next marginal tooth. Orbit with a distinct notch beneath the outer angle; margins otherwise entire, above and below. Front somewhat deflexed, very little projecting; margin unarmed and profoundly notched at the middle. The basal joint of the external antennæ falls considerably short of reaching the front. There is no ridge on the endostome. Feet setose; greater cheliped less setose than the rest; carpus and hand covered externally and above with small, subequal granules, regularly crowded, and diminishing in size below; carpus with two minute, sharp teeth at the inner angle. Ambulatory feet with a few minute, short spines along the superior edge. Color yellowish, marbled with red.

Dimensions of a male: Length of carapax, 0.18 inch; breadth, 0.25 inch; proportion, 1 : 1.38.

A male and a female of this species were found on the reef at Cruz del Padre, Cuba.

Melybia nov. gen.

Carapax broad, subquadrate; front rather depressed, very broad; antero-lateral margin short, only one third as long as the postero-lateral, and armed with three or four teeth. Basal joint of the external antennæ occupying the hiatus of the orbit, firmly soldered, and reaching a process of the front. External maxillipeds very narrow, widely gaping; exognath half the width of the endognath. Feet all spinulose; chelipeds rather large, even in the female; ambulatory feet long, slender, and compressed.

This genus is closely allied to *Melia,* but differs therefrom in its broader carapax, three-toothed antero-lateral margin, firmly soldered basal-joint of the external antennæ, broader exognath of the external maxillipeds, and spinulose feet. It has somewhat the appearance of a *Thalamita.*

Melybia thalamita nov. sp.

Carapax somewhat convex, slightly pubescent; surface nearly smooth and even; regions faintly defined. Antero-lateral margin three-toothed (the little-prominent angle of the orbit not included); teeth spiniform, pointing forward, the anterior one longest, the posterior one minute. Front bilobed; margin of the lobes nearly straight. Orbit with two fissures above, and one below near the outer side; margins smooth or minutely crenulated. Subhepatic region minutely granulated. In the chelipeds the meros-joint is spinulose along the upper edge, and armed with two slender spines on the inner edge; carpus with four or five spines on the upper side, the spine at its summit being the longest one on the chelipeds; hand oblong, with two longitudinal rows of spines on the upper edge; fingers two thirds as long as the palm. Ambulatory feet sparsely hairy; meros armed with spines along the upper edge, and with one spine below near the extremity; dactyli nearly as long as the penult joint.

Dimensions of a female specimen: Length of carapax, 0.25; breadth, 0.36 inch; proportion, 1 : 1.44.

In a variety (?) of the species, dredged, as stated below, in 42 fathoms, the carapax and feet are naked.

Off French Reef,	April 3, 1869.	Cast No. 1.	15 fathoms.
West of the Tortugas,	January 16, 1869.	Cast No. 7.	35 "
West of the Tortugas,	January 16, 1869.	Cast No. 8.	37 "
West of the Tortugas,	January 16, 1869.	Cast No. 12.	42 "

Subfamily ERIPHIINAE.

Eriphia gonagra H. M.-Edw.

Cancer gonagra Fabr., Ent. Syst., II, p. 460. Suppl. Ent. Syst., p. 337.
Eriphia gonagra H. Milne-Edwards, Hist. Nat. des Crust., I, 426, pl. xvi, figs. 16 and 17. Gibbes, Proc. Am. Assoc. Adv. Sci., 1850, p. 177. Dana, U. S. Expl. Exped., Crust., I, 250. Stimpson, Notes on North American Crust., p. 89. Smith, Trans. Conn. Acad. Arts and Sciences, II, 7.

Dredged at Key West, in from two to five fathoms.

Domecia hispida Soul.

Domecia hispida Souleyet, Voyage au Pole Sud., pl. vi, figs. 3, 7. Stimpson, Notes on N. American Crust., p. 90.

Of this species I find three lots of specimens, labelled as follows: —

Florida Reefs, in shallow water.
Reef at Eastern Dry Rocks, littoral.
Reef at Cruz del Padre, Cuba.

Family PORTUNIDAE.

Subfamily PORTUNINAE.

Bathynectes nov. gen.

Very near *Portunus*,* but differing in its antero-lateral teeth, which are not like those of a saw, but are somewhat spiniform, and separated by

* By *Portunus* the typical forms are meant, *P. puber*, *corrugatus*, etc. *P. holsatus* (*marmoreus*) should be separated generically; it is quite distinct in its external max-

considerable intervals. The front, also, has no median tooth, and the hiatus of the orbit is widely open, not being filled by the basal-joint of the external antennæ, which is narrow, and firmly soldered anteriorly to the process of the front. The meros-joint of the external maxillipeds is as broad as long, and does not project anteriorly, but fits accurately to the anterior edge of the buccal area. The ambulatory feet are very slender; those of the first pair much shorter than those of the second; second and third pairs very long, the third longest; fourth pair two thirds as long as third.

Bathynectes longispina nov. sp.

The following description is that of a male: Body naked; feet also naked, except the posterior ones, which are ciliated, as usual. Carapax subhexagonal, with a granulated and uneven surface. A well-defined ridge crosses the middle, connecting the lateral spines; while a shorter ridge crosses the cardiac, and another, interrupted at the middle, the gastric region. Antero-lateral margin armed with five sharp, spiniform teeth, including the angle of the orbit; the posterior tooth or spine being three times as long as the others, and more than one third as long as the width of the carapax, excluding the spines; first (anterior) two teeth broader and less spiniform than the others; third and fourth teeth very acute and a little longer than the distance between their bases. Front prominent, four-toothed; the middle two teeth being smaller than, and projecting a little beyond, the two lateral ones. Orbit with two open fissures above and one below; besides which, below, there is a sinus beneath the outer angle, and a broader one, with a denticulated margin, next the inner tooth. From the base of this inner tooth of the orbit a small projecting lobe crosses the bottom of the hiatus of the orbit and reaches the basal joint of the antenna. This joint is oblong in form, and bears a crest or carina along the outer side, terminating anteriorly in a slight tooth. Flagellum of the outer antennæ more than half as long as the carapax. Chelipeds one half longer than the carapax; meros with a long spine on the inner edge, and a short one on the superior edge, both distant from the anterior extremity of the joint about one third its length; carpus with a very long spine at the inner angle, which spine is itself armed with two or three small teeth on the anterior edge, and with three

illipeds, the meros-joint of which is elongated, projecting considerably beyond the buccal margin; and the basal joint of the external antennæ is slightly movable; the carapax is naked; there is no elevated line on the surface of the terminal and penult joints of the posterior pair of ambulatory feet, and the first joint of the abdomen is almost entirely concealed beneath the carapax. For *P. holsatus* and its allies the name *Liocarcinus* is proposed.

other spines, and several spinuliform tubercles on the supero-exterior surface. Hand costate, there being three ridges on the outer, two on the upper, and one on the inner side; of the superior ridges, the outer one is armed with five spines, and the inner one is denticulated, with a long spine at the summit anteriorly; fingers nearly as long as the palm, and strongly toothed within, the teeth being four or five in number on each. Ambulatory feet of the third pair two and a half times as long as the carapax. Colors: Body greenish; ambulatory feet white.

Dimensions: Length of carapax, 0.58; breadth, including the lateral spines, 1.10; excluding the spines, 0.68 inch; proportion of length to latter breadth, 1 : 1.17; length of third pair of ambulatory feet, 1.45 inch.

Off Sand Key,	May 15, 1868.	Cast No. –.	100 fathoms.
Off Key West,	April 21, 1869.	Cast No. 5.	120 "
Off American Shoal,	May 8, 1868.	Cast No. 3.	150 "

Bathynectes brevispina nov. sp.

This species greatly resembles the typical form in color and most other characters, but differs in the following important particulars: The carapax is more convex, and the transverse ridges are less prominent The antero-lateral teeth are much smaller and shorter, the second, third, and fourth teeth being only half as long as the distance between their bases, and the posterior tooth (lateral spine) equalling in length only one seventh the width of the carapax, excluding the spines.

The dimensions of the only specimen in the collection — a female — are: Length of carapax, 1.96; breadth, including the lateral spines, 2.95; excluding the spines, 2.40; proportion of length to latter breadth, 1 : 1.22.

The specimen was taken in 107 fathoms, off the Marquesas, February 11, 1869.

It was at first regarded as a large female of *B. longispina*, but the differences between the two forms are so much greater than is usual between the sexes in Portunidae, that I have preferred to consider them distinct, until the question can be decided by the acquisition of additional materials.

Subfamily LUPINAE.

Neptunus Sayi Stm.

Lupa pelagica Say, Jour. Acad. Nat. Sci. Philad., I, 97 (1817).

Lupa Sayi Gibbes, Proc. Am. Assoc. Adv. Sci., 1850, p. 178. Dana, U. S. Expl. Exped., Crust., I, 273, pl. xvi, fig. 8.

Neptunus Sayi Stimpson, Notes on N. American Crustacea (1860), p. 92. A. Milne-Edwards, Arch. du Mus, X, 317, pl. xxix, fig. 2.

Found on Gulf weed, January 18, 1869.

Callinectes ornatus Ordway.

Callinectes ornatus Ordway, Monograph of the genus Callinectes (1861), p. 6.

Found at Key West in from 2 to 5 fathoms.

The *Callinectes ornatus* of Smith (Trans. Conn. Acad. of Arts and Sci. II, 8) is probably not the same as that of Ordway, as the Brazilian specimens are described as having the carapax deeply areolated, which is not the case in specimens from the Florida coast.

Acheloüs Ordwayi Stm.

Acheloüs Ordwayi Stimpson, Notes on N. American Crustacea (1860), p. 96. Smith, Trans. Conn. Acad. of Arts and Sciences, II, 9.

Neptunus Ordwayi A. Milne-Edwards, Arch. du Muséum d'Hist. Nat., X, Add.

The carapax is everywhere granulated above, except on certain spaces about the middle. The depressed pubescent areas on the male abdomen are characteristic.

For the differences between this species and *A. spinimanus* and *A. cruentatus*, see the excellent description of Smith, referred to in the synonymy.

Dredged in from 5 to 7 fathoms between East and Middle Keys, Tortugas.

Acheloüs spinicarpus nov. sp.

Carapax convex, and rendered uneven by granulated ridges and protuberances similar to those seen in all species of *Acheloüs*, but which are generally much less prominent than in the species under consideration. The branchial ridge (that extending inward from the lateral spine) is sinuous and strongly convex forward. The lateral spine is long, equalling in length two thirds that of the entire antero-lateral margin. The eight smaller teeth of the antero lateral margin vary somewhat in size, the second, fourth, and sixth, counting from the front, being smaller than the others. Front moderately prominent, projecting slightly beyond the level of the outer angles of the orbit; teeth sharp, triangular, rather deeply cut, and about equal in size, but the median ones are more prominent than the outer ones. The postero-lateral angles of the carapax are armed with a slight tooth. In the chelipeds, the meros-joint is armed in front with four or five spines (usually four on one side and five on the other) and with one spine at the outer extremity. The inner spine of the carpus is very long, two thirds as long as the palm of the hand. The outer spine of the carpus is short. There is only one spine on the superior margin of the hand. There is no spine on the meros-joint of the posterior pair of ambulatory feet, but the margins of this joint are denticulated both above and below, most strongly so toward the extremities.

The abdomen of the male is naked, smooth, and polished, and the sternum is granulated.

Dimensions of an adult male: Length of carapax, 0.37; breadth, including spines, 0.84; excluding spines, 0.50 inch; proportion of length to latter breadth, 1 : 1.35. In a young male the length of the carapax is 0.25; breadth, including spines, 0.55; excluding spines, 0.34 inch.

This species is easily recognized among most of its congeners by its long carpal spines. From *A. Ordwayi* and *A. tumidulus* it is distinguished by the great length of the lateral spines.

Off the Tortugas,	January 4, 1868.	Cast No. 1.	13	fathoms.
Off Carysfort Reef,	March 21, 1869.	Cast No. 7.	40	"
Off Conch Reef,	May 11, 1869.	Cast No. 3.	49	"
Off Alligator Reef,	May 8, 1869.	Cast No. 3.	53	"
Off Pacific Reef,	May 13, 1869.	Cast No. 3.	60	"
Lat 31° 31′, Long. 79° 41′,	May 25, 1868.	Cast No. 1.	74	"
Off American Shoal,	May 8, 1868.	Cast No. 3.	150	"

Acheloüs tumidulus nov. sp.

Carapax rather narrow, only one fourth broader than long, rather more convex than is usual in the genus, and somewhat protuberant about the middle and posteriorly. Posterior tooth of the antero-lateral margin (lateral spine) of moderate length, about as long as the space occupied by the three teeth next in front of it. Front prominent, projecting much beyond the level of the outer angles of the orbits, convex; teeth rounded, the two middle ones being smaller and most prominent, and separated from the lateral ones by a rather broad, shallow sinus. No notch on the orbital margin above the insertion of the external antennæ. Meros-joint of the outer maxillipeds longer than broad. Chelipeds rather short; meros armed with three large and one small spine on the front edge; spine of the outer extremity of the posterior edge of the meros almost obsolete. Inner spine of the carpus long, reaching to the middle of the palm of the hand. There is only one spine on the superior margin of the hand. On the meros-joint of the posterior pair of ambulatory feet there is a denticulated extero-inferior margin, but no spine. The abdomen of the male is smooth and polished.

Dimensions of a male: Length of carapax, 0.20; breadth, including the lateral spines, 0.31; excluding the spines, 0.25 inch; proportion of length to latter breadth, 1 : 1.25.

This differs from most other American species heretofore described in the narrowness of the carapax and the prominence of the front. From *A. Ordwayi* it differs in the frontal teeth, which are not deeply cut.

West of Tortugas,	January 16, 1869.	Cast No. 8.	37	fathoms.
Off Conch Reef,	March 21, 1869.	Cast No. 1.	40	"

Acheloüs spinimanus De Haan.

Portunus spinimanus Latreille, Encyc. Méth., X, 188.
Lupa spinimana Leach, in Desmarest, Considérat. sur les Crustacés, p. 98. H. Milne-Edwards, Hist. Nat. des Crust., I, 452.
Acheloüs spinimanus De Haan, Fauna Japonica, Crust., p. 8. A. Milne-Edwards, Arch. du Muséum d'Hist. Nat., X, 341, pl. xxxii. Smith, Trans. Conn. Acad. of Arts and Sciences, II, 9.

Taken in shallow water on the Florida coast.

Acheloüs depressifrons Stm.

Amphitrite depressifrons Stimpson, Notes on N. American Crustacea (1859), p. 12.
Acheloüs depressifrons Stimpson, Notes on N. American Crustacea (1860), p. 95. A. Milne-Edwards, Arch. du Muséum d'Hist. Nat., X, 342.

Key West, in from two to five fathoms.
Two miles south of Rebecca Shoal, in ten fathoms.

OCYPODOIDEA.

Family CARCINOPLACIDAE.

In this family the base of the abdomen covers the entire width of the posterior extremity of the sternum.

Subfamily EURYPLACINAE.

The genus *Euryplax* is the type of a group which differs from the usual forms of Carcinoplacidae (as *Pseudorhombila*, *Eucrate*, *Pilumnoplax*, and *Heteroplax*) in having the verges lodged in covered or closed canals, and in having the anterior corners of the posterior segment of the sternum exposed instead of being covered by the abdomen. The first joint of the abdomen is narrow and very little developed. The eyes are long and the antennæ are excluded from the orbit by the internal suborbital lobe.

Euryplax nitida Stm.

Euryplax nitida Stimpson, Notes on N. American Crust., p. 14. Smith, Trans. Conn. Acad. of Arts and Sciences, II, 162.

The female, now for the first time described, differs remarkably from the male in its narrower and more convex carapax, in which the broadest part is at the second antero-lateral tooth. The outer angle of the orbit is very prominent, forming the largest tooth of the antero-lateral margin, the posterior tooth of which is the smallest; just the opposite of what occurs in the male. There is no pit on the meros-joint of the chelipeds. This pit would, therefore, appear to be a sexual character, belonging to the male.

In a young female specimen, probably of this species, which was dredged in forty-nine fathoms, and is less than two tenths of an inch in length, the posterior tooth of the antero-lateral margin is obsolete. The same thing occurs in a young male of about the same size from St. Thomas. In this young male the pits are already present on the meros of the chelipeds, but the shape of the carapax is like that of the female, and the internal suborbital lobe is much less developed than in the adult.

Key West, 2 to 5 fathoms.

Off Elbow Reef, March 21, 1869. Cast No. 3. 49 fathoms.

Subfamily EUCRATOPSINAE.

In this group the vergal canals are closed, and the last joint of the sternum in the male is exposed at the anterior corners, as in the Euryplacinae; but the first joint of the abdomen is well developed, and is much broader than the second, reaching to the coxæ of the posterior feet, which the second joint does not. The third joint of the abdomen is much wider than the second, but falls considerably short of the margins of the sternum. The third, fourth, and fifth joints are soldered together. Except in the passage of the verges through the sternum, the typical genus of this group (*Eucratopsis*) differs little from *Panopeus.*

Panoplax nov. gen.

This genus resembles *Panopeus* in general appearance. The carapax is somewhat depressed, and much broader than long. Antero-lateral margin short, with three teeth (not including the angle of the orbit, which is not prominent), and a slight emargination indicating the fifth, or posterior tooth, which, being placed within as well as behind the prominent fourth tooth, belongs more properly to the postero-lateral margin. Facial region narrow; eyes short; orbit rather small, with a slight hiatus beneath the outer angle. Antennæ and outer maxillipeds as in *Panopeus.* Ambulatory feet compressed; dactyli but little longer than the penult joint.

It is very closely allied to *Eucratopsis* Smith (*Eucrate* Dana), but differs in its broader and more depressed carapax, deflexed front, more elongated hands, etc.

Panoplax depressa nov. sp.

Carapax faintly areolated, and smooth and naked above. Third and fourth antero-lateral teeth triangular, acute, and about equal in size, the third, however, being somewhat broader. Second antero-lateral tooth half as large as the third. Front deflexed, in a curve; lobes broadly convex, smooth. There is a slight, straight, acute transverse ridge crossing the frontal region just above the margin. Chelipeds rather large; carpus with a small spine at the inner angle; hand compressed, smooth. Ambulatory feet pubescent, the dactyli in particular being covered with short hairs on all sides.

Dimensions of a male: Length of carapax, 0.28; greatest breadth, at tips of the fourth antero-lateral teeth, 0.43 inch; proportion, 1 : 1.54; length of ambulatory feet of the second pair, 0.60 inch.

Dredged between East and Middle Keys, Tortugas, in from 5 to 7 fathoms.

LEUCOSOIDEA.

Family CALAPPIDAE.

Subfamily CALAPPINAE.

Cyclois Balguerii Stm.

Mursia Balguerii Desbonne et Schramm, Crust. de la Guadeloupe, p. 52, pl. iv, fig. 20.

The specimens agree in all respects with the description and figure quoted, except in the proportions of the carapax, which is narrower than in the Guadaloupe specimens, being fully as long as broad.

Key West, 2 to 5 fathoms.

Between East and Middle Keys, Tortugas, 5 to 7 fathoms.

Off Orange Key, Bahamas,	April 1, 1869.	Cast No. 2.	9	fathoms.
Off the Tortugas,	March 4, 1868.	Cast No. –	13	"
Off Pacific Reef,	May 13, 1869.	Cast No. 1.	30	"
Off Carysfort Reef,	March 21, 1869.	Cast No. 8.	35	"
Off Carysfort Reef,	March 21, 1869.	Cast No. 7.	40	"
Off French Reef,	March 21, 1869.	Cast No. 2.	45	"

Acanthocarpus nov. gen.

Body regularly ovate, strongly convex in its antero-posterior dorsal outline. Carapax as broad as long, broadest in front. Antero-lateral continuous with the postero-lateral margin; the latter armed with a strong tooth at about the middle. Fronto-orbital region very broad, occupying more than half the width of the carapax. Eyes large. External maxillipeds not reaching to the anterior extremity of the buccal area; ischium truncate in front, without projecting at the inner angle, which, like the outer one, is a right angle; meros shorter and broader than the ischium, and narrowed in front, with the palpus attached at the antero-interior angle; exognath reaching to the tip of the meros. Chelipeds with a great spine on the carpus placed in a horizontal plane and pointing outward in a direction exactly transverse to the axis of the body. The ambulatory feet all have slender dactyli, as in *Calappa* and *Mursia*.

This genus differs from *Calappa* in the want of lateral expansions of the carapax, and from *Mursia* in the want of lateral spines. From all the genera of the family hitherto described it differs in its great facial width.

Acanthocarpus Alexandri nov. sp.

Carapax regularly convex, with uneven surface, the protuberances being arranged obscurely in five longitudinal rows anteriorly, the middle ones of which form centrally and posteriorly three conspicuous ridges, the lateral ridges terminating in the teeth of the postero-lateral margin. The surface is uniformly, but not thickly, covered with minute, equal granules, the interspaces between which are wider than the granules themselves. The posterior margin is regularly arcuate, and bears a slightly prominent tooth at the middle, and a slight wave in the outline on either side. The lateral margin is unarmed, except by two or three slight tuberculiform teeth near the orbit. The orbits are large, without fissures, except the inner superior one, which is itself nearly obsolete; orbital margin ciliated. The front is of moderate width, a little convex, but not toothed, and is separated from the orbit by its lateral angle simply, and not by any notch. The spine on the carpus of the cheliped is nearly half as long as the carapax; and above it, on the same joint, there is another spine, stouter, but only one fourth as long as the first. Both these spines are granulated. The hand is provided with a seven-toothed crest above, and another, oblique, six-toothed crest on the outer surface, extending from the base of the dactylus to the postero-inferior angle. On the latter crest the posterior tooth is largest, and forms by itself a short crest, separated from the other teeth by a considerable interval. Between the upper and lower crests of the hand there are four or five tubercles scattered upon the surface. Ambulatory feet naked, unarmed, with smooth polished surface.

Dimensions of a male: Length of carapax, 0.31 inch; breadth the same.

Off the Quicksands, January 23, 1869. Cast No. 2. 74 fathoms.

Calappa marmorata Fabr.

Cancer marmoratus Fabricius, Ent. Syst., II, 450 (1793).

Cancer flammeus Herbst, Naturg. d. Krabben und Krebse, II, 161; pl. xl, fig. 2.

Calappa marmorata Fabricius, Suppl. Ent. Syst., p. 346. H. Milne-Edwards, Hist. Nat. des Crust., II, 104. Desbonne et Schramm, Crust. de la Guadeloupe, p. 51.

Found at Key West, in from 2 to 5 fathoms.

Calappa galloides Stm.

Calappa galloides Stimpson, Notes on N. American Crustacea, p. 25.

Found at Key West, in 4 to 5 fathoms.

Family MATUTIDAE.

The Matutidae may conveniently be divided into two subfamilies, Matutinae and Hepatinae. The latter group differs from the former in having a broader carapax, a narrow facial region, and short orbits and eyes.

Subfamily HEPATINAE.

Osachila nov. gen.

This genus is allied to *Hepatus* in all essential characters, but differs considerably in the shape of the carapax, which is nearly as long as broad, and has the front much produced, so much so as to form a true rostrum in one species. The carapax is also more or less depressed and expanded at the sides, and its surface is very uneven, having six chief protuberances.

Species of this genus are found in the seas of both sides of Tropical America. The name is that of a Florida Cacique.

Osachila tuberosa nov. sp.

Carapax somewhat octagonal, very slightly broader than long; surface very uneven, deeply pitted on the protuberances, and finely, densely punctate on the depressed parts. Three of the protuberances are on the gastric region, and correspond to the metagastric and urogastric lobes, the protuberance of the latter being much the smallest, and continued anteriorly in the form of a slight ridge in the furrow between the metagastric lobes, reaching, with the furrows, nearly to the frontal region. The cardiac protuberance is rounded and smaller than the metagastric ones. The mesobranchial lobes are strongly protuberant and larger than the metagastric, and there is a small, elongated, longitudinal protuberance between them and the cardiac protuberance. The front is projecting, and bilobed, with the lobes very obtuse and separated by a deep furrow. No protuberance on the concave hepatic region. Antero-lateral margin straight or slightly concave anteriorly, but quickly curving backward and becoming parallel to the axis of the body in the greater, posterior part of its length; it is armed with numerous small irregular teeth, and is pitted above like the protuberant parts of the carapax; and the posterior tooth, which forms part of the branchial protuberance, is larger than the others. Postero-lateral margin nearly straight, obtuse, rugose, and armed with two or three tuberculiform teeth, of which one, separated from the posterior extremity of the carapax by a concavity, is the largest. Posterior extremity of the carapax narrow, with a rugose and much-thickened margin concealing the base of the abdomen. Beneath, the entire surface of the carapax, maxillipeds, sternum, abdomen, and of the bases of the feet, is densely covered with rather large pits, giving it a vermiculated or reticulated appearance.

Chelipeds rather stout; outer surface strongly rugose with punctate tubercles and pits; hand with four teeth on the superior crest. Ambulatory feet (except dactyli) naked, compressed, and crested above and below; crest of meros-joint with a row of pits along the posterior side, giving it a plicated appearance; last three joints with another crest on the postero-superior surface; dactyli stout, densely pubescent below.

Dimensions of a male: Length of carapax, 0.56; breadth, 0.59 inch; proportion, 1 : 1.054.

West of Tortugas,	January 16, 1869.	Cast No. 4.	36	fathoms.
Off Conch Reef,	March 21, 1869.	Cast No. 1.	40	"
Off French Reef,	March 21, 1869.	Cast No. 2.	45	"
Off Carysfort Reef,	March 21, 1869.	Cast No. 5.	60	"
West of Tortugas,	January 16, 1869.	Cast No. 13.	68	"

Family LEUCOSIDAE.

Subfamily ILIINAE.

No attempt has yet, I believe, been made to separate the Leucosidae into subfamilies. The existence of the group which I have here named Iliinae seems to be sufficiently well indicated by tangible characters, such as the long, slender chelipeds, and the two-notched extremity of the pterygostomian channel.

Iliacantha nov. gen.

Closely allied to *Ilia*, but having three spines (one median) at the posterior extremity of the carapax, instead of four tuberculiform teeth. From *Persephona*, *Myra*, and other allied genera of Leucosidae, it differs in the peculiar conformation of the hands, which are twisted, so that the fingers open in a vertical instead of a horizontal plane.

The pterygostomian channels at their anterior extremities project considerably beyond the orbits. The abdomen in a young male, the only specimen of that sex I have seen, is seven-jointed, none of the joints being soldered together.

The species of *Ilia*, the nearest ally of this new genus, are confined to the Mediterranean Sea.

Iliacantha subglobosa nov. sp.

Carapax subglobose, smoothly and evenly convex, and unarmed, except at the posterior extremity, where there are three spines, similar in position to those of the species of *Myra* and *Persephona*, the middle one being long (equalling in length one seventh that of the carapax) and curved upward, and the lateral ones flattened, triangular. The hepatic region is considerably swollen, but entirely unarmed, and is bounded posteriorly by a depression indicating the outer extremity of the cervical sulcus, which is entirely obsolete in its median portion. The margin of the carapax is distinct and somewhat acute on the hepatic region, and on the anterior part of the branchial, as far as a slight angular projection, posterior to which it ceases to be defined. Surface of the carapax minutely granulated. Chelipeds in the female two and a half times as long as the carapax, excluding the spine, and minutely granulated; meros more sharply granulated than carpus and hand; fingers very slender, much longer than the palm, and armed within with needle-like teeth. Ambulatory feet very slender and smooth, those of the first pair reaching to the middle of the palm of the chelipeds; meros-joint as long as the terminal three joints taken together.

The above description is that of a female. In the male the carapax is less smoothly rounded above, the regions being faintly indicated, and the intestinal region protuberant above the base of the posterior spine.

Dimensions of a sterile female: Length of carapax, including the posterior spine, 0.63; breadth, 0.52; length of cheliped, 1.38 inch.

Off Carysfort Reef,	March 21, 1869.	Cast No. 7.	40 fathoms.
Off French Reef,	March 21, 1869.	Cast No. 2.	45 "
Off Pacific Reef,	May 13, 1869.	Cast No. 3.	60 "

Iliacantha sparsa nov. sp.

Carapax oval; intestinal and hepatic regions only defined; surface sparsely granulated; granules scattered, sharply projecting, almost like short capitate spines; surface between the granules punctate, or, as near the margins, covered with smaller granules. Postero-lateral margin less convex than in *I. subglobosa.* Posterior spines large; lateral ones similar in shape to and more than one half as large as the middle spine. A spine on the hepatic region half as large as the lateral posterior ones. Depression between the frontal and gastric region very deep, giving great prominence to the facial projection; median sinus of front very deep; frontal teeth much projecting. External maxillipeds larger, more produced in front, and more coarsely granulated than in the preceding species; granules prominent, like those of the back of the carapax.

Dimensions of a sterile female: Length of carapax, posterior spine included, 0.30; breadth, 0.25 inch.

It is easily distinguished from *I. subglobosa* by its hepatic spine.

West of the Tortugas, January 16, 1869. Cast No. 1. 30 fathoms.

Myropsis nov. gen.

This genus differs from *Myra*, to which it is nearly allied, in its more globular form, in having five instead of three posterior spines, in the want of the median and hepatic ridges, and in having the outer margin of the exognath of the outer maxillipeds straight instead of curved. From *Ilia* and *Iliacantha* it differs in its chelipeds, the fingers of which open in a horizontal plane. From *Persephona* it differs, among other characters, in the basal joint of the antennulæ, which is indurated and crested. The anterior extremity of the pterygostomian channel does not reach beyond the orbits. All the joints of the male abdomen are soldered together, except the terminal one.

The species of *Myra*, the nearest ally of the new genus, are all, as far as known, inhabitants of the East Indian and Australian seas.

Myropsis quinquespinosa nov. sp.

Body and chelipeds everywhere granulated, above and below. Carapax subglobular, regularly and evenly convex, as in *Iliacantha subglobosa;* intestinal and cardiac regions only defined, and defined by rather deep furrows on either side; hepatic region not swollen; cervical sulcus obsolete; granules of the surface equal in size and distributed with great regularity, being distant from each other by a space equal in width to two or three times their diameter. Lateral margins of carapax regularly arched. Of the five posterior spines, the median one is situated on the intestinal region; the intermediate ones are but little smaller than the median one, and are placed at a lower level, occupying the postero-lateral angles of the carapax; the outer ones, placed on the branchial region over the insertion of the posterior feet, are small, only one third as long as the median spine. There is also a small spine at the middle of the lateral margin, and one on the hepatic region. The frontal teeth are obtuse, and not very prominent. Chelipeds cylindrical; meros more than two thirds as long as the carapax, and covered with granules as large as those of the carapax, but densely crowded; granules of hand smaller, but also densely crowded; fingers longer than the palm, and armed within with very minute and acute teeth varying in size. Ambulatory feet naked (except the dactyli), cylindrical, and partly microscopically granulated; those of the first pair one sixth longer than the carapax.

Dimensions of a male: Length of carapax, spines included, 0.72; breadth, 0.58; length of cheliped, 1.25 inch.

Off Tennessee Reef, May 7, 1869. Cast No. 1. 21 fathoms.
——————— May 11, 1868. Cast No. 5. 82 "

Callidactylus nov. gen.

Carapax rounded, nearly as broad as long, regularly convex, except near the anterior margins; hepatic region well defined, protuberant, and toothed; posterior extremity armed with three spines, as in *Persephona*, etc. Front short; basal joint of the antennulæ not indurated. Orbit longitudinal, with three very distinct fissures on the outer side, which extend to the base of the orbital tube. Pterygostomian channel much narrower than in *Myra*, strongly tridentate in front, and extending beyond the orbit. External maxillipeds sharply granulated; exognath with a convex outer margin, but much less dilated than in *Myra;* meros-joint of endognath with a concave outer surface. Chelipeds of moderate length; hand much longer than the meros; palm short, pyriform, much swollen within toward the base, and somewhat twisted, though less so than in *Ilia*, so that the fingers move in an oblique plane; fingers much longer than the palm, very thin and delicate, laminate, curving upward and inward toward the tips, serrated on the outer edge, and armed within with numerous needle-shaped teeth. Ambulatory feet naked (except the dactyli of the posterior pair, which are sparsely pilose); penult joint compressed, with a laminiform crest above and below; dactyli lanceolate, those of the first three pairs three-edged, those of the posterior pair two-edged and shorter and broader than the others.

In the female there is a deep, smooth channel on the outer maxillipeds, in the median line, between and on the ischium joints, defined on either side by a strong ciliated ridge. This channel does not exist in the male, and has doubtless something to do with the flow of the water which bathes the eggs or young in the abdominal cavity.

In the male, all the joints of the abdomen, except the terminal one, are soldered together.

The genus resembles *Myrodes* somewhat in the character of the fingers, but differs from it as well as from *Myra* and the allied genera in the want of an indurated crest on the basal joint of the antennulæ, and in the character of the dactyli of the ambulatory feet. From *Persephona*, etc., it differs in the convex outer margin of the exognath of the outer maxillipeds.

Callidactylus asper nov. sp.

The following is a description of an adult female. Carapax convex in the middle and posteriorly, but somewhat depressed toward the anterior margins. The sulci separating the gastric, cardiac, and intestinal from the branchial regions are easily traceable, as well as that between the cardiac and the gastric; but there is none between the cardiac and the intestinal regions. The hepatic region is surrounded by rather profound depressions, and on its posterior part there is a strong tooth-like protuberance, occupying about one third its area. The upper surface of the carapax is ornamented with scattered, prominent granules, or short, capitate spinules, which become less prominent posteriorly and disappear altogether near the posterior extremity, where the surface is covered with smaller and more crowded and depressed granules. On the lateral parts of the branchial region the two kinds of granules are found together. In the median line there are three or four short blunt spines on the posterior part of the gastric and the cardiac regions, the posterior one of which is rather remote from the others, and much larger than they, nearly as large as the median posterior spine. There is a strong, triangular tooth, pointing forward, on the subhepatic region, and a smaller tooth at the anterior extremity of the branchial region on the antero-lateral margin. On the postero-lateral margin there is also a small tooth, or short spine. The three posterior spines occupy the usual position (as in *Persephona*, *Myra*, etc.), and are short. The outer maxillipeds are granulated, like the upper surface of the carapax, and somewhat setose, the setæ arising between the granules. The fourth, fifth, and sixth joints of the abdomen are soldered together; the surface is smooth and glossy about the middle, but there is a transverse tuberculated ridge on the fourth joint, and the sixth joint is sparsely granulated.

Of the male sex I have but one half-grown example. The carapax is rather broader and more depressed than in the female, and the granules are smaller, less numerous, and more scattered. The posterior spines are longer. The sternum and abdomen are evenly covered with minute, depressed, crowded granules.

Dimensions of a female specimen: Length of carapax, spine included, 0.70; breadth, 0.61; length of meros-joint of cheliped, 0.42; length of hand, 0.65 inch. In the young male the length of the carapax is 0.39; breadth, 0.65 inch.

Lat. 24° N. Long., 83° W.,	January 22, 1868.	Cast No. 3.	16 fathoms.
Off Carysfort Reef,	March 21, 1869.	Cast No. 8.	35 "
West of Tortugas,	January 16, 1869.	Cast No 8.	37 "

SUBFAMILY EBALIINAE.

The genera *Ebalia*, *Nursia*, *Lithadia*, *Oreophorus*, *Spelaeophorus*, etc., appear to form a natural group, to which the name Ebaliinae may be applied.

Lithadia cadaverosa nov. sp.

The following description is that of a female, no males having occurred: Carapax broad, somewhat octagonal in shape, very little produced posteriorly, and very strongly convex; the branchial regions being more swollen than in any of the other known species of the genus, and occupying by far the greater portion of the carapax These regions and the other protuberant parts of the carapax are more or less covered with depressed, often confluent granules, arranged in lines or groups with depressed spaces intervening, giving to the surface an eroded or vermiculated appearance.

The excavations between the regions are very deep, but those surrounding the cardiac region are broader and less abrupt than in other species of the genus; those surrounding the hepatic region and lying in front of the branchial are very narrow. In one of the two specimens there are several small, round, isolated tubercles in the depression between the cardiac and gastric regions; while in the other this space, as well as the entire gastric and part of the branchial region, is evenly covered with flat, translucent granules, giving the surface a finely reticulated appearance. The hepatic region is narrow, with a granulated ridge extending inward a short distance from the antero-lateral margin, which is here defined by a similar ridge. Behind the hepatic region, and separated from it by a deep transverse sinus below, there are on the margin two strong, triangular teeth pointing downward on the antero-lateral part of the branchial region. The posterior of these two teeth corresponds to the anterior lateral tooth of other species of the genus, but the tooth in front of it is the larger; the surface of both is flattened. The posterior lateral tooth of the branchial region is blunt. The intestinal region is broad, and the two marginal lobes are thickened, but very little projecting, and not at all dentiform. On the inferior surface of the branchial region there are one or two rows of small tubercles. The front is thick, the epistome and suborbital region ample, and the external maxillipeds bent nearly to a right angle in front, so that the anterior portion of the facial region is large and lies in a vertical plane. The frontal margin is slightly concave, but not notched. The chelipeds are rugose, with angular, granulated protuberances; meros not at all flattened, but nearly as thick as it is broad. Ambulatory feet armed above with short, thick spines, as in *L. Cumingii;* dactyli and penult joints somewhat setose. Color, bluish-white, with flake-white ridges and tubercles; frontal portion and feet, flesh-colored; a few blood-red spots on the abdomen and about the bases of the feet, particularly of the chelipeds.

Dimensions of the larger female: Length of carapax, 0.26; breadth, 0.30 inch.

This crab is well protected by its general appearance, and with its feet retracted would scarcely be taken for a living object. It differs from *L. cariosa* in its broader and more convex carapax, and in the much less prominent lobes of the intestinal region.

West of Tortugas,	January 16, 1869.	Cast No. 7.	35 fathoms.
Off Conch Reef,	March 21, 1869.	Cast No. 1.	40 "

Academy of Sciences, Chicago, Ill.,
December 1st, 1870.

No. 3. — *On the Mammals and Winter Birds of East Florida, with an Examination of certain assumed Specific Characters in Birds, and a Sketch of the Bird-Faunæ of Eastern North America.* By J. A. Allen.

Introduction.

The present paper embraces five more or less distinct parts. The first consists of introductory remarks respecting the topographical, climatic, and faunal features of that part of the peninsula of Florida usually known as East Florida. The second is an annotated list of the mammals of this region. The third is devoted to a consideration of individual, seasonal, age and geographical variation among birds, with reference to certain characters commonly assumed to be specific. The fourth contains a list of the winter birds of East Florida, with field and revisionary notes. The fifth is given to an examination of the geographical distribution of the birds and mammals (more particularly of the birds) of Eastern North America, in which is considered the number of the natural faunæ of this region, their distinctive features and their boundaries.

The enumeration of the mammals and birds, forming Parts II and IV, is based partly on my own observations and partly on notes kindly furnished me by Messrs. C. J. Maynard and G. A. Boardman. These observations may be considered as equivalent collectively to the labors of a single observer constantly in the field for at least four or five winters.

My own observations were made during a three months' exploration of the country bordering the St. John's River, between Jacksonville and Enterprise, in the winter of 1868 and 1869, under the auspices of the Museum of Comparative Zoölogy. The greater part of January was passed at Jacksonville, where I also spent the last week of March. Five weeks were also passed in the vicinity of Enterprise, and the balance of the time at various intermediate points.

Mr. Maynard's explorations were made during the same winter, mainly in portions of the country unvisited by myself, a large part of his collection coming from the Upper St. John's and Indian Rivers. He also spent several weeks at Dummitt's, twenty miles south of New Smyrna. During most of December and January he collected in the vicinity of Jacksonville, at which point one of his assistants, Mr. Charles Thurston, remained during April and a portion of May, collecting, among other things, the later arriving birds. Nearly all the birds and mammals collected by these gentlemen, and by Mr. J. F. Le-Baron, a third member of Mr. Maynard's party, have been added to the collection of the Museum of Comparative Zoölogy, and are accompanied by measurements carefully taken before skinning.

Mr. Boardman's observations were continued through three successive winters, during which he spent considerable time at the following points: St. Augustine and Fernandina on the coast, Jacksonville, Green-Cove-Springs and Enterprise on the St. John's River. Although the numerous specimens he collected at these and intermediate points were presented by him to the Smithsonian Institution, I am indebted to him for an annotated manuscript list of the species he met with. I am also indebted to the Rev. Thomas Marcy, who accompanied me on my Florida trip, for valuable assistance in collecting, and to Mr. J. E. Brundage for similar aid.

Having made use of the reports of previous visitors on the faunæ of this region, the following lists are believed to embrace all the species of mammals thus far known from East Florida, and all the birds regularly present in winter, of nearly all of which I have examined specimens from Florida. A few other birds not included in my list doubtless occasionally visit this region from the North, and others may linger here which usually pass the winter further south. In order to increase the value of the bird list as a faunal record, those species known to be resident throughout the year have been indicated by an asterisk (*), and those known only as winter visitors by an obelisk (†). The date of the first appearance of the strictly spring visitors is also noted, so far as such arrivals were observed.

The specimens on which the investigations detailed in Part III are based, as well as the revisionary notes of Parts II and IV, are mainly those of the Museum of Comparative Zoölogy, which embrace, among others, nearly a thousand specimens of birds from Florida.*

The topics discussed in Part III, namely, individual and climatic variation, necessarily involve the question of the nature of species, as well as the validity of various diagnostic characters. Many details

* I have also made use of measurements, taken by Mr. Wm. Brewster and Mr. C. J. Maynard, of hundreds of specimens not in the collection of the Museum.

in reference to these variations are given in this part, but a large proportion are recorded in the general and revisionary notes of Part IV. The conclusions arrived at, it may be here premised, are mainly the following: (1.) That the majority of nominal species originate in two principal sources of error; namely, (*a*) an imperfect knowledge of the extent and character of individual variation, and (*b*) of geographical variation. (2.) That this imperfect knowledge is mainly due to the neglect of zoölogists to study with sufficient care the common species of their respective countries, whence has arisen a faulty method of investigation and erroneous ideas respecting species and specific characters. (3.) Instead of the method at present pursued by a large school of descriptive naturalists — the analytic, or the search for differences — being the proper one, that synthesis should be duly combined with analysis, and that general principles should be sought as well as new forms, or so-called "new species" and "new genera." (4.) It is claimed that nothing is to be gained by giving binomial names to climatic or other forms, in cases where, however considerable the differences between them may be, a complete transition from the one to the other can be traced in specimens from intermediate localities, notwithstanding the plea sometimes urged that their use affords "convenient handles to facts."

In accordance with such views a partial revision of the species of certain groups is incidentally attempted in Part IV, more especially of the *Icteridæ*, the raptorial birds, and the genera *Parus*, *Turdus*, *Passerculus*, etc.

Part I.

The Topographical, Climatic, and Faunal Characteristics of East Florida.

No part of the Florida Peninsula, as is well known, is much elevated above the level of the sea, the greater portion being extremely low and large areas swampy. The surface is slightly undulating, but the higher ridges rarely attain a height of more than fifty or seventy-five feet, and the highest eminence is less than two hundred. A large part of Northern Florida, including what is usually termed East and West Florida, is covered with open pine forests, constituting the so-called "pine barrens." These barrens frequently rise into dry knolls, but they likewise embrace considerable tracts that are so low as to be more or less submerged during a portion of the year, especially in wet seasons; they are also interspersed with cypress swamps of varying extent. Such swamps usually border the St. John's on its upper course, sometimes extending back from the river for several miles. Other portions of the low grounds support a mixed forest of live-oak, water-oak, elm, bitter-nut hickory, maple, laurel, sweet gum, etc., with a more or less dense undergrowth, such forests forming the so-called "hummocks." Some portions of these forests are swampy; others are dry, and slightly elevated. The saw and dwarf palmettos (*Sabal serrulata* R. & S. and *S. Adansonii* Guerns.) frequently render the former difficult to penetrate, and extensive groves of the cabbage palm (*Chamærops palmetto* Michx.; *Sabal palmetto* R. & S.) here and there occupy the banks of the streams. At intervals in the pine barrens extensive thickets of low trees and thickly growing shrubs are met with, which are exceedingly difficult to enter, and are appropriately termed "scrubs." Each of these kinds of country, as would be naturally expected, forms the favorite haunt of certain species of birds and mammals, the grassy or open pineries being frequented by some that rarely visit the swamps and hummocks, and the latter by others that rarely visit the open pineries. The extensive savannas which occur along the upper portion of the St. John's River and elsewhere form the favorite haunts of numerous wading birds; and the numerous lakes are congenial to the swimming birds.

East Florida hence differs but little in its general character from the lower portions of Georgia and the low lands of the coast of South Carolina. The trees, especially of the hummocks and swampy forests, are usually covered with the pendant *Tillandsia usnoides*, or "Spanish moss," and the abundance of epiphytic orchids and other plants, as well as the palms, clearly indicates the subtropical and peculiar character of the climate.

From the great extent in latitude of the Florida peninsula — from 25° to 31°, or about four hundred miles — considerable differences necessarily exist between the fauna and flora of the northern and southern portions. Although the change in these features from the north southward is more or less gradual, it seems to be appreciably greater near Lake George than elsewhere. At this point so well-marked a change occurs in the vegetation as to attract the attention of unscientific observers, and a corresponding change in the fauna is readily traced. Above Lake George the general aspect of both the flora and fauna is decidedly more southern than it is below the lake. The boundary between the Floridian and Louisianian faunæ and floræ, it would hence seem, may be properly regarded as passing near this point, the portion of the State to the southward being alone properly Floridian, the northern resembling more the Louisianian type.*

As already observed, Florida, from its excessively marshy character, is pre-eminently suited to the wants of the grallatorial birds. Immense numbers of the heron tribe hence make it their permanent home, while it is the favorite winter resort of numerous species of *Grallæ* that pass the breeding season far to the northward. Ibises and egretts abound in its swamps and savannas, forming at all times, by their numbers and showy plumage, a characteristic feature of the fauna. In winter the abundance of snipe and other species of *Grallæ* and ducks render it at that season a sportsman's paradise. Florida hence attracts great numbers of sportsmen in winter, through whose reckless and often wanton waste of life the water-fowl, especially of late years, are annually decimated.

The summer bird fauna of Florida is probably not better represented in species than that of the temperate parts of the continent generally; but this State being the winter resort of numerous species of sparrows and warblers, and of those smaller land birds generally that pass the summer in much higher latitudes, its winter bird fauna, as compared with that of the Northern States, is extremely rich. In New England the number of species of birds that can be regarded as "common" in winter does not exceed fifteen,† but in Florida at that season at least five times that number can be so regarded. This, however, accords with a general law of distribution in respect to the relative number of species found at different points in latitude from the arctic zone southward, the number increasing in proportion to the decrease of the latitude, or with the increase of the mean temperature. In winter, through the southward migration of many species, the minimum number of species which in summer is characteristic of the arctic zone is carried down nearly to the Northern States, there being a marked decrease from summer to winter as far south as the warm temperate or subtropic belt; within the tropics, on the contrary, the number of species is far greater in winter than in summer, through the temporary influx of species from colder regions.

* For a further definition of the Floridian bird fauna, as distinguished from the Louisianian, see beyond, Part V.

† See American Naturalist, Vol. I, p. 47, March, 1867.

In consequence of the subtropical character of the climate of Florida certain peculiarities occur in respect to the development of vegetation at the vernal period, and in the time of breeding of the resident birds, that seem in this connection worthy of record. The mildness of the winter climate is such that the verdure of the forests is to a greater or less degree perennial, severe frosts being of rare occurrence. Some of the early flowering trees, such as the maples, ashes, and elms, begin to bloom and to gradually unfold their leaves early in January. Although the forest trees in general put forth their leaves in February, and a few have acquired their full summer dress by the 1st of March, their development is slow and irregular. I observed peach-trees in flower at the same locality (Jacksonville) in January and in April; and the flowering period of some of the forest trees is nearly as protracted. The development of vegetation is hence as great during a single week in May, in New England, as during any four weeks in February and March, in Florida.

A similar irregularity is observed in respect to the pairing and breeding of the resident birds. Some of the rapacious species, as the fish-hawk and the white-headed eagle, commence incubation in January, and, as I have been informed, occasionally in December; other members of the same species delay breeding till February or March. The great blue heron and the egretts nest in February, as do also the courlans, several of the hawks, the sandhill crane, the wood-duck and the blue-bird; the mocking-bird and other resident song-birds, in March and April.

In the Northern States the vivacity of the birds during the pairing season is as much greater than it is in Florida as is the rapidity of the development in vegetation. In spring at the North the woods, the fields, and the hedgerows are ever vocal with bird music; but in Florida no such outburst of song marks the arrival of the vernal season. The brown thrush, the blue-bird, the cat-bird, the towhee, and the various kinds of sparrows that are common in the breeding season to both New England and Florida, seem to lose at the latter locality the vivacity which characterizes them at the North, their attempts at song being listless and feeble. The songs of some are also much abbreviated, and so different from what they are at the North as to be sometimes scarcely recognizable as proceeding from the same species. Even the mocking-bird sings far less than in the Middle States, and with much less power. Such at least is the general fact as indicated by my own limited experience in Florida, which accords, I find, with that of various other observers.

In recounting the faunal peculiarities of Florida it is necessary to allude further to a few facts that will be more fully presented in the following chapters, namely, the differences which distinguish the Florida representatives of species that have a wide distribution to the northward from the northern ones. It has for some time been well known that a difference in size in birds and mammals usually accompanies differences of locality in respect to latitude and elevation. Other differences, however, are found to accompany these with considerable uniformity; namely, a relative increase in the length or general size of the bill, and an increase in the intensity of the general color of the plumage.* Florida birds, in short, usually differ considerably in these respects from their New England cospecific representatives; so much so, indeed, that in many cases the majority of ornithologists would probably regard the two forms as distinct species, though few of them have as yet been specifically separated.

Hence not only do birds of the same species living at distant points differ considerably in size, color, and other features, but also in their habits, notes, and songs. With the decrease in size to the southward there seems to be a corresponding decrease in vivacity, — a fact which accords with the general law of the distribution of the higher forms of life in the temperate latitudes. Although a few structurally high types are, from certain peculiarities of their conformation, necessarily tropical, the highest races of men, whether considered physically, intellectually, or morally, are inhabitants of a medium climate, and gradually decline in rank both to the northward and southward from this favored region, animal and vegetable life reaching, as a whole, its highest manifestation in the temperate latitudes. The excessive variety of forms within the tropics mainly results from the addition of those of comparatively low or medium grades, only a few of the exclusively tropical forms being of absolutely high rank. Generally, too, the forms to be properly regarded as temperate are represented in the tropics by only their lower members, while, conversely, many of the higher types of the tropics are really cosmopolitan.

* See Annual Report of the Mus. Comp. Zoöl., 1869, p. 16.

Part II.

List of the Mammals of East Florida, with Annotations.

FELIDÆ.

1. **Felis concolor** *Linné.* Panther.

Not very unfrequent in the more unsettled parts of the State. I saw several hunter's skins of it at Jacksonville, said to have been taken up the river.

2. **Lynx rufus** *Rafinesque.* Bay Lynx.

Abundant. Especially numerous on the Upper St. John's and Indian Rivers, according to Mr. Maynard and others.

CANIDÆ.

3. **Canis lupus** *Linné.* Gray Wolf.

Canis lupus Linné, Syst. Nat., I, 58, 1767. — Allen, Bull. Mus. Comp. Zoöl., I, 154, October, 1869

Canis lupus, occidentalis Rich., Fauna Bor. Amer., I, 60, 1829.

Canis occidentalis et var. Baird, Mam. N. Amer., 104, 111, 113, 1857.

Not numerous. They were described to me as being very dark colored, or black.* This account tends to confirm the statement of Audubon and Bachman in respect to this point.† After citing the comparative frequency of this form of the common wolf in Kentucky, and in several of the Southern Atlantic and Gulf States, as compared with its occurrence in regions more to the northward and westward, they observe: "The varieties with more or less of black continue to increase, as we proceed farther to the south; and in Florida the prevailing color of the wolves is black." ‡

4. **Vulpes virginianus** *Richardson.* Gray Fox.

Canis virginianus Erxl., Syst. Reg. Anim., 567, 1777. — "Schreber, Säugeth., III, 361, pl. xcii, 1778."

Canis cinereo-argentatus Erxl., Syst. Reg. Anim., 567, 1778. — "Schreber, Säugeth., 360, pl. xcii." — Godman, Am. Nat. Hist., I, 280, 1826.

Canis griseus Bodd., Elenchus Anim., I, 77, 1784.

* Since writing the above, I have received a letter from Mr. G. A. Boardman, of Milltown, Me., in which he also refers to the dark color of the Florida wolves.

† Quad. N. Amer., Vol. II, p. 130.

‡ Respecting the distribution of the different color races of the common wolf in North America, see my paper on the Mammals of Massachusetts, Bulletin Mus. Comp. Zoöl., Vol. I, p. 156, 1869.

Canis (Vulpes) virginianus RICH., Faun. Bor. Am., I, 96, 1829.
Vulpes virginianus DEKAY, New York Fauna, I, 45, pl. vii, fig. 2, 1842. — AUD. & BACH., Quad. N. Am., I, 162, pl. xxi, 1849.
Vulpes (Urocyon) virginianus BAIRD, Mam. N. Am., 138, 1857.

Common.

MUSTELIDÆ.

5. Putorius lutreolus *Cuvier*. MINK.

Mustela lutreola LINN., Syst. Nat., 66, 1766.
Putorius lutreolus CUV., Règ. Anim., I, 148, 1817. — ALLEN, Bull. Mus. Comp. Zoöl., I, 175, October, 1869.
Putorius vison GAPPER, Zoöl. Journ., V, 202, 1830.
Putorius nigrescens AUD. & BACH., Quad. N. Am., III, 104, pl. cxxiv, 1853.

"Not common." — *Boardman*. I did not meet with it. It is well known to be common, however, in the adjoining States. Audubon and Bachman speak of it as being very numerous in the rice-fields of South Carolina

6. Lutra canadensis *Sabine*. OTTER.

Abundant. Its fur, however, is of little value, compared with that of northern specimens, and the animal is hence not much hunted.

7. Mephitis mephitica *Baird*. COMMON SKUNK.

Viverra mephitica SHAW, Mus. Lever., 172, 1792. — IBID., Gen. Zoöl., I, 390, 1809.
Mephitis chinga TIEDEM., Zoöl., 362, 1808.
Mustela (Mephitis) americana DESM., Mamm., I, 186, 1820.
Mustela varians GRAY, Charlesw. Mag. Nat. Hist., I, 581, 1837.
"*Mustela mesomelas* LICHT., Darst. Säugeth., I, fig. 2." — GEOFF. ST. HIL., Voy. de la Venus, Zool., I, 133, 1855. — MAX. ZU WIED, Archiv für Naturgesch., XXVII, 218, 1861. — BAIRD, Mam. N. Am., 199, 1857.
Mephitis macroura AUD. & BACH., Quad. N. Am., III, 11, 1853.
Mephitis mephitica BAIRD, Mam. N. Amer., 195, 1857. — ALLEN, Bull. Mus. Com. Zoöl., I, 178, October, 1869.
Mephitis occidentalis BAIRD, Mam. N. Amer., 194, 1857.

Common on the Lower St. John's, but, according to Mr. Maynard, quite unknown on the Indian River.

8. Mephitis bicolor *Gray*. LITTLE STRIPED SKUNK.

Mephitis bicolor GRAY, Charlesw. Mag. Nat. Hist., I, 581, 1837. — BAIRD, Mam. N. Amer., 196, 1857.
Mephitis zorilla LICHT., Abhand. Akad. Wiss. Berlin, for 1836, 281, 1838. — AUD. & BACH., Quad. N. Amer., III, 276, 1854.
Mephitis interrupta LICHT., Abhand. Akad. Wiss. Berlin, for 1836, 283, 1838.

This beautiful little animal was obtained by Mr. C. J. Maynard at Captain Dummitt's, where it was said to be common in the scrub. Mr. Maynard says they are domesticated and used there as cats, the odor glands being removed when the animals are young; they become very tame and are quite efficient in destroying the mice (*Hesperomys* sp.) that infest the houses. I am not aware that this animal has been reported before from any point east of the Mississippi River. It has been recently ascertained to extend northward in the interior as far as Central Iowa.*

URSIDÆ.

9. Procyon lotor *Storr.* Raccoon.

Ursus lotor Linné, Syst. Nat., 48, 1758.

Procyon lotor Baird, Mam. N. Amer., 209, 1857. — Allen, Bull. Mus. Comp. Zoöl., I, 181, October, 1869.

Procyon Hernandezii Wagler, Isis, XXIV, 514, 1831. — Baird, Mam. N. Amer., 212, 1857. — Ibid., U. S. and Mex. Bound. Surv., II, Mam., 22, 1859.

Exceedingly numerous.

10. Ursus arctos *Linné.* Common Bear.

Ursus arctos Linné, Syst. Nat., 69, 1766. — Cuvier, Règ. Anim., I. 142, 1817. — Blainville. — Middendorff, Sibirische Reise, II, ii. 1854. — Gray, Proc. London Zoöl. Soc., 1864, 682. — Allen, Bull. Mus. Comp. Zoöl., I, 184, October, 1869.

Ursus americanus Pallas, Spicelegia Zoöl., XIV, 6, 1780. — Gmelin, Syst. Nat., I, 101, 1788. — Richardson, Faun. Bor. Amer., I, 14, 1829. — Aud. & Bach., Quad. N. Amer., III, 187, 1853. — Max. zu Wied & Mayer, Verhandl. Akad. der Naturf., XXVI, i, 33, 1857. — Baird, Mam. N. Amer., 225, 1857.

Ursus (*Euarctos*) *americanus* Gray, Proc. Lond. Zoöl. Soc. 1864, 692.

Ursus horribilis Ord, "Guthrie's Geog., 2d Amer. ed., II, 291, 299, 1815." — Say, Long's Exped., II, 53, 1823. — Baird, Mam. N. Amer. 219.

Ursus horribilis, var. *horriaceus*, Baird, U. S. & Mex. Bound. Survey, Rep., II, Mam., 24, 1859.

Ursus cinereus Desm., Mam., I, 164, 1820.

Ursus (*Danis*) *cinereus* Gray, Proc. Lond. Zöol. Soc., 1864, 690.

Ursus ferox Richardson, Faun. Bor. Amer., I, 24, 1829. — Max. zu Wied, Reise in das innere Nord Amer., I, 488, 1839. — Max. zu Wied & Mayer, Verhandl. Akad. der Naturforsch., XXVI, 39.

Ursus cinnamomeus Baird, U. S. & Mex. Bound. Survey Rep., II, Mam., 29.

* See H. W. Parker, in Amer. Nat, Vol. IV, 376, August, 1870.

Numerous and often troublesome, occasionally destroying swine, of which they are exceedingly fond. Judging from their tracks in the swamps, they must not only be exceedingly numerous, but some of them of enormous size. The several skins seen by me were all intensely black.*

CERVIDÆ.

11. Cariacus virginianus *Gray.* Virginia Deer.

Cervus virginianus Boddært, Elench. Animal., I, 136, 1784. — Gmelin, Schreber, Desmerest, Aud. & Bach., Baird, &c.
Cariacus virginianus Gray, Cat. of Bones in Brit. Mus., 266, 1862.

Abundant almost everywhere. Not so numerous along the Lower St. John's as in the more unsettled districts further south. As remarked by Professor Baird, the Florida deer are considerably smaller than those of the Northern States; so much so that it is a fact of common observation.

MANATIDÆ.

12. Trichechus manatus *Linné.* Manatee.

Trichechus manatus Linné, Syst. Nat., I, 34, 1758.
"*Manatus australis* Tilesius, Jahrb. der Naturg., I, 23." — Gray, Cat. Seals and Whales, 358, 1866. — Murray, Geog. Distr. Mam., 202, 1866.
Manatus amer' anus Desm., Mam., 507, 1822.
Manatus latirostris Harlan, Journ. Phil. Acad. Nat. Sci., III, 390, pl. xii, fig. 1-3, 1824. — Ibid., Faun. Amer., 277, 1825.

I learn from Mr. Maynard that the manatee is still quite common in Indian River, where they are often caught in nets. They come into the river at night to feed on the mangrove bushes. Mr. Maynard did not meet with them in Mosquito Lagoon, which he traversed nearly its whole length, and he thinks they do not occur there.

The manatees of America and Africa seem to be very closely allied, and to number at most but two species. Those of the same species also appear to be exceedingly variable in their osteological characters. Dr. J. E. Gray,

* In my recent paper in this Bulletin, cited above, I have discussed the mutual relationship of the numerous supposed species of land bears of the northern hemisphere. The close affinity between the bears of Northwestern America and Northeastern Asia is especially noticed; but at that time I was not aware that Temminck, in the Fauna Japonica, had referred the large land bear of Japan to the *U. ferox* of authors, or to the so-called "grizzly bear" of Western America. This indicates the very close affinity, in this author's opinion, of the Japan and American bears.

in a valuable paper entitled "On the Species of Manatees (*Manatus*), and on the Difficulty of distinguishing such Species by Osteological Characters,"* states that he finds the African and American species are distinguished by only a single character, — the absence of the nasal bones in the African species. Concerning the individual variation in the skulls of the two species, he observes as follows: "When Cuvier had a skull of the American and one of the African Manatee, he gave eight characters by which the African skull could be known from the American. Now we have a series of skulls of each kind, we find that not one of these characters will separate the skulls of the two countries from one another. Indeed, the skulls of each kind are so variable that, after having them laid out before me for two or three days, studying them every now and then, and inducing two proficients in the study of bones, and in observing minute characters, to give me their assistance, we came to the conclusion that we believed there was no character, common to all the skulls of each kind, which could be used to separate them. As a proof of the difficulty of so doing, I may state that there was one skull in the series which had been long in the collection, and had been received without any habitat, and neither of the three could decide to which of the series this skull should be referred; and it was not until I accidentally observed the character, derived from the absence of the nasal bones in the African kind, that this question could be settled."

Having myself been struck with the variability of osteological as well as external characters in individuals of the same species, in both birds and mammals, — a matter to which I have already often called attention, and the consideration of which occupies a considerable portion of Part III of the present paper, — I can hardly refrain, in this connection, from citing further the judicious remarks of Dr. Gray on this point. "The examination," he says, "of a large series of skulls of the bears (*Ursus*) and *Paradoxuri*, shows how difficult it is to distinguish species by the study of the skulls alone. Thus, when we have a series of skulls of bears from different localities, which, from their external form and habits, are known to be distinct species, it is easy to say which is the skull of *U. thibetanus*, *U. syriacus*, *U. arctos*, *U. cinereus*, and *U. americanus*, when we have the habitat marked on each; but the true test of the power of distinguishing the one from the other is to determine to what species a skull belongs, of which we have no information as to its origin; and we have several skulls in the British Museum under these circumstances, and I cannot, with the best assistance at my command, determine to which species they ought to be referred. And it is the same with the *Paradoxuri*." "If this is the case with the skulls," he continues, "how must the difficulty of distinguishing species with certainty be increased when we have only fossil bones, which are generally more or less imperfect,

*Ann. and Mag. Nat. Hist., 3d Ser., Vol. XV, pp. 130 - 139, 1865.

to examine and compare, or of which only a limited number of examples are to be obtained and compared? They [the skulls] vary in most genera much more than was expected, before series of the skulls of each species were collected and compared."

These observations by Dr. Gray are fully confirmed by my own studies; and I hence believe that, as the number of specimens of different species increases in our museums, many species now believed to be valid will be found to rest merely on individual characters.

VESPERTILIONIDÆ.

13. Lasiurus noveboracensis *Gray*. RED BAT.

Vespertilio noveboracensis ERXL., Syst. Règ. Anim., 135, 1717.
Vespertilio lasiurus GMEL., Syst. Nat., 1788.
Vespertilio rubellus PAL. DE BEAUV., Cat. Peale's Mus., 1796.
? *Vespertilio cinereus* PAL. DE BEAUV., Ibid.
? *Vespertilio pruinosus* SAY, Long's Exped., 67, 1823. — RICH., Faun. Bor. Am., I, 1, 1829.
Taphozous rufus HARLAN, Faun. Amer., 23, 1825.
Lasiurus rufus GRAY, List Mam. Brit. Mus., 32, 1842.
Lasiurus noveboracensis TOMES, Proc. Lond. Zoöl. Soc., 1857, 34.
? *Lasiurus pruinosus* TOMES, Ibid., 37.
Lasiurus noveboracensis H. ALLEN, Mon. N. Am. Bats, 15, 1864. — J. A. ALLEN, Bull. Mus. Comp. Zoöl., I, 207, 1869.
? *Lasiurus cinereus* H. ALLEN, Mon. N. Am. Bats, 21.

Common. All of the several specimens obtained, both by myself and Mr. Maynard, are of a deep cherry red, with but a slight skirting of ash, and are uniformly much darker or deeper colored than any I have seen from the Northern States. All examined (nine specimens) were males.

14. Scotophilus fuscus *H. Allen*. CAROLINA BAT.

Vespertilio fuscus PAL. DE BEAUV., Cat. Peale's Mus., 14, 1796. — LECONTE, Proc. Phil. Acad. Nat. Sci., VII, 437, 1855.
Vespertilio carolinensis GEOFF. ST. HIL., Ann. du Mus., VIII, 193, 1806, pl. xlvii, fig. 7. — HARLAN, North Am. Jour. Geol. & Nat. Sci., I, 218, 1831 — LECONTE, Proc. Phil. Acad. Nat. Sci., VII, 437.
Vespertilio arcuatus SAY, Long's Exped., 167, 1823.
Vespertilio phaiops RAF., Amer. Month. Mag., 445, 1818.
Vespertilio ursinus TEMM., Mam., II, 234, 1835.
Scotophilus fuscus H. ALLEN, Mon. N. Am. Bats, 31, 1864.
Scotophilus carolinensis H. ALLEN, Ibid., 28.

Common. Several specimens taken.

15. **Scotophilus georgianus** *H. Allen.* Georgia Bat.

Scotophilus georgianus H. Allen, Mon. N. Am. Bats, 35, 1864, *nec. syn.* — J. A. Allen, Bull. Mus. Comp. Zoöl., No. 8, 1809.

This species doubtless occurs in Florida, at least in the northern part, since the capture of specimens at different localities in Georgia and at New Orleans is on record.*

16. **Nycticejus crepuscularis** *H. Allen.*

Vespertilio crepuscularis LeConte, McMurtrie's Cuv. An. King., I, 432, 1831. Ibid., Proc. Phil. Acad. Nat. Sci., VII, 438, 1855.

Nycticejus crepuscularis H. Allen, Mon. N. Am. Bats, 12, 1864.

A specimen collected by Mr. Maynard at Jacksonville, in January, but afterwards lost, I refer from his measurements and description of it to this species. There is also a specimen (No. 731) in the Museum of Comparative Zoölogy, collected in Florida by Mr. Chas. Belknap.

17. **Corynorhinus macrotis** *H. Allen.* Big-eared Bat.

Plecotus macrotis LeConte, McMurtrie's Cuv. An. King., I, 431, 1831.

Plecotis LeContei Cooper, Ann. Lyc. Nat. Hist., IV, 12, 1837.

Synotus macrotis H. Allen, Mon. N. Am. Bats, 63, 1864.

Corynorhinus macrotis H. Allen, Proc. Phil. Acad. Nat. Sci., XVII, 173, Aug. 1865.

A specimen of this species from Micanopy, Florida, collected by Dr. Bean, is cited by Dr. Allen.† This Southern species ranges northward along the coast nearly or quite to the Middle States, it being comparatively common, according to authors, in South Carolina.

NOCTILIONIDÆ.

18. **Nyctinomus nasutus** *Tomes.*

Molossus nasutus Spix, Sim. et Vesp. Bras., 60, pl. xxxv, fig. 7, 1823.

Nyctinomus nasutus Tomes, Proc. Lond. Zoöl. Soc., 1861, 68. — H. Allen, Mon. N Am Bats, 7, 1867.

This widely distributed southern species should unquestionably be included among the mammals of Florida. It has been reported from Texas, Louisiana, South Carolina, and the West Indies,‡ as well as from South America, as far south even as Buenos Ayres.§ Specimens in

* Dr. H. Allen, Monograph of North American Bats, p. 38.

† Ibid., p. 55.

‡ Ibid., p. 10.

§ Tomes, Proc. Lond. Zoöl. Soc., 1861, p. 68.

the Museum of Comparative Zoölogy from Hayti, collected by Mr. P. R. Uhler, have been identified by Dr. Harrison Allen as of this species.

19. Megadermatidæ *Sp.?*

A large species of bat was noticed by both Mr. Maynard and myself, but as it always flew very high, neither of us obtained it. It was very much larger than any other species yet described from the United States, and is doubtless a West Indian form; probably a species of *Megadermatidæ*.

SORECIDÆ.

20. Blarina brevicauda *Baird.* MOLE SHREW.

Sorex brevicaudus SAY, Long's Exped., I, 164, 1862-63.
Sorex parvus SAY, Ibid., 164.
Sorex talpoides GAPPER, Zoöl. Journ., V, 208, pl. viii, 1830.
Sorex carolinensis BACH., Journ. Phil. Acad. Nat. Sci., VII, 366, pl. xxvi, fig. 3, 1837.
Sorex cinereus BACH., Ibid., 373, fig. 3.
Sorex Dekayi BACH., Ibid., 377, fig. 4.
Corsira (Blarina) talpoides GRAY, Proc. Lond. Zoöl. Soc., V, 124, 1837.
Blarina brevicauda BAIRD, Mam. N. Am., 42, pl. xxx, fig 6, 185⁷.— ALLEN, Bull. Mus. Comp. Zoöl., I, 212, October, 1869.
Blarina talpoides BAIRD, Mam. N. Am., 37, pl. xxx, fig 5.
Blarina carolinensis BAIRD, Ibid., 45, pl. xxx, fig. 8.
Blarina cinerea BAIRD, Ibid., 48, pl. xxx, figs. 9 and 10, young.
Blarina exilipes BAIRD, Ibid., 51, pl. xxviii, young.
Blarina Berlandieri BAIRD, Ibid., 53, pl. xxviii, young.

A single specimen of *Blarina* from Indian River, Florida, collected by Mr. G. Wurdemann, is mentioned under "*Blarina cinerea*," by Professor Baird, as having been received at the Smithsonian Institution.* While it may be of a species distinct from *B. brevicauda*, it seems more probable that it is the young of that species, as I have elsewhere stated.† *Sorex cinereus* of Bachman,‡ which Professor Baird cites as a synonyme of his *Blarina cinerea*, Dr. Bachman subsequently regarded as the young of his *S. carolinensis*,§ which is the same as *B. talpoides et brevicauda* of recent writers.

* North American Mammals, p. 50.
† Bull. Mus. Com. Zoöl., Vol. I, No. 8, p. 212.
‡ Journ. Phil. Acad. Nat. Sci., Vol. VII, 1837, p. 373, pl. xxiii, fig. 3.
§ Quadrupeds of North America, Vol. III, p. 344.

TALPIDÆ.

21. Scalops aquaticus *Fischer*. SHREW MOLE.

Several specimens of this species from Indian River and Jacksonville, Florida, are mentioned by Professor Baird in his list of the specimens of this species in the Museum of the Smithsonian Institution, in his Report on North American Mammals. Mr. Boardman has also informed me that it is not uncommon there.

SCIURIDÆ.

22. Sciurus niger *Linné*. SOUTHERN FOX SQUIRREL.

Sciurus niger LINNÉ, Syst. Nat., I, 64, 1758.
Sciurus vulpinus GMEL., Syst. Nat., I, 147, 1788
Sciurus vulpinus et syn. BAIRD, Mam. N. Am., 246, 1857.

Common. Confined chiefly to the pine woods. Extremely variable in general color, the variations in this respect ranging from pale yellowish gray to black. The specific name *niger* of Linné is the one which has unquestionably the priority, as observed by Professor Baird, and its applying only to a single stage of coloration, inasmuch as it is a common one, does not seem to be sufficient reason for rejecting it, since it is as applicable as any name referring to its color can be, and is not likely to seriously mislead.*

23. Sciurus carolinensis *Gmelin*. GRAY SQUIRREL.

Sciurus carolinensis GMEL., Syst. Nat., I, 143, 1788. — BAIRD, Mam. N. Am., 256, 1857.
" *Sciurus cinereus* SCHREBER, Säugeth., IV, 766, pl. ccxiii, 1792."
Sciurus niger GODMAN, Am. Nat. Hist., II, 133, 1826.
Sciurus leucotis GAPPER, Zoöl. Journ., V, 206, pl. xxi, 1830.

Exceedingly abundant, and generally very tame. Two of my party shot a dozen one evening in less than half an hour at Hawkinsville. They are considerably smaller than at the North, and also differ somewhat in color from northern specimens, the gray being more suffused with brownish than in the gray northern type.

The fifty or sixty specimens carefully examined were quite uniform in color and generally so in size. The yellowish-brown patch on the back usually present in the gray type of this species was of greater extent and less distinctly defined than in northern examples. No

* See Baird, North American Mammals, p. 248.

dusky or black varieties were noticed, nor could I learn that they existed here. Their voice is not so heavy as that of the northern animal, but in no other respects than in those above mentioned do they differ from it. Professor Baird has quite fully described the gradual transition from the common gray to the glossy black type of coloration seen at the North, where the dark varieties are most common.*

Measurements of Florida Specimens.

M. C. Z No.	Original No.	Sex.	Locality.	Date.	Collected by	Total Length.	Nose to Occiput	Nose to Tail.	Tail to end of Vertebræ	Tail to end of Hairs.	Length of Fore Foot	Length of Hind Foot
2455	203	♂	Jacksonv'l	Jan. 12	C.J.Maynard	20.00	2.50	9.00	8.00	11.00	2.00	2.45
2454	206	♀	"	" 10	"	18.20	2.40	9.00	7.75	10.45	1 35	2.35
2453	207	♀	"	" 12	"	17.75	2.45	8.45	7.50	10.25	1.45	2.45
2040	351	♀	"	" 25	J. A. Allen	19.50	—	9.50	7.50	10 00	—	—
2041	352	♂	"	" 25	"	20.50	—	10.50	7.50	10.00	—	—
	221	♀	Dummitt's	Mar.16	C.J.Maynard	20.00	2.45	9 50	8.15	10.50	1.60	2.56
	222	♂	"	" 18	"	18.56	2.55	10.20	8.00	10.56	1.35	2 40
2054	365	♂	Welaka	Feb. 6	J. A. Allen	21.00	—	10.00	8.25	11.00	—	—
2055	366	♀	"	"	"	21.50	—	10.00	8.75	11.50	—	—
2056	367	♂	"	"	"	19.00	—	10.00	8.40	9.00	—	—
2057	368	♂	"	"	"	19 00	—	9.00	7.50	10.00	—	—
2058	369	♀	"	"	"	19.00	—	9.15	7.60	9.85	—	—
2059	370	♂	"	"	"	21.50	—	10.15	9.60	11.35	—	—
2066	377	♂	Hawkinsv'l	Mar.12	"	19.50	2.40	9.50	8 00	10.50	1.50	2.15
2067	378	♀	"	"	"	19.50	2.42	9 25	8.00	9.25	1.60	2.23
	379	♀	"	"	"	19.25	2 33	8.25	8.75	11.00	1.35	2.22
	380	♀	"	"	"	20 00	2 50	9.25	8 00	9.75	1.40	2.20
	381	♀	"	"	"	18.75	2.45	8.75	7.60	10.00	1.50	2.25
2068	382	♂	"	"	"	19.50	2.35	8.90	7.80	10.60	1.50	2.05
	384	♂	"	"	"	19.00	2.45	9.00	7.60	10.00	1.50	2.25
	385	♂	"	"	"	18.50	2.30	9.50	6.75	9.00	1.40	2.20
	386	♀	"	"	"	18.50	2 35	8.50	8.00	10.00	1.40	2.15
	387	♂	"	"	"	19.75	2.45	9.00	8.50	10.75	1.45	2 20
	388	♂	"	"	"	20.50	2.50	10 00	8.00	10.50	1.45	2.37
	389	♂	"	"	"	19.75	2.35	8.75	8.00	11.00	1.42	2.25
	390	♂	"	"	"	19.25	2.40	9.00	8.00	10.25	1.45	2.22
	391	♂	"	"	"	19.00	2 35	9.25	7.65	9.75	1.40	2.30
	392	♂	"	"	"	18.50	2.40	9.00	7 50	9.50	1.45	2.32
	393	♂	"	"	"	19.25	2.40	9.15	7.85	10.10	1.45	2.22
	394	♀	"	"	"	20.00	2.38	9.25	8.15	10.75	1.45	2.20
	395	♂	"	"	"	19.50	2.40	9.00	7.90	10.50	1 50	2.40
	396	♂	"	"	"	20.00	2.50	9.75	8.15	10.25	1.55	2.35
	397	♂	"	"	"	19.25	2.40	9.00	7.75	10.25	1.40	2 30
	398	♂	"	"	"	18.35	2.40	8.75	7.95	9.60	1.55	2.20
	399	♀	"	"	"	20.50	2.50	10.15	7.85	10 35	1.65	2.45
	400	♂	"	"	"	19.00	2 40	8.90	7.35	10.10	1.60	2.15

* N. Am. Mam., p. 259. See further on this point my remarks on this species in No. 8 of the first volume of this Bulletin, already cited.

24. **Geomys pineti** *Rafinesque.* "SALAMANDER."

Geomys pinetis RAF., Amer. Month. Mag., II, 45, 1817.
Pseudostoma floridana AUD. & BACH., Quad. N. Am., III, 242, pl. cl, fig. 1, 1853.

Common, but mainly confined to the drier portions of the pine woods. The five specimens collected by me differ very much in size, and considerably in color, some of them being plumbeous and others brownish-plumbeous; in other words, some are much darker than others. The difference in size appears to be mainly due to age. This species extends southwards at least as far as Lake Harney, and at some localities is particularly numerous, the little hillocks of earth it throws up sometimes nearly covering the ground.

MURIDÆ.

25. **Mus decumanus** *Pallas.* BROWN RAT.

Abundant at Jacksonville, but not observed by any of my party on the Upper St. John's, nor by Mr. Maynard on Indian River.

Although no other species of *Mus* was observed, it is not improbable that the common mouse (*M. musculus*) occurs in the vicinity of the towns. It was not found on the Upper St. John's (to which locality it probably has not yet extended), where the common house mice are a species of *Hesperomys*, as are also the house mice on Indian River, according to Mr. Maynard. Neither was any species of *Reithrodon* obtained. The *R. humilis*, which occurs in Georgia and South Carolina, is certainly to be expected in Northern Florida; but it has not yet to my knowledge been reported from there.

26. **Hesperomys leucopus** *Wagner.* WHITE-FOOTED MOUSE.

Mus sylvaticus, var. ERXL., Syst. Reg. An., I, 390, 1775.
Mus leucopus DESM., Mam., II, 307, 1822. — AUD. & BACH., Quad. N. Am., I, 300, pl. xlvi, 1849.
Mus agrarius GODMAN, Am. Nat. Hist., II, 1826.
Mus noveboracensis SELYS-LONGCH., Étude Micromam., 67, 1839.
Mus Emmonsii DEKAY, Emmon's Rep. Quad. Mass., 61, 1840.
Cricetus myoides GAPPER, Zoöl. Journ., 1830, 204.
Hesperomys polionotus WAGNER, Wiegm. Arch., 1843, ii, 52.
? *Hesperomys cognatus* LECONTE, Proc. Phil. Acad. Nat. Sci., VI, 442, 1852.
Hesperomys leucopus LECONTE, Ibid., 413. — BAIRD, Mam. N. Am., 459, 1857. — ALLEN, Bull. Mus. Comp. Zoöl., I, 227, October, 1869.
Hesperomys myoides BAIRD, Mam. N. Am., 472.
Hesperomys indianus MAX. ZU WIED., Arch. für Naturg., XXVIII, i, 111, 1862.

A mouse provisionally referred to this species was abundant, especially at certain localities. At my first camp, about twenty-five miles above Jacksonville (near Hibernia), an *Hesperomys* and the wood rat (*Neotoma floridana*) were excessively numerous. At evening they began scampering over the leaves, their little footsteps being heard in every direction ; at times they approached so near the camp-fire as to be distinctly seen. They ascended the bushes, and could be heard on the lower branches of the trees. Some of my party being unaccustomed to such manifestations of nocturnal life, were at first filled with apprehension as to the character of their visitors, and could scarcely be convinced that the place was not infested with poisonous snakes or other dangerous animals. Depending upon my traps for specimens, which unfortunately for me the mice avoided, I secured but two or three examples of the *Hesperomys* so abundant here. These, with several others obtained by me elsewhere, as also others obtained on Indian River by Mr. Maynard, including both young and adult, are undistinguishable from the common *H. leucopus* of the North, the young being deep plumbeous.

I observed at this place a fact in respect to the habits of the *Hesperomys* I had not previously noticed nor seen pointed out, though it was noticed in all the parts of Florida I visited. I refer to its habit of cutting off the branches and main stems of the young saplings. I at first supposed this work to be that of the wood-boring larvæ of some coleopterous insect, so nearly did the "pruning" resemble that of the so-called "oak-pruners" (*Cerambycidæ* sp.). A closer examination, however, showed that, instead of the twigs being smoothly cut, as by a boring insect working from within outwards and severing the bark last, the cutting was begun from without, and that a considerable portion of wood had been gnawed away, both the cut surfaces being highest at the middle. Marks of the teeth of these little gnawers were also generally clearly distinguishable. No traces of boring by insect larvæ could be detected near the severed point. The branches thus cut are generally of about the size of one's finger, and are usually the main stem of a young sapling. Various species of trees are thus mutilated ; but as they are usually destitute of fruit, the purpose of these animals in this work is not apparent. It is a habit that may be common to the *Hesperomys* of the North, but I have never seen it referred to. These little animals being a hundred-fold more numerous in East Florida than they generally are in the Northern States, their work would here be of course much more noticeable.

27. **Hesperomys aureolus** *Wagner*. GOLDEN MOUSE.

Arvicola Nuttalli HARLAN, Month. Amer. Journ. Geol. &. Nat. Sci., I, 446, 1842. — IBID., Med. & Phys. Researches, 55, pl. ——, 1835.
Mus (Calomys) aureolus AUD. & BACH., Journ. Phil. Acad. Nat. Sci., VIII, 302, 1842. — AUD. & BACH., Quad. N. Am., II, 305, pl. xcv, 1851.
Hesperomys aureolus WAGNER, Wieg. Archiv, 1843, ii, 51.
Hesperomys Nuttalli BAIRD, Mam. N. Am., 467, 1857.

A single specimen which I refer to this so-called species was obtained by Mr. Maynard at Dummitt's. While this example is of the size and general proportions of *H. leucopus*, it is markedly different in color, being of a bright golden yellow above, which color reaches on the outside of the legs to the feet; the under surface has also a yellowish wash. It also differs in the texture of its fur, which is remarkably soft and fine. It is a little lighter colored than Audubon and Bachman's description and figure of *H. aureolus* represent that animal to be, but the distribution of the colors is the same, the specimen in question being not orange, but bright yellowish-cinnamon. It is, however, much nearer this than to Dr. Harlan's *Arvicola Nuttalli*. The latter does not differ very appreciably, judging from Dr. Harlan's very unsatisfactory description and his wretched figure of it, which was evidently made from a badly stuffed skin. Mr. Maynard believes the specimen referred to above to be a young animal, and states that it was so regarded by the people in whose house it was caught. He further informs me that he captured another of the same color, but very much larger, which was lost. This he regards as merely the adult of the same species. His measurements show the latter to have agreed in size and proportions with the so-called *H. gossypinus*. The texture of the fur of the small specimen above referred to agrees with that of the plumbeous, immature stage of *H. leucopus*. This form, whether a valid species or not,* is now known to occur in Southeastern Pennsylvania, Southern Illinois, Georgia, Florida, Mississippi, Missouri, and at several intermediate points.

28. **Hesperomys gossypinus** *LeConte*. COTTON MOUSE.

Hesperomys gossypinus LECONTE, Proc. Phil. Acad. Nat. Sci., VI, 411, 1853. — BAIRD, Mam. N. Am., 469, 1857.

* This and the following species are only provisionally adopted. See a previous number of this Bulletin (Vol. I., No. 8, p. 227) for a fuller expression of my views as to the number of North American species of this group, and their mutual affinities.

Several specimens were obtained, corresponding in size and color with what LeConte and Baird have described under this name. It is apparently common. As I have previously stated elsewhere,* these Florida specimens have well-developed cheek-pouches.

The specimens in question are rather larger than any examples of *H. leucopus* I have seen from the Northern States, they agreeing very well in measurements with the two specimens cited by Professor Baird.† The large size of these specimens, conjoined with their southern habitat, would seem at first to clearly indicate their being distinct from *H. leucopus*, as they are at least one third larger than the average size of the latter at the North. Professor Baird in speaking of this species observes: "There is every reason to consider this mouse as specifically distinct from *H. leucopus* of the North; although skins, when much stretched (as Nos. 1105, 1112, from Middleboro', Massachusetts), of the latter, may measure as much as those recorded here, yet they are certainly actually smaller, as shown by the feet, which never attain anything of the length of .45 for the anterior and .90 for the posterior." But he is "hardly satisfied," he adds, "that this animal is different from the smaller *H. leucopus*, as the difference in size is no greater than is to be seen in a series of *Hesperomys* from more northern localities. The tail is duskier beneath than in *H. cognatus*, and the sides more rusty; otherwise I can realize only the larger size. Should both [*H. cognatus* and *H. gossypinus*] prove to be the same, the name *H. gossypinus* must of course take precedence."

As already observed, the prevailing form of the *Hesperomys* of East Florida is not essentially different from a large proportion of the *H. leucopus* of the North, either in measurements, proportions, or color, although it is unmistakably referable to the so-called *H. cognatus*, which has been supposed to replace in the Southern Atlantic and Gulf States the *H. leucopus* of the more northern ones. If, as I have elsewhere suggested (*loc. cit.*), as Professor Baird admits may be, and as the facts seem to indicate, *H. gossypinus* is inseparable from *H. cognatus*, and the latter being most unquestionably referable to *H. leucopus*, it would seem that *H. gossypinus* must also be referred to the *H. leucopus*.

Respecting the variations in this species and the affinities of the *H. gossypinus*, Audubon and Bachman observe as follows: "That a species so widely distributed and subject to so many variations in size, length of tail, and color, should have been often described under different names is not surprising. We have ourselves often been in a state of doubt on obtaining some striking variety. The name *Hypudæus gossypinus* of our

* Bulletin Mus. Comp. Zoöl., Vol. I, No. 8, p. 229, 1869.

† Mam. N. Am., p. 469.

friend Major LeConte (see Appendix to McMurtrie's translation of Cuv. An. Kingd., Vol. I, p. 434) was intended for this species, as it is found in the Southern States. We were for several years disposed to regard it as distinct, and have, not without much hesitation, and after an examination of many hundred specimens, been induced to set it down as a variety only." These authors also remark that they are considerably larger in the Carolinas than in the Eastern States.*

29. **Hesperomys palustris** *Wagner.* RICE-FIELD MOUSE.

Mus palustris HARLAN, Am. Journ. Sci., XXXI, 386, 1837.
"*Hesperomys palustris* WAGNER, Supplem. Schreb. Säugeth., III, 543, 1843."
Hesperomys (*Oryzomys*) *palustris* BAIRD, Mam. N. Am., 482, 1857.
Arvicola oryzivora AUD. & BACH., Quad. N. Am., III, 214, pl. cxliv, fig. 3, 1857.

No specimens of this species were obtained by either Mr. Maynard or myself. Its habitat is usually given as South Carolina and Georgia, but Audubon and Bachman state: "The late Dr. Leitner brought us a specimen obtained in the Everglades of Florida." † It in all probability occurs also in East Florida. The above-mentioned authors give it as somewhat common in the salt-marshes near Savannah and Charleston. Professor Baird has received it from Columbus and St. Simon's Island, Georgia, and Society Hill, South Carolina.

30. **Neotoma floridana** *Say & Ord.* WOOD RAT.

Mus floridanus ORD, Bull. Soc. Philom., 1818, 181. — SAY, Long's Exped., I, 54, 1823.
Arvicola floridana HARLAN, Faun. Amer., 141, 1825.
Neotoma floridana SAY & ORD, Journ. Phil. Acad. Nat. Sci., IV, ii, 352, 1825. — BAIRD, Mam. N. Am., 487, 1857.

I found this species very abundant on the Lower St. John's, especially around Jacksonville and Hibernia, but I did not meet with it above Lake George. The old residents about Hawkinsville seemed wholly unacquainted with it. Mr. Maynard also failed to meet with it on Indian River. It hence appears probable that it may not occur very frequently in the southern part of the peninsula. Professor Baird, however, has recorded a specimen from "Indian River, Fla.," collected by Dr. Wurdemann.

The present usual northward range of this species does not appear to extend beyond North Carolina; but Professor Baird, writing in 1857,‡

* Quad. N. Amer., Vol. I, pp. 301, 305.
† Ibid., Vol. III, p. 216.
‡ Mam. N. Am., p. 489.

remarks: "A few specimens of unusually large size were captured some years ago by J. G. Bell, near Piermont, on the Hudson River, but I have not heard of any in intermediate localities [New York and Society Hill, South Carolina]." Mr. George Gibbes states that he "caught a specimen, many years ago, in Massachusetts." * Audubon and Bachman remark that specimens of it have been obtained in North Carolina, and that they had "observed a few nests in the valleys of the Virginia mountains," and that they had "somewhere heard it stated that one or two had been captured as far to the north as Maryland." †

31. **Sigmodon hispidus** *Say & Ord.* Cotton Rat.

Arvicola hispidus Godman, Am. Nat. Hist., II, 68, 1826.
Arvicola hortensis Harlan, Faun. Am., 138, 1825.
Arvicola ferrugineus Harlan, Am. Journ. Sci., X, 285, 1826.
Sigmodon hispidum Say & Ord, Journ. Phil. Acad. Nat. Sci., IV, ii, 354, pl. x, figs. 5–8, 1825. — Baird, N. Am. Mam., 503, 1857.
Sigmodon Berlandieri Baird, Proc. Phil. Acad. Nat. Sci., VII, 333, 1855. — Ibid., N. Am. Mam., 504.

Abundant throughout the country along the St. John's River, and also on Indian River, whence Mr. Maynard brought fifteen specimens. They are quite a pest to the farmers, who often successfully resort to poison to reduce their numbers. By scattering grain poisoned with strychnine about their fields they are able to destroy hundreds with slight trouble. Different specimens vary considerably in color, from gray through yellowish-brown to rufous. The so-called *Sigmodon Berlandieri*, from Texas and New Mexico, seems undistinguishable from *S. hispidus*.

In its general economy, the cotton rat represents the *Arvicolæ* of the North, especially *A. riparius*.

Concerning *S. Berlandieri*, Professor Baird remarks: "This species is readily distinguishable from *S. hispidus* by the much lighter color above, where it is grayish-yellow brown instead of distinct reddish-brown; the tail is considerably longer and covered by finer annuli. The toes are shorter, and the metatarsus shorter, while the feet are nearly the same length. The claws, however, are much weaker." The tail in this species is said to be "equal to or longer than the trunk"; the "color above grayish-yellow brown, lined with black"; while *S. hispidus* is said to have the

* Nat. Hist. Wash. Terr., Zoöl., p. 128, 1860.

† Quad. N. Am., Vol. I, p. 36.

tail "less than the trunk," and "the color above reddish brown, lined with very dark brown." The specimens from Florida examined by me are mainly of the gray type, and hence like *S. Berlandieri*, but some were decidedly rufous, or like *S. hispidus*. In "Mammals of North America' measurements of specimens of the so-called *S. Berlandieri* are given, and of twelve of *S. hispidus*. In the latter the length of the tail to the length of the trunk is as 69 to 100; in the former (*S. Berlandieri*) as 63 to 100! It hence appears from Professor Baird's own measurements that the *S. Berlandieri* is far from having the tail relatively the longer. The other distinctions are based on too few specimens to have much value, since individual variations of the same character are common.

32. **Arvicola pinetorum** *Le Conte.* PINE MOUSE.

Psammomys pinetorum LECONTE, Ann. N. Y. Lyceum Nat. Hist., III, 132, pl. ii, 1829.

Arvicola scalopsoides AUD. & BACH., Journ. Phil. Acad. Nat. Sci., VIII, 299, 1842.

Arvicola pinetorum AUD. & BACH., Quad. N. Am., II, 216, pl. lxxx, 1851.

Arvicola (Pitymys) pinetorum BAIRD, N. Am. Mam., 544, 1857.

Included on the authority of Audubon and Bachman, who state that they had received it from Florida, Alabama, Mississippi, and Georgia. Professor Baird also cites specimens from Georgia and Louisiana. This is the most southern of the *Arvicolæ*, and the only one, except *A. austerus*, whose habitat includes the Gulf States.

LEPORIDÆ.

33. **Lepus sylvaticus** *Bach.* GRAY RABBIT.

Lepus americanus DESM., Mam., II, 351, 1822. — HARLAN, Faun. Amer., 193, 1825.

Lepus sylvaticus BACH., Journ. Phil. Acad. Nat. Sci., VII, 1837. — WATERH., Nat. Hist. Mam., II, 116, 1848. — AUD. & BACH., Quad. N. Am., I, 173, pl. xxii, 1849. — BAIRD, Mam. N. Am., 597, 1857.

Abundant. Mr. Maynard obtained a specimen but a few weeks old, at Dummitt's, as early as the 16th of February.

34. **Lepus palustris** *Bachman.* MARSH RABBIT.

Lepus palustris BACH., Journ. Phil. Acad. Nat. Sci., VII, 194, 336, pl. xv, xvi, 1837; Ibid., VIII, 79, 1839. — AUD. & BACH., Quad. N. Am., I, 151, pl. xviii, 1849. — BAIRD, Mam. N. Am., 615, 1857. — COUES, Proc. Bost. Soc. Nat. Hist., XIII, 86, 1869.

Common, especially on the Lower St. John's.*

* See on the habits and anatomy of this species a paper by Dr. Elliott Coues, Proceed. Bost. Soc. Nat. Hist., Vol. XIII, pp. 86 - 101, June, 1869.

DIDELPHIDÆ.

35. Didelphys virginiana *Shaw*. OPOSSUM.

Didelphys virginiana SHAW, Gen. Zoöl., I, 473, pl. cvii, 1800. — DESMAREST, HARLAN, TEMMINCK, WATERHOUSE, BAIRD, and most other authors.

? "*Didelphys marsupialis* SCHREB., Säugeth., III, pl. cxlv, 1778."

Didelphys californica BENNETT, Proc. Lond. Zoöl. Soc., I, 40, 1833. — Also WAGNER, WATERHOUSE, AUD. & BACH. (from Bennett). — BAIRD, Mam. N. Am., 233, 1857. — BAIRD, U. S. & Mex. Bound. Surv. Rep., II, Zoöl., 32, 1859.

Didelphys breviceps BENNETT, Proc. Lond. Zoöl. Soc., I, 40, 1833. — WATERHOUSE, Nat. Hist. Mam., I, 477, 1846 (from Bennett ?). — AUD. & BACH., Quad. N. Am., III, 330, 1851 (from Bennett).

Didelphys pruinosus WAGNER, Wiegmann's Archiv, 1842, 358. — WATERHOUSE, Nat. Hist. Mam., I, 477, 1846, (from Wagner).

Abundant.

This species is quite variable in its color-markings, and remarkably so in many other features, especially in the length and size of the nose, and in the size and proportions of the skull, even in specimens from the same locality.* Slight and quite inconstant differences also occur between examples from the Southern States, Texas, Mexico, and California. It would, in fact, be quite unusual if specimens of any species ranging so widely should not be found to differ somewhat at localities so widely separated. Two supposed species of North American *Didelphys* described by Mr. Bennett, as cited above, have been quoted by numerous other authors, and by them currently adopted, without apparently an examination of their merits. Professor Baird, rejecting one of them, has endeavored to separate the opossums occurring west of the Mississippi valley from those living farther eastward, designating the western one as *D. californica*. The distinctions claimed are somewhat similar to those urged as distinguishing the so-called *Procyon Hernandezii* of the western half of the continent from the *P. lotor* of the Atlantic States. They are equally slight and unsatisfactory, and at most mark but a geographical race, so intimately allied to and intergrading with the better-known eastern form that the point at which the one supplants the other is thus far undetermined. The *Didelphys breviceps* of Bennett was founded on a single specimen from California, which differed from the so-called *D. californica* only in having a relatively shorter head.

* Since writing the above I have been incidentally informed by Dr. Coues that, in preparing his memoir on the anatomy of *Didelphys virginiana* (now publishing in the Mem. of the Bost. Soc. Nat. Hist., Vol. II, Pt. I), he had occasion to examine a large number of specimens, and that he found the variation in size and proportions to amount to nearly twenty per cent.

PART III.

On Individual and Geographical Variation among Birds, considered in respect to its bearing upon the Value of certain assumed Specific Characters.

A systematic investigation of the extent and character of individual variation in birds seems not to have hitherto been attempted; in fact, few collections exist that furnish the material necessary to such a work. In occasional instances considerable differences between individuals of the same species, other than those that result from age and sex, have, however, already been pointed out, but these instances seem to have been generally, but improperly, regarded as exceptional cases.

The collection of birds in the Museum of Comparative Zoölogy now offers unusual facilities for a general investigation of this subject, most of the common species of Eastern North America being each represented by fifty to one hundred and fifty or more specimens. The greater part of them having been collected in Southern New England, and a large proportion in Eastern Massachusetts, they are the more valuable for this purpose, from their having been collected essentially from the same locality. The examination of this material has disclosed a hitherto unsuspected range of purely individual differentiation in every species thus far studied. At the same time regard has been had to the more obscure seasonal variations in color, and to the general differences that depend upon age, including such as result from senility as well as from immaturity. Local or geographical variations have likewise been carefully considered, with results that a short time since were unsuspected. These several lines of investigation have shown that in many instances what have been regarded as reliable characteristics of species have in not a few cases really little or no value; that the importance of many diagnostic features has been too highly estimated, and that consequently a careful revision of our published faunæ will be necessary for the elimination of the merely nominal species. In the following pages many of the data which have led to these conclusions will be presented.

Individual variation not only affects color and size, but the proportions of different parts, as the relative size and form of the wings, tail, bill, toes, and tarsi, including the skeleton as well as the external organs;

of the soft parts no account can as yet be given. Geographical variation has an equally universal range, but is most strikingly exhibited in the color, in size, and in the form of the bill. Individual variation will be first considered, and subsequently geographical variation. In each case each prominent phase of variation will be more or less fully described.

1. Individual Variation.

Individual Variation in Color. — In birds of whatever age, two lines of variation from the average or medium type of coloration are readily distinguishable, the variation depending essentially on differences in the depth or intensity of the general tint. On the one hand, individual variation in color results from a greater than the average amount of coloring matter in the integuments ; on the other hand, from an amount less than the average amount. The difference in this respect between the extremes of a series of fifty or one hundred specimens of any species, collected in course at a single locality, and nearly at the same season of the year, is often as great as occurs between truly distinct species. But the difference is here solely one of *intensity of color*, while in allied species there is almost always an appreciable variation in the *style of coloration*. In individual variation the differences usually extend alike to all parts of the integuments ; that is, if the plumage of the upper surface of the body is brighter or paler than usual, the same difference extends to the plumage of the lower surface of the body, and also to the bill and the feet. This is noticeable not only in species that have the color in uniform masses, differing in tint on different regions of the body, as in the robin (*Turdus migratorius*), the bluebird (*Sialia sialis*), the Maryland yellow-throat (*Geothlypis trichas*), the mocking-bird (*Mimus polyglottus*), and species generally of that type of coloration, but also in spotted birds, as in the various spotted species of *Fringillidæ*, *Turdus*, *Dendrœca*, etc., where the plumage on certain regions of the body is marked with numerous streaks and spots differing from the ground color, in which case the intensity of the color of the markings correllates in its variations with that of the ground color. Closely allied species, on the contrary, usually vary more or less, not only in respect to the ground color, but also to a greater or less degree in the style of the markings. In illustration of this point the familiar group of the small, spotted-breasted wood-thrushes of Eastern

North America — the group *Hylocichla* of Professor Baird — may be taken. Three of these species (*Turdus fuscescens*, *T. Swainsoni*, and *T. Pallasi*) are so closely related that for many years they were variously confounded with each other by almost all who wrote of them, one of them not being clearly recognized as distinct from the others till thus established by Dr. T. M. Brewer,* in 1844, and also at about the same time by Mr. J. P. Giraud,† each apparently independently of the other. Yet they are so distinct that there seems to be not the slightest excuse for again confounding them. While they all agree so closely in general size, in form, and in proportions, that a series of detailed measurements of many specimens of each species gives in the average no constant differences in any of these particulars, each differs from the other radically and constantly in style of coloration, and somewhat in general tints, in habitat, nidification, habits and song. Two of these species (*T. fuscescens* and *T. Swainsoni*) agree in the *style* of the coloration of the dorsal surface, but differ so much in the *color* of this part, that this character alone is always sufficient to separate them, while a still wider difference is seen in the color and markings of the ventral surface, a glance at this part of *T. fuscescens* being sufficient to invariably distinguish it from either of its above-named allies. The third species (*T. Pallasi*) differs markedly from both the other two in the style of coloration of the *dorsal surface*, the rump and tail being conspicuously different in color from the anterior part of the body, whilst the others exhibit no contrast of color between these regions. But the under surface of *T. Swainsoni* is so like that of *T. Pallasi* that frequently specimens cannot readily be referred to the one species rather than to the other from a view of this surface alone. This group serves as a fair general illustration of the kind of variation in color usually seen in closely allied species, but there occur occasional exceptions, where a difference in the relative proportions of different parts, or a wide difference in size, is the prominent specific distinction, the smaller species, so far as color is concerned, being a diminutive representative of the larger.

Taking the present group of *Hylocichla* (for reasons that will appear hereafter ‡) as a group illustrative also of individual variation, it is found that the differences in color in different individuals of either species

* Proc. Boston Soc. Nat. Hist., Vol. I, p. 191, July, 1844.

† Birds of Long Island, p. 91, 1843 - 44.

‡ See the remarks on these species in Part IV.

results from the amount of rufous pervading the plumage. Individuals of *Turdus Swainsoni* of the rufous or bright-colored type have the dorsal surface of a uniform brownish-olivaceous tint, and the sides of the head and breast strongly suffused with yellowish-brown, which tint is also traceable throughout the lower plumage, in the brighter color of the basal brownish band on the inside of the wings, and in the color of the mouth and base of the bill. In other individuals the upper plumage is of a dark olivaceous tint, without any trace of brownish, the sides of the head, neck, and breast being ashen, with often no appreciable tinge of ferruginous; specimens of this type thus differing widely in general aspect from those of the other. Between these extremes, of which examples are not unfrequent, nor confined to any particular locality or season of the year, there is every degree of intergradation, specimens intermediate between the two being by far the most frequent, and constituting the average or common form.

Turdus Pallasi and *Turdus fuscescens* present precisely similar variations. They are also seen in *Turdus mustelinus*, in *Turdus migratorius*, in *Sialia sialis*, in *Seiurus noveboracensis*, in many species of *Dendrœca*, sparrows, and other species which I have especially investigated in reference to this point, embracing examples of all the leading families of birds. The ruffed grouse (*Bonasa umbellus*), as is well known, varies in the color of the upper parts from reddish-brown to gray; the great horned owl (*Bubo virginianus*) from dusky through numerous shades of rufous and fulvous to nearly white, the fulvous suffusion so commonly present in this species varying from ferruginous on the one extreme to its complete obsolescence on the other. In such common and thoroughly known species as the robin, blue-bird, etc., the true character of these variations is recognized, but in groups where the species are not well known, and especially in specimens from partially explored regions, they are frequently regarded as of specific value, and the addition of numerous nominal species is the result.

Besides the variation in the *depth* of color already noticed, birds having the plumage varied with streaks and spots differ exceedingly in different individuals of the same species in respect to the size, shape, and number of these marks, and in the general aspect of the plumage resulting from such variations. Generally, as already stated, such differences correllate with the variations in the intensity of the ground color, the darker or more deeply colored birds being usually those with the markings largest and brightest. A wide range of variation in this respect is seen in all birds which have the breast and lower plumage marked with dark streaks and spots on a lighter ground, or that have the whole plumage streaked. In the common song sparrow (*Melospiza melodia*), the fox-colored sparrow (*Passerella iliaca*), the swamp sparrow (*Melospiza palustris*), the black and white creeper (*Mniotilta varia*), the water wagtail (*Seiurus noveboracensis*), in *Turdus fuscescens* and its allies, etc., the difference in the size of the streaks is often very considerable. In the song sparrow they vary to such an extent that in some cases * they are reduced to narrow lines; in others so enlarged as to cover the greater part of the breast and sides of the body, sometimes uniting on the middle of the breast into a nearly continuous patch. Variation in this respect is equally great in the fox-colored sparrow and in the grass finch (*Poocætes gramineus*). Massachusetts specimens of the savanna sparrow (*Passerculus savanna* auct.) also present variations exactly parallel with those of the song sparrow. Yet these differences, with other variations to be hereafter mentioned,† have been regarded, as in the case of *Passerculus savanna*, as of specific value. Similar variations in the *Hylocichla* group are very marked, as in *Turdus* (*Hylocichla*) *fuscescens* especially. In some specimens of this species the colors are on all parts not only very pale, but the markings on the breast are reduced to indistinct narrow lines; in others, in which the general color of the plumage is darker, the markings on the breast are dark, broad, and triangular. Two specimens taken in Cambridge the same day (early in May), both of which are males, exhibit these extremes. Average male specimens of the black and white creeper (*Mniotilta varia*), in which the plumage is varied with longitudinal black and white streaks, have the black streaks about a third broader than the white ones; but other specimens occur in which the white ones are equal to and even broader than the black ones; others have the black streaks so much broader than they usually are, — the white ones of course being proportionally reduced, — that the general aspect of the plumage at a short distance is nearly black. The difference between these two extremes is strikingly great. Yet similar variations, scarcely less in degree, occur in nearly all of the striped-breasted warblers.

In birds which have the ground color of certain areas of the body

* Perfectly mature specimens only are here referred to.

† See the remarks on the genus *Passerculus* in Part IV.

black spotted with white, as in some of the woodpeckers (*Picus villosus* and *P. pubescens*, for example), the white markings vary in size most notably, and sometimes in number. The white markings so common on the wings and tails of birds, as the bars formed by the white tips of the greater wing coverts, the white patch occasionally present at the base of the primary quills, or the white band crossing them, and the white patch near the end of the outer tail feathers, are also extremely liable to variation in respect to their extent and the number of feathers to which, in the same species, these markings extend. Variation in the tail markings is particularly common, as may be seen by comparing numerous specimens of almost any species of *Dendrœca*, *Junco*, *Pipilo*, of *Mimus polyglottus*, *Chordeiles popetue*, etc. In the latter species the white patch on the wing does not ordinarily encroach upon the outer vane of the first primary, and rarely upon its shaft, but in several specimens before me it covers not only the shaft of the first primary, but extends completely across its outer vane! The black subterminal bar on the upper surface of the tail of the ruffed grouse (*Bonasa umbellus*) ordinarily crosses all but the middle pair of feathers, on which there is usually no trace of this bar; in many specimens, however, it is barely traceable on them, and in others it is as distinct and perfect on the middle pair as on the others.*

The *Parula americana* presents also remarkable examples of individual color variation. The colors of the males are usually much brighter than those of the females, but cases are frequent where the sex cannot be determined by the color of the plumage. Adult males also vary greatly in the *style* of coloration. They are generally bright yellow anteriorly below, with a broad band of dusky reddish-brown across the breast, varying in tint from nearly pure chestnut to dusky reddish-brown, and even black, and also greatly in extent. In some, however, this band is partially obsolete, in which case the whole plumage is generally paler than in average specimens. More rarely large, brightly colored males are taken, even in New England, with the whole breast bright yellow, the brownish pectoral band being entirely absent. This condition, however, seems to be more frequent in specimens of *Parula* collected in Mexico, and Central and Northern South America, which on this account have been regarded as distinct from the *Parula* of the North; yet all the conditions of color seen in specimens from

* See remarks on color variations in other species in Part IV.

the North are also common to those from the South, and *vice versa*.

In species in which the female usually differs from the male in being paler colored, the pattern of coloration being the same in both sexes, females occur more or less frequently which are as brightly colored as the brightest males, and males that are paler than the generality of the females.

Variation in Color depending on Season. — A word in this connection seems necessary concerning some of the more obscure variations depending upon season and age, since it is sometimes difficult to avoid confounding these differences with those resulting from individual variation. In many species there is a marked change in the color of the plumage without a change of the plumage itself. No experienced collector can have failed to notice the much brighter and livelier tints the plumage of most song birds presents immediately after the autumnal moult, in species in which there is no marked seasonal change of color, in comparison with the faded appearance they exhibit towards the close of the breeding season. This brighter autumnal tint is particularly marked in the *Vireos*, the different species of *Empidonax*, *Sayornis*, *Contopus*, and in some of the *Sylvicolidæ*, and is clearly traceable in hundreds of other species. But almost as great a difference is seen when specimens of any species taken in spring, on its first arrival at its breeding station, are compared with those collected several weeks later, or just before the autumnal renewal of the plumage. In this case the variation results in part from an actual fading of the color, and in part from the wearing of the edges of the feathers. Seasonal differences of this character are often only readily appreciable to the experienced eye, and the failure to recognize the cause of these differences has led in many instances to their being regarded as of specific value. Especially noteworthy instances of such mistakes will be noticed later. Collectors, and even naturalists, generally place little value on faded or dull-colored specimens, so that ordinarily in collections of our native birds only fine-looking specimens are preserved. But travellers and explorers of new localities are often compelled to content themselves with any representative they may be able to get, so that the "closet" or exclusively "museum naturalist" has not usually the material necessary to furnish him with a clew to the cause of these variations.

Generally, aside from the paler tints of late-collected birds, as compared with those taken early in the season, there is a total absence of the grayish, yellowish, brownish, or rufous suffusions (the particular tint varying of course in different species) that tinges the feathers early in the season. The general aspect of the plumage at the two periods in question is thus essentially different. The common chickadee (*Parus atricapillus*) will illustrate this point, in which the brownish tint so conspicuous on the lateral portions of the ventral plumage in autumn and winter is gradually lost as spring approaches, and in summer is almost entirely wanting, especially in nesting females, which at this season have the plumage generally much more worn than the males. The savanna sparrow will also illustrate the differences resulting simply from the fading of the color during the breeding season. In spring both sexes have a greenish-yellow, superciliary stripe, varying more or less in intensity in different specimens, but rarely or never of the pale soiled-whitish so frequently met with late in the breeding season. In the large series of specimens before me collected at that season in Massachusetts, few if any have this stripe so bright as average spring specimens have it, in many it having faded to soiled white. Scores of similar cases might be cited, but the above are sufficient for illustration.

Variations in Color depending upon Age. — So well known are many of the variations depending upon age, that it seems necessary to advert to only a few of the lesser known phases. In many species there is no marked difference between old and young birds, after the moulting of the first or nestling plumage, which usually occurs in the oscine groups in a few weeks after they leave the nest. But even in these, in many cases, sufficient marks of immaturity remain for a time to enable any one acquainted with such features to recognize birds of one or two years of age from those that are older. Yearling birds of this group are often recognizable by their having more or less well-defined bars across the wings, formed of light-colored, hastate, or drop-shaped spots on the ends of the greater wing-coverts and inner secondaries, which in many genera are peculiar to yearling birds, though in other respects, so far as the plumage is concerned, they are not distinguishable from adults, — a difference which in some instances has been considered specific. Similar marks are also seen in older birds, in species that do not obtain their adult colors till later in life.

Yearling and two-year-old birds are also often distinguishable from older ones by the presence, after the spring moult, of a greater than the ordinary amount of ferruginous, ashy, or yellowish edging to the feathers, such as is often seen in the winter plumage of adult birds. In some cases such a bordering to the clothing feathers, especially those of the back, is often strictly distinctive of young birds, and is, moreover, a feature of common occurrence.

Generally speaking, several years elapse before the purity of the colors and the definiteness of outline of the markings characteristic of maturity is fully obtained, especially in highly colored species. In birds of variegated colors the contrasts of color become for a time more and more decided with each moult, and the markings better and better defined, especially in respect to the white bars of the wings and the spots on the tail common to a large number of species. The latter markings usually gradually increase in extent for a considerable period. A good illustration of this is seen in many of the gulls, particularly in the genus *Larus*. In *L. argentatus* the following gradual change with age occurs in the white markings on the tips of the primaries. At first, as ornithologists are aware, the plumage of this species is uniformly dusky, the adult colors not being acquired before the second year, and apparently frequently not before the third, there being in the breeding season usually a large proportion of individuals in the brown plumage.* But there are wide differences in the intensity of the color in different individuals in this stage of plumage, some being but slightly dusky and others extremely dark, — differences that probably result mainly from differences in age, the darker birds being probably yearling birds and the lighter ones two years old, though part of the difference is doubtless due to individual differentiation. In this stage the wings and tail are of nearly the same uniform dusky tint as the general plumage. In what may be considered as the second stage, the general color is somewhat lighter, the tail much lighter, and the primaries much darker, with a distinct paler apical margin. At a third stage the tail becomes white, the dorsal plumage begins to assume the blue tint characteristic of maturity, the primaries change from dull blackish brown to black, and a small white spot appears near the end of the inner vane of the first

* Generally the large parties that spend the summer on the coast of Massachusetts, where none of these birds now breed, consist almost wholly of birds in the brown stage of plumage. See American Naturalist, Vol. III, p. 640, 1870.

primary, separated from the white at the extreme tip by a broad space of black. A subsequent gradual increase occurs in the purity of the colors and in the extent and form of the wing markings. The complete series of the changes in the latter is as follows: At first, as previously remarked, the primaries are dull brownish black, a little darker than the general plumage, with their extreme apical margins lighter. At the next stage the three inner primaries have become much lighter, and the light border to all broader and whiter. Later the three inner primaries and the distal portions of most of the others become wholly ashy white, and the outer portion of the other primaries much blacker. The subapical dark portion of the wing now embraces only the seven outer primaries, and is of a triangular form, the first primary forming the base of the triangle. The black on the outer vane of the first primary reaches nearly to the base of the outer vane of the second, and is more and more restricted on the others, till on the sixth (or, more rarely, on the seventh) it forms only a narrow bar near the tip. In other words, the black, if present on the seventh primary, exists as a narrow transverse subapical bar, which bar increases in distal extension on the sixth, fifth, fourth, third, and second, to the first, and embraces the whole outer vane of the first primary. The basal outline of the black area being an oblique one, a much larger portion of the outer than of the inner vane of each feather is embraced in the black space. All the primaries are now terminated with a narrow white border, the first primary having also an oval white spot on the inner vane, near the end of the feather. Subsequently this spot enlarges so as to embrace a part of both vanes, the white at the tip of the feather also meantime increasing somewhat in extent, and the two being separated by a broad bar of black. Coincident with this increase in the amount of white on the first primary, a small white spot appears on the inner vane of the second primary. Subsequent increase in the extent of these white markings goes on until the white area on the second primary extends to both vanes, and the two white spots on the first primary are separated by only a narrow bar of black. Later still this bar becomes broken, through the partial union of the two white spots, and finally becomes entirely obsolete, leaving the first primary with a single continuous white apical area, an inch and a half to two inches in length. It is probable that not all individuals reach this final stage, though most doubtless do in old age. A large series of specimens of mature birds usually exhibit the gradual change above described, and indicate the inconstancy of these markings and their unreliability as specific characters. Often, as is well known, these markings in the gulls differ considerably in the two wings of the same bird.

Although the *L. argentatus* has been taken as a general illustration, the same variations with age, or in different individuals, are exhibited by most species of the genus *Larus*. Generally they are admitted to have no value as specific characters, even by those who in the case of *L. argentatus* have accorded to them this importance.

In some of the species of *Junco* and *Pipilo*, in *Mimus*, in numerous species of *Dendrœca*, in *Parula*, *Mniotilta*, etc., there is a similar increase with age in the extent of the white markings on the tail, sometimes three and sometimes four pairs of feathers being spotted or terminated with white in different specimens of the same species. In short, these variations occur in so many species that they may be looked upon as indicating a general law of variation in color depending upon age, namely, *an increase in the purity or intensity of the general color, and an increase in the size of the wing and tail markings, for a time, with age.*

After complete maturity is attained there is, however, unquestionable evidence of a decline in color, which in many cases, and especially in bright-colored species, is quite marked. So general is such a decline in other groups of the animal kingdom that a citation of evidence on this point seems wholly needless. Yet in birds, in numerous instances, it is scarcely appreciable, and doubtless is in most species too slight to be readily traced. This obscurity may result, however, more from an absence of favorable conditions for such a decline to be recognized than from its real absence. It can hardly be doubted, in fact, that a share of the color variation seen in mature birds is attributable to this cause. It is well known that young mammals in their first pelage are, as a general rule, much darker colored than the adults of the same species. At a later period the color fades more slowly, but in old age the hair often becomes more or less gray, the blanching being in some cases very marked. Nearly all birds are also darker in their nestling and immature stages of plumage than after they arrive at maturity, especially if in the adult stage the plumage is light colored; and it is more than probable, and in some cases certain, that the decline in color continues in a slight degree through life. The change of *Falco candicans* from dusky when young to nearly white when fully mature may be hardly referable wholly to the blanching of age; but the gradual obsolescence of the dusky mottlings of the snowy owl (*Nyctea nivea*), as it advances in age, seems strictly parallel to the blanching of the gray colt to a white horse. Hence a second law of variation in color in old age, namely, that of *senile decline.*

Individual Variation in General Size and in the Relative Size of Different Parts.

Individual Variation in General Size and Form. — Measurements of scores of specimens of birds of the same species and sex, collected at the same locality and season, show the existence of a large range of individual variation, both in size and in general proportions; the variation extending to every external part of the body, and implying a corresponding variation in the internal anatomy. In birds size has usually been regarded, from its comparative constancy in the same species, as an important specific character. But from the fact that specimens of closely allied species often differ but little from each other in this respect, it has been justly looked upon as being in some cases more or less unreliable; but from the great importance commonly attached to it, it is evident that such instances are usually regarded as exceptional. Individual variation in this respect having been formerly regarded as too slight to have any significance, the size of a single specimen has usually been given as that of the species to which it belonged; hence subsequent variations from it discovered in other specimens of the same species has sometimes led to the recognition of the latter as specifically distinct. Especially has this been the case when a difference in size has been associated with a wide difference of locality. The facts in the case, however, show that a variation of fifteen to twenty per cent in general size, and an equal degree of variation in the relative size of different parts, may be ordinarily expected among specimens of the same species and sex, taken at the same locality, while in some cases the variation is even greater than this. Table A (p. 198) shows to some extent the general variation in size, but it does not always give, nor even generally, the extreme differences in the size of similar parts, as the wing, tail, etc., since those averaging the largest or smallest for the four measurements given are often not those having the longest or the shortest wing, tail, or tarsus, or which measure the most or the least in length or alar extent. The extremes of variation in the size of the wing and tail is given in Tables B, C, and D.*

Table A.—. Variation in General Size.

Mus Comp. Zoölogy No.	Collector's Number.	Sex.	Name.	Locality.	Date.	Collected by	Length.	Alar Extent.	Wing.	Tail.
8844	696	♂	Turdus Swainsoni	Belmont, Mass.	May 27, '68	C.J.Maynard	7.76	12.65	4 20	3 00
1520	—	—	Turdus Swainsoni	Springfield, "	May 14, '62	J. A. Allen	6.62	11.40	3 80	2.83
——	250	♂	Turdus Pallasi	Newton, "	Apr. 25, '68	C J.Maynard	7.30	12.83	3 80	3.83
——	608	♀	Turdus Pallasi	Newton, "	May 25, '68	C.J.Maynard	7.00	10 64	3.00	2 45
8830	337	♂	Turdus fuscescens	Newton, "	May 5, '68	C.J Maynard	7.81	13.70	4 16	4.00
8834	553	♂	Turdus fuscescens	Watertown, "	May 20, '68	C.J.Maynard	7.00	11.95	3.58	3.55
——	621	♂	Dendrœca striata	Newton, "	May 27, '68	C J.Maynard	5.45	8.75	2.80	1.70
——	641	♂	Dendrœca striata	Newton, "	May 27, '68	C.J.Maynard	5.51	9 30	3.10	2.00
——	543	♂	Dend. pennsylvanica	Newton, "	May 20, '68	C.J Maynard	5.40	8 25	2.61	2.07
——	451	♂	Dend pennsylvanica	Newton, "	May 20, '68	C J.Maynard	5.00	7.56	2 35	1.75
4374	1011	♂	Spizella pusilla	Newton, "	July 22, '68	C J.Maynard	6.00	8.32	2.62	2.60
4383	—	♂	Spizella pusilla	Waltham, "	Sept.19, '67	C J Maynard	5.06	7.62	2.00	2.62
4900	1411	♂	Sayornis fuscus	Newton, "	Sept 30, '68	C J.Maynard	7.50	11.40	3.60	3.00
——	164	♂	Sayornis fuscus	Waltham, "	Mar. 28, '68	C.J Maynard	7.25	12.60	3 82	2.20
4819	5	♂	Sayornis fuscus	Newton, "	Oct. 9, '69	C.J.Maynard	6.51	10.32	3 20	2.85
4701	317	♂	Passerculus savanna	Newton, "	Apr. 5, '68	C.J.Maynard	5.85	9.73	3.00	2 26
5093	873	♂	Passerculus savanna	Ipswich, "	June17, '68	J. A. Allen	5.83	7.75	2.80	2.10
——	890	♀	Passerculus savanna	Ipswich, "	June17, '68	J. A. Allen	5.35	7.75	2.51	1.95
5088	851	♀	Passerculus savanna	Ipswich, "	June17, '68	J. A. Allen	5.75	9.75	2.78	2.05
——	714	♂	Vireo olivaceus	Waltham, "	May 30, '68	C J.Maynard	6.55	10 65	3 48	2.46
——	713	♂	Vireo olivaceus	Waltham, "	May 30, '68	C.J Maynard	6.25	9.88	3.22	2.10
4624	1407	♂	Chrysomitris tristis	Newton, "	Sept.28, '68	C J Maynard	5 35	9.40	3.00	2.00
4926	150	♂	Chrysomitris tristis	Newton, "	Mar. 26, '68	C.J.Maynard	5.00	8.60	2.65	1.85
——	106	♂	Melospiza melodia	Newton, "	Mar. 12, '68	C J.Maynard	6.75	9.15	2.65	2.80
——	55	♂	Melospiza melodia	Newton, "	Nov. 24, '67	C.J.Maynard	6.00	8.25	2.35	2.68
1456	—	♂	Sialia sialis	Worthingt'n,"	July —, '63	C.H Hamlin	6 50	11.10	3 75	2.45
2378	—	♂	Sialia sialis	Waterville, Me.	Apr. 15, '64	W. H Niles	7.00	12.25	4.10	2.60
4371	334	♂	Mniotilla varia	Newton, Mass.	Apr 20, '68	C.J Maynard	5 40	9.00	3 00	2 15
4376	372	♂	Mniotilla varia	Waltham, "	May 6, '68	C.J Maynard	5.35	8.25	2.87	2.05
——	887	♂	Cotyle riparia	Ipswich, "	June17, '68	J. A. Allen	5.45	11 00	4.65	2.10
5111	868	♂	Cotyle riparia	Ipswich, "	June17, '67	J. A. Allen	5 25	10.55	3.75	1.86
——	1082	♂	Passerella iliaca	Springfield, "	Mar. 22, '68	J. A Allen	7.50	11.65	3.65	2.98
——	—	♂	Passerella iliaca	Newton, "	Mar. 27, '68	C J Maynard	6.80	10.80	3.40	2 50
——	786	♂	Icterus Baltimore	Newton, "	June 6, '68	C J Maynard	8.00	12.25	4.00	3.10
4852	653	♂	Icterus Baltimore	Newton, "	May 27, '68	C.J.Maynard	7 30	11.15	3.56	2.55
——	946	♂	Sterna hirundo	Muskeget Isl	June29, '68	J. A. Allen	15.50	31.85	11.30	7.00
10485	913	♂	Sterna hirundo	Muskeget Isl.	June29, '68	J. A. Allen	14.90	29 30	10 40	5 50
10464	932	♂	Sterna arctica	Muskeget Isl.	July 2, '68	J. A. Allen	16.15	32.15	11.60	7.50
——	992	♂	Sterna arctica [mus	Muskeget Isl.	July 2, '68	J A. Allen	14.40	29.00	10 70	6 30
4009	—	♂	Pipilo erythrophthal-	Milton, Mass.	——	H C. Daring	8.55	12.25	3.57	3.85
10151	—	♂	Pipilo erythrophthal.	Cambridge, "	——	L. Agassiz	7.50	10.20	3.34	3.60

As a large proportion of the specimens mentioned in some of the following tables (most of Tables A to G) were taken during the season of their migration, they may have originated at widely different localities, and thus the differences indicated may be in some measure due to geographical causes. In other cases, however, all the specimens

* The measurements given in this paper were all taken either from fresh specimens by the collector, or by myself from specimens preserved in spirits.

were taken in the breeding season; while in still other instances (Tables II to P) the species were purposely chosen from among such as find their northern limit of distribution near the locality where all were taken. Of ten species of the latter class, twenty perfect male specimens have been carefully measured,* the measurements embracing a series of eighteen to twenty distinct parts; under such circumstances the variation in general size, in length, in alar extent, in the length of the folded wing, the tail, the tarsus, the head, the bill, etc., etc., commonly ranged from twelve to eighteen per cent.

In respect to the differences in the general form of the body, two leading styles of variation from the average form may be recognized in nearly all species, namely, a relatively robust form, in which the stoutness extends to all parts, and a relatively slender form, in which the slenderness is equally general. Variations of this general and symmetrical character are remarkable only for their extent, since in such cases there are no marked discrepancies between the relative size of different parts. Contrary, however, to our usual notions of exact symmetry in animals, the unsymmetrical variations are by far the most frequent and important.

Variation in the Relative Size of Different Parts. — In specimens of average size of any given species, considerable differences exist in the relative size of different parts. In individuals of the average alar extent of their species, for example, the length of the folded wing may vary very considerably, in consequence of a difference in the length of the primary quills as compared to the length of the bones of the wing. The length of the folded wing or the alar extent may vary with reference to the whole length of the specimen, in consequence of differences in the relative length of the tail, the neck, or the body. The tarsus also varies independently of variation in the general size, as do also the toes to the tarsi, relatively short toes being found to accompany tarsi of ordinary length, and, conversely, long toes short tarsi.† The wing varies in its form in consequence of the different relative development of the primary and secondary quills.‡ The tail varies in respect to its form, especially in regard to the degree of its emargination or graduation, and, in some groups, in respect to the number of its feathers. The bill also varies greatly in size and form. The variations in these various parts will be considered separately and in detail.

* See below, Tables H to P, pp. 210–219.

† See Table F, p. 205.

‡ See Table E, p. 204.

Variation in the Length of the Folded Wing and the Tail.—The measurements given in the following table (Table B) sufficiently illustrate the variation in the length of the folded wing in fully mature specimens of the same sex and species, while Table C indicates the variation in the length of the tail, in specimens of a similar character. All the specimens, with a few exceptions, were taken within a few miles of Cambridge; the others are mainly also from Eastern Massachusetts, a few * being from a single locality in Florida. The series from which these extremes are taken embrace ordinarily not more than twenty-five or thirty specimens; with larger suites the differences would in many cases doubtless be much increased. The largest and smallest only are taken, between which, however, there is every gradation. The difference between these extremes is indicated, and also the percentage of the variation, based on the average of the two extremes. The amount of the variation in the length of the folded wing ranges, as will be seen from the table, from twelve to twenty-one per cent of the average length. In the tail the amount of variation in respect to length ranges from fourteen to twenty-three per cent. The different species vary considerably in respect to the amount of variation each presents, some being much more variable than others. It should be stated, however, that as a general rule the widest extremes, or the highest percentages of variation, occur in those species of which the greatest number of specimens has been examined. It will also be noticed that the tail usually varies more than the wings. In species with a relatively long tail the percentage of variation in the length of this member is found to be greater than in those species in which it is of medium length or short, as would have been naturally expected. In several cases the greater differences occur between females, but this may be a mere coincidence.

In this connection it may be added that the variation proves to be much less between specimens of the same species and sex when taken at a single locality in the breeding season than when taken during the period of migration. In many instances specimens of the same species may be obtained at one locality which shall represent the whole range of its geographical variation, as well as its individual variation, as in the case of those species which breed far to the North, but migrate in winter to the tropics, being thus but transient visitors to the temperate portions of the United States.

* Those of Mimus polyglottus, Cardinalis virginianus, Picus borealis.

Table B.—Individual Variation in the Length of the Folded Wing.

M. C. Z. No.	Orig. No.	Sex		Folded Wing	Difference.	Per cent of Variation.
10596	2510	♀	Mimus polyglottus	4.75	.75	17.0
——	2485	♀	Mimus polyglottus	4.00		
10716	1987	♂	Cardinalis virginianus	3.85	.55	14.6
——	1993	♂	Cardinalis virginianus	3.30		
——	316	♂	Passerculus savanna	2.95	.40	14.5
——	820	♂	Passerculus savanna	2.55		
8830	367	♂	Turdus fuscescens	4.16	.61	15.8
8834	556	♂	Turdus fuscescens	3.55		
4821	148	♂	Sayornis fuscus	3.87	.67	19.0
4819	5	♂	Sayornis fuscus	3.20		
9057	618	♂	Geothlypis trichas	2.56	.50	21.0
5020	703	♂	Geothlypis trichas	2.06		
4648	1389	♂	Carpodacus purpureus	3.70	.60	17.6
4655	751	♂	Carpodacus purpureus	3 10		
9696	——	♂	Pipilo erythrophthalmus	3.68	.51	14.6
1421	——	♂	Pipilo erythrophthalmus	3 17		
——	170	♂	Junco hyemalis	3.20	.45	18 0
4910	140	♂	Junco hyemalis	2 75		
1568	——	?	Tyrannus carolinensis	4.85	.68	15.0
10025	——	?	Tyrannus carolinensis	4 17		
10014	——	?	Galeoscoptes carolinensis	3 85	.60	17.0
2734	——	?	Galeoscoptes carolinensis	3.25		
786	——	♂	Icterus Baltimore	4.00	.58	16.0
1334	——	♂	Icterus Baltimore	3 42		

Table C.—Individual Variation in the Length of the Tail.

M. C. Z No	Orig No	Sex.		Tail.	Difference.	Per cent of Variation.
——	2474	♂	Mimus polyglottus	5.15	.95	20.5
10592	2372	♂	Mimus polyglottus	4 20		
——	1955	♂	Cardinalis virginianus	4.30	.90	23.4
——	2460	♂	Cardinalis virginianus	3 40		
——	317	♂	Passerculus savanna	2.26	.41	19.5
5086	846	♂	Passerculus savanna	1.85		
8830	528	♂	Turdus fuscescens	3 00	.45	14.4
8835	556	♂	Turdus fuscescens	2 55		
——	——	♀	Parus atricapillus	2.63	.48	20.0
——	——	♀	Parus atricapillus	2 15		
9056	454	♂	Geothlypis trichas	2 15	.45	23.4
5020	703	♂	Geothlypis trichas	1.70		
4651	1071	♀	Carpodacus purpureus	2.57	.52	22.5
4653	1371	♀	Carpodacus purpureus	2.05		
4614	1330	♂	Pipilo erythrophthalmus	4.00	.71	19.5
4727	415	♂	Pipilo erythrophthalmus	3.29		
——	160	♂	Junco hyemalis	2.78	.38	15.0
4917	201	♂	Junco hyemalis	2.40		
10646	1972	♀	Picus borealis	3.75	.50	14.0
10633	41	♀	Picus borealis	3.25		
1317	——	?	Tyrannus carolinensis	2.93	.61	19.0
1568	——	?	Tyrannus carolinensis	3.54		
2734	——	?	Galeoscoptes carolinensis	3.35	.75	20.0
10014	——	?	Galeoscoptes carolinensis	4 10		
1334	——	♂	Icterus Baltimore	2.70	.40	13 8
2289	——	♂	Icterus Baltimore	3.10		

Variation in the Relative Length of the Wings and Tail. — Table D illustrates the irregularity of the variation in the wings and the tail. The first column of measurements gives the length of the folded wing, and

Table D. — Individual Variation in the relative Length of the Folded Wing and Tail.

M. C. Z. No.	Original No.	Sex.		Wing.	Tail.	Diff. betw'n Wing and Tail.	Amount of Variation.
——	2429	♂	Mimus polyglottus	4.35	4.35	.00	
10590	2342	♀	Mimus polyglottus	3.25	4.35	+1.00	
——	2560	♀	Mimus polyglottus	4 15	4.35	+ .25	
——	2614	♂	Mimus polyglottus	4.40	4 90	+ .50	1.20
——	2340	?	Mimus polyglottus	4.40	4.50	+ .10	
——	2478	♀	Mimus polyglottus	4.40	4.20	— .20	
——	2374	♂	Mimus polyglottus	4 30	4.16	— .14	
8881	441	♂	Galeoscoptes carolinensis	3 60	3.60	.00	
——	1376	♀	Galeoscoptes carolinensis	3.70	3 60	— .10	.45
8879	412	♂	Galeoscoptes carolinensis	3.75	4.10	+ .35	
8841	495	♂	Turdus fuscescens	4.00	3.00	1.00	
8832	332	♂	Turdus fuscescens	4.10	4.00	.10	1.15
8835	581	♂	Turdus fuscescens	4.15	2.90	1.25	
8821	374	♂	Seiurus aurocapillus	3.00	2.00	1.00	.66
——	423	♂	Seiurus aurocapillus	3.00	2 66	1.66	
8851	322	♀	Turdus Pallasi	3.50	2 60	.90	.67
——	301	♂	Turdus Pallasi	3.43	3.17	.23	
4301	514	♂	Dendrœca æstiva	2.85	1.80	1.05	.58
——	362	♂	Dendrœca æstiva	2.45	1.98	.47	
5058	707	♂	Dendrœca striata	2.85	2.00	.85	
——	1341	♂	Dendrœca striata	3.00	1.75	1.25	.79
5062	734	♀	Dendrœca striata	2.45	1.98	.46	
——	741	♀	Dendrœca striata	2.80	1.80	1 00	
5041	665	♂	Setophaga ruticilla	2.60	2.10	— .50	.57
——	698	♂	Setophaga ruticilla	2.43	2.50	+ .07	
——	693	♀	Regulus satrapa	2.20	1.52	.68	.49
——	50	♀	Regulus satrapa	1.94	1.75	.19	
4808	711	♂	Contopus virens	3 35	2.36	.99	.54
4994	1116	♂	Contopus virens	3.15	2.70	.45	
10645	1924	♂	Picus borealis	4.80	3.32	1.48	.48
10646	1972	♀	Picus borealis	4.75	3.75	1.00	
4587	323	♂	Agelæus phœniceus	4.85	3.40	1.45	.67
4589	214	♂	Agelæus phœniceus	4.60	3.82	.78	
4654	1069	♂	Carpodacus purpureus	3 85	2.00	1.35	.64
4655	286	♂	Carpodacus purpureus	3.03	2.32	.71	
——	288	♂	Poocætes gramineus	3.55	2.41	1.14	.54
——	846	♀	Poocætes gramineus	3.10	2.50	.60	
——	881	♂	Passerculus savanna	2.75	1 85	.90	.41
——	127	♂	Passerculus savanna	2.74	2.25	.49	
——	115	♂	Passerella iliaca	3.75	2.65	1.10	.78
——	55	♀	Passerella iliaca	3.32	3.00	.32	
——	177	♂	Melospiza melodia	2.35	2.68	+ .33	.53
——	2363	♂	Melospiza melodia	2 60	2.40	— .20	
——	2369	♂	Cardinalis virginianus	3.60	3 40	— .20	.70
——	——	♂	Cardinalis virginianus	3.60	4.10	+ .50	
2298	——	♂	Dolichonyx oryzivora	3.75	2.78	.96	.32
5741	——	♂	Dolichonyx oryzivora	4 00	2.72	1.28	
10107	——	♂	Hedymeles ludoviciana	4.20	2.93	1.27	.39
9787		♂	Hedymeles ludoviciana	3.83	2.95	.88	

the second the length of the tail, of the same specimens; the third column shows the difference in length between the tail and the wing, and the fourth column the amount of the difference between the two extremes. In *Mimus polyglottus* the tail is usually one fourth to one half an inch longer than the wing; but in many specimens the wings and tail are equal, and in a small proportion the tail is *shorter* than the wing. In the seven specimens of this species cited in the table, the variation ranges from the tail being one fifth of an inch shorter than the folded wing to one inch longer. In the three specimens which agree in the length of the tail (4.35 in.), the variation in the length of the folded wing ranges from 3.25 in. to 4.25 in., or is nearly twenty-seven (26.85) per cent. The larger specimen, however, is a male, while the others are females; but between the two females the difference is over twenty-four (24.3) per cent. Similar differences have been met with in various other species, but it has not been deemed necessary to cite a larger list of examples.

Variation in the Form of the Wing. — By the form of the wing is meant its general outline when expanded, which is mainly determined by the relative length of the remiges. The form of the wing, and especially the relative length of the different primary remiges, has direct relation to the power of flight. In strong, swift-flying birds, the outer primaries are the longest, giving a narrow pointed form to the expanded wing, as in the swifts, the swallows, in *Chordeiles*, in the *Sterninæ* and in most of the *Procellaridæ*. In birds of medium powers of flight, as in most of the true finches (*Coccothraustinæ*) and *Turdinæ*, the *Tyrannidæ*, the *Sylvicolidæ*, etc., etc., the third, fourth, and fifth primaries are the longest, the wing being less pointed and broader. In species with low power of flight, as the *Troglodytidæ*, several genera of sparrows, the grouse, etc., the outer primaries are still more reduced, the wing is much more rounded and shorter, and the power of flight is in each case correspondingly less. In birds of the first class, which live almost wholly on the wing, little variation is seen in the relative length of the primaries. In those of the second and third classes, slight variations affect in less degree the particular habits of life, so that among the latter would be naturally expected the greatest range of individual variation.

Correlating with the variation in the form of the wing, as determined by the relative length of the outer primaries to the length of the inner primaries are similar variations in the relative length of the inner secondaries as compared with the outer secondaries. Relatively short inner secondaries (generally improperly called "tertiaries") hence accompany long primaries, and, conversely, long inner secondaries, short outer primaries. The particular form of the wing in any group depending upon the relative development of these several elements, they hence afford excellent generic characters; but while thus important, they are subject to a considerable range of individual variation. The form of the wing being readily determined by measurements, and easily expressed mathematically, the amount of the variation is easily measured and tabulated. In the following table (Table E) the extent and character of this variation is to some degree illustrated. In the first column of measurements is given the length of the folded wing; in the second the extent of the longest primary beyond the outer (or shortest) secondary, and in the third the extent of the longest primary beyond the inner (or longest) secondary. The fourth column gives the amount of variation in each specimen cited.

Table E.—Variation in the Form of the Wing.

M. C. Z. No.	Sex.	Species.	Length of the Wing.	Ext. of Pr. beyond Outer Sec.	Ext. of Pr. beyond Inner Sec.	Amount of Variation.
2319	♂	Icterus Baltimore	3.75	.77	.90	.13
2290	♂	Icterus Baltimore	3.83	.67	.81	.14
1333	♂	Icterus Baltimore	3.64	.57	1.06	.49
1567	♂	Icterus Baltimore	3.80	.56	.92	.36
2964	♂	Icterus Baltimore	3.85	.77	1.07	.30
2299	♂	Icterus Baltimore	3.85	.87	1.12	.25
2296	♂	Dolichonyx oryzivora	3.80	.98	1.42	.44
5741	♂	Dolichonyx oryzivora	4.00	1.20	1.40	.20
119	♂	Dolichonyx oryzivora	3.82	.78	1.23	.45
9854	♂	Dolichonyx oryzivora	3 53	.98	1.14	.16
284	?	Tyrannus carolinensis	4.30	.85	1.15	.30
113	?	Tyrannus carolinensis	4.60	.90	1.45	.55
1317	?	Tyrannus carolinensis	4.25	.76	1.10	.34
4008	?	Tyrannus carolinensis	4 60	1.35	1 62	.27
10107	♂	Hedymeles ludoviciana	4.20	.90	1.05	.15
590	♂	Hedymeles ludoviciana	4 00	.90	1.25	.35
9935	♂	Hedymeles ludoviciana	4.00	.60	1.06	.40
1456	♂	Sialia sialis	3.75	1.00	1.10	.10
1945	♂	Sialia sialis	3.90	1.03	1.10	.07
338	♂	Sialia sialis	4.07	1.30	1.30	.00
5606	♂	Sialia sialis	4 05	1 25	1.40	.15
10292	♂	Sialia sialis	3.90	.95	1.15	.20
256	?	Galeoscoptes carolinensis	3.37	.55	.50	—.05
1790	?	Galeoscoptes carolinensis	3.75	.55	.70	+.15
5858	?	Galeoscoptes carolinensis	3.55	.35	.57	+.22
10014	?	Galeoscoptes carolinensis	3.85	.70	.75	+.05
2274	?	Galeoscoptes carolinensis	3.75	.67	.70	+.03

Variation in the relative Length of the Primary Quills. — From the great stress laid upon the relative length of the outer primaries by descriptive ornithologists in determining genera and species, one would be led to expect but a slight amount of variation in this respect in specimens of the same species. On the contrary, however, it is soon found, on giving special attention to this character, that a considerable amount of individual variation in this regard really exists. That the wing formula, so generally introduced of late years into specific diagnoses, is in a great degree unreliable as a specific character, is sufficiently shown by the subjoined table (Table F, p. 206) of the relative proportions of the primaries. The comparison, extended in the table to only a few species has been carried to scores of others with similar results.

In general, in species of the *Oscines* which have the second primary usually the longest, it is sometimes the first and sometimes the third that is the longest. In those which have the third ordinarily the longest, the second and third, the third and the fourth, or the second, third, and fourth are frequently equal. In those in which the first (or the second when the first is very short) is intermediate to the second and fourth or to the third and fifth, it may be equal to or longer than the second or third, or only equal to the fourth or fifth.

Variation in the Form of the Tail, and in the Number of the Rectrices. — Individual variation in the form of the tail is often quite marked. In species with the tail deeply forked, different specimens vary considerably in respect to the depth of the fork. Those with the tail rounded and much graduated differ greatly in respect to the amount the middle feathers exceed the outer ones in length. In species with a normally nearly even tail, the tail is sometimes distinctly emarginate, and sometimes as distinctly rounded in different specimens of the same species.

In regard to the number of rectrices, in those groups in which the number exceeds twelve, as in the *Rasores*, the *Lamellirostres*, etc., the number is frequently variable. The rectrices of the common ruffed grouse (*Bonasa umbellus*) are usually eighteen in number, but an examination of numerous specimens shows that the number varies from sixteen to twenty. The usual number in *Tetrao canadensis* is sixteen, but the number varies from fourteen to eighteen. In *Cupidonia cupido*, and in other species of grouse, similar variations also occur. They are also frequent in the *Anserinæ*. In *Bernicla canadensis*, for example, the usual number of rectrices is eighteen, but the number

Table F. — Variation in the relative Length of the Primaries.

M. C. Z. No	Species.	Longest.	2d in Length	3d in Length.	4th in Length	5th in Length.	6th in Length	7th in Length	8th in Length.	9th in Length.
3289	Turdus fuscescens	4	3	2	5	6	7			
6764	Turdus fuscescens	3	4	2	5	6	7			
8837	Turdus fuscescens	4, 3	2	5	6	7	8			
8848	Turdus Pallasi	4	3	5	6	2	7			
5197	Turdus Pallasi	4	5	3	6	2	7			
8205	Turdus Pallasi	4	3	5	6, 1	7	8			
8206	Turdus Pallasi	4	3, 5	6	2	7	8			
10698	Myiarchus crinitus	3	4	2	5	6	1	7		
10699	Myiarchus crinitus	3	2	4	5	6	1	7		
8166	Myiarchus crinitus	4	3	2	5	6	1, 7	8		
10700	Myiarchus crinitus	3, 4	2	5	6	1	7	8		
10701	Myiarchus crinitus	3	4, 2	5	6	1	7	8		
12420	Tyrannus carolinensis	2	3	1	4	5	6			
4612	Tyrannus carolinensis	2	3	4	1	5	6			
6457	Tyrannus carolinensis	2	3	1, 4	5	6	7			
4816	Contopus borealis	2	1	3	4	5	6			
6665	Contopus borealis	2	3	1	4	5	6			
6938	Sayornis fuscus	3	4	2	5	6	1	7		
6932	Sayornis fuscus	3, 4	2, 5	6	1	7	8	9		
5364	Lophophanes bicolor	4	5	6	3	7	8	9	2	1
5248	Lophophanes bicolor	5	4	6	7	3	8	9	2	1
——	Lophophanes bicolor	5, 4, 6	7	3	8	9	2	1		
5080	Dendrœca coronata	2	3	1	4	5	6			
5176	Dendrœca coronata	3	2	4	1	5	6			
6678	Dendrœca coronata	3	2, 4	1	5	6	7			
3412	Dendrœca coronata	2, 3	4	1	5	6	7			
10533	Dendrœca coronata	2, 1, 3, 4	5	6	7	8	9			
5056	Dendrœca striata	2	1	3	4	5	6			
5057	Dendrœca striata	1	2	3	4	5	6			
3390	Dendrœca striata	2	1, 3	4	5	6	7			
6675	Dendrœca striata	2	3	1	4	5	6			
10958	Pinicola enucleator	3	4	2	5	1	6	7		
10963	Pinicola enucleator	3	2	4	1	5	6	7		
10960	Pinicola enucleator	3	2	1	4	5	6	7		
10962	Pinicola enucleator	3, 2	4	1	5	6	7	8		
8114	Pinicola enucleator	3	4, 2	1	5	6	7	8		
4843	Ampelis cedrorum	2	3	1	4	5				
4633	Ampelis cedrorum	1	2	3	4	5				
4844	Ampelis cedrorum	2	1	3	4	5				

varies from fourteen to twenty. Specimens with sixteen are tolerably frequent. Yet one of the principal characters urged as separating the *B. Hutchinsii* from the *B. canadensis* is the possession of two more feathers in the tail by the latter than the so-called *B. Hutchinsii* is assumed to have. In *Bernicla brenta* the usual number is sixteen, but in different specimens they vary from fourteen to eighteen. A greater or less amount of variation in the number of the feathers of the tail is more or less common to numerous other species of the duck tribe. An odd number is even quite frequent, one half of the tail having normally one more feather than the other.

Variation in the Relative Length of the Tarsus and Toes. — A common feature in modern generic and specific diagnoses is a statement of the ratio the length of the tarsus bears to the length of the middle toe or to the hallux, and the relative length of the hallux to the outer or inner toe, as though we had here constant structural proportions. The following table (Table G) shows that such is not the case, the varia-

Table G.—Relative Length of Tarsi and Toes.

M. C. Z. No.	Sex.	Species.	Tarsus.	Middle Toe.	Outer Toe.	Hallux.
5858	?	Galeoscoptes carolinensis	1.08	1.04	.77	.75
2273	?	Galeoscoptes carolinensis	1.15	.98	.70	.70
10356	?	Galeoscoptes carolinensis	1.00	1.00	.70	.73
5857	?	Galeoscoptes carolinensis	1.18	1.08	.70	.75
2229	?	Galeoscoptes carolinensis	1.07	.93	.68	.67
5605	♂	Sialia sialis	.77	.77	.57	.58
1456	♂	Sialia sialis	.74	.84	.62	.65
5766	♂	Sialia sialis	.83	.80	.56	.60
1883	♂	Sialia sialis	.80	.91	.77	.65
1946	♂	Sialia sialis	.80	.84	.77	.61
1881	♂	Sialia sialis	.77	.85	.56	.72
1771	♂	Pipilo erythrophthalmus	.98	.95	.73	.80
1399	♂	Pipilo erythrophthalmus	1.05	1.05	.80	.78
350	♂	Pipilo erythrophthalmus	1.05	1.12	.76	.84
1476	♂	Pipilo erythrophthalmus	1.10	1.03	.75	.78
2985	♂	Pipilo erythrophthalmus	1.13	1.00	.80	.80
9854	♂	Dolichonyx oryzivora	.98	1.17	.83	.82
5585	♂	Dolichonyx oryzivora	1.15	1.27	.98	.93
9894	♂	Dolichonyx oryzivora	1.00	1.00	.83	.81
10219	♂	Dolichonyx oryzivora	1.03	1.25	.98	.76
2320	♂	Icterus Baltimore	.83	.68	.88	.72
9793	♂	Icterus Baltimore	1.02	.85	.70	.70
1567	♂	Icterus Baltimore	.97	1.00	.75	.80
10025	?	Tyrannus carolinensis	.67	.73	.53	.54
10027	?	Tyrannus carolinensis	.80	.85	.55	.61
10028	?	Tyrannus carolinensis	.70	.87	.53	.57
5546	?	Tyrannus carolinensis	.70	.80	.60	.60

tion being as great between different specimens of the same species as between different species of the same genus, and even of different genera. The variation in the length of the toes is often due to an increase or a decrease in the length of the nail, but by no means rarely to variations in the length of the phalanges themselves. As already stated, and as appears from the table, toes of less than the average length accompany tarsi of the average or of more than the average length, and toes of more than the average length accompany tarsi of medium or less than the medium length. In compiling the above table the specimens mentioned have been selected in each case from a series of only twenty specimens of the species to which they respectively belong, and represent the longest and shortest tarsus, middle toe, outer toe, and hind toe met with in each series, and also the greatest and least amount of difference in these several elements. They are all taken from Tables H to Q (see pp. 210–219), which serve to show the usual range of variation, in respect to size and proportions, in ten species.*

Individual Variation in other Parts.—In addition to the instances already mentioned, individual variation of a similar character and equal extent occurs in the relative size of other parts. The length of the bill, for instance, is often compared to the length of the head, or to that of the tarsus in specific diagnoses. Table G[1] (see next page) serves to show the individual variation in respect to the proportion of length to alar extent ordinarily met with in specimens of the same species.

To show more fully, however, the exact nature and extent of what may be considered as purely individual variation, tables of detailed measurements of about twenty specimens of each of a number of species are herewith appended (Tables H to Q). Care has been taken to not only select specimens of the same sex, collected at the same locality, and as nearly as possible at the same season, but also such species as find their northern limit so near the locality at which they were taken as to obviate the complication of individual with geographical variation, which would result if the range of the species extended far to the northward of the locality in question. In general, the specimens are all from Eastern Massachusetts, and

* Icterus Baltimore, Dolichonyx oryzivorus, Pipilo erythrophthalmus, Sialia sialis, Galeoscoptes carolinensis, Pyranga rubra, Geothlypis trichas, Harporhynchus rufus, Tyrannus carolinensis, Hedymeles ludoviciana.

Table G[1] — Individual Variation in the Proportion of Length to Alar Extent.

M. C. Z. No.	Orig. No.	Sex.	Species.		
5056	668	♀	Dendrœca striata	5.45	9.70
——	777	♀	Dendrœca striata	5.50	8.68
5087	848	♂	Passerculus savanna	5.50	9.13
——	981	♂	Passerculus savanna	5.83	7.75
——	——	♂	Passerculus savanna	6.00	8.27
——	1987	♂	Cardinalis virginianus	9.00	11.50
——	2394	♀	Cardinalis virginianus	8.00	11.75
9901	——	♂	Dolichonyx oryzivorus	6.65	11.50
2295	——	♂	Dolichonyx oryzivorus	7.50	11.50
——	2340	?	Mimus polyglottus	9.60	14 25
——	2374	♀	Mimus polyglottus	9.75	14.00
——	2371	♀	Mimus polyglottus	9.80	13 00
5757	——	?	Turdus Swainsoni	7.25	12.15
2930	——	?	Turdus Swainsoni	7.75	11.20
1829	——	?	Turdus Swainsoni	6.90	11.20
307	——	?	Turdus Swainsoni	7.24	11.00
9691	——	?	Turdus Pallasi	7 00	10.50
145	——	?	Turdus Pallasi	7.00	11.40
5756	——	?	Turdus Pallasi	7.38	11.05
——	314	♂	Turdus Pallasi	7.38	12.33
——	363	♂	Turdus Pallasi	7.23	11.94
——	26	♂	Turdus Pallasi	6.80	11.28
——	367	♂	Turdus fuscescens	7.81	13.70
——	495	♂	Turdus fuscescens	7.87	11.91
——	551	♂	Turdus fuscescens	7.00	11.95
——	112	♂	Parus atricapillus	5.50	8.12
4946	268	♀	Parus atricapillus	5 00	8.60
11714	114	♀	Parus atricapillus	5.75	7.88
95	——	♂	Agelæus phœniceus	9.00	15.10
93	——	♂	Agelæus phœniceus	9 20	14.40
5723	——	♂	Agelæus phœniceus	8.45	14.45

from within a short distance of Cambridge. A very few are from Southern Maine and from the Connecticut valley at Springfield; but the general faunal character of all these localities is essentially the same.*

In addition to the measurements given in these tables, several others are sometimes taken by collectors, as the relative posterior extent of the outstretched feet and the wing, as compared with the tail. As they are, however, among the most variable of proportions, and are likewise among the most difficult measurements to take with accuracy, they have been here neglected.

* In consequence of the small size of these pages, it has been found impracticable to include the names of the localities, the date of collecting, and the name of the collector in the tables, as would have been desirable.

Table H. — Icterus Baltimore *Daud.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus.	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill. Culmen.	Bill. Commissure.	Bill. Gonys.	Bill. Height.	Bill. Width.
1332	♂	7.45	11.75	3.70	2.90	.70	.97	1.50	1.40	.96	.72	.89	.67	.65	1.62	.76	.77	.47	.32	.33
9793	♂	7.50	11.60	3.70	2.95	.76	1.07	1.67	1.33	1.02	.70	.85	.70	.66	1.58	.76	.77	.47	.38	.35
1333	♂	7.20	11.20	3.64	2.88	.57	1.06	1.52	1.40	.93	.67	.85	.70	.66	1.62	.78	.81	.50	.35	.32
2289	♂	8.00	11.90	3.85	3.10	.87	1.12	1.77	1.65	.91	.69	.95	.75	.73	1.63	.75	.77	.52	.37	.34
9884	♂	7.00	10.40	3.54	2.82	.86	.93	1.37	1.15	.87	.65	.93	.70	.69	1.60	.73	.46	.46	.33	.35
2733	♂	7.55	11.30	3.75	3.00	.82	1.03	1.82	1.18	.87	.70	.92	.70	.68	1.60	.80	.83	.48	.34	.35
2962	♂	7.50	11.50	3.72	3.00	.68	.95	1.63	1.38	.90	.70	.87	.70	.65	1.60	.77	.78	.48	.37	.35
1567	♂	7.60	11.75	3.80	3.00	.56	.92	1.53	1.40	.97	.75	1.00	.80	.78	1.63	.77	.80	.50	.32	.32
1334	♂	7.20	11.00	3.45	2.70	.60	.84	1.45	1.20	.90	.70	.90	.73	.73	1.55	.75	.77	.48	.35	.35
1566	♂	7.40	11.50	3.60	2.90	—	—	1.55	1.10	.90	.73	.86	.73	.70	1.60	.82	.82	.53	.35	.34
2993	♂	7.60	11.90	3.75	2.97	.68	.96	1.43	1.30	.91	.70	.90	.70	.67	1.58	.78	.78	.52	.34	.33
388	♂	7.40	11.00	3.68	2.78	.85	1 00	1.58	1.27	.95	.70	.88	.75	.72	1.62	.78	.77	.51	.37	.35
2320	♂	7.30	11.50	3.60	2.75	.77	.95	1.30	1.25	.83	.68	.88	.72	.68	1.50	—	—	—	—	—
2964	♂	7 75	11.90	3.85	3.00	.77	1.07	1.57	1.50	.90	.62	.82	.73	.68	1.62	.75	.76	.50	.32	.33
2290	♂	7.80	11.75	3.75	2.95	.62	.85	1.67	1.35	.86	.68	.87	.64	.61	1.60	.77	.78	.45	.34	.34
2499	♂	7.75	11.75	3.78	2.96	.90	1 03	—	—	.94	.70	.82	.68	.65	1.55	.72	.74	.44	.38	.38
2290	♂	7.55	11.75	3.83	2.95	.67	.81	1.58	1.37	.95	.72	.80	.67	.67	1.62	.82	.84	.50	.40	.38
2319	♂	7.65	11.75	3.75	2.85	.77	.90	1.54	1.40	.95	.70	.98	.70	.73	1.58	—	—	.50	.35	.33
9885	♂	7.50	11.75	3.55	3 00	.78	.95	1.87	1.65	.90	.70	.90	.75	.75	1.60	.80	.82	.47	.35	.35
2500	♂	7.65	12.00	3.83	3.00	—	—	—	—	.98	.72	.90	.75	.72	1.58	.75	.78	.50	.37	.37

Table I. — Dolichonyx oryzivorus *Swain.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus.	Hind. Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill. Culmen.	Bill. Commissure.	Bill. Gonys.	Bill. Height.	Bill. Width.
2293	♂	7.50	11.50	3.75	2.68	.93	1.27	1.10	1.00	1.05	.87	1.12	.77	.80	1.32	.60	.63	.34	.36	.36
10342	♂	7.00	11.00	3.64	2.45	.88	1.20	.80	—	1.07	.92	1.17	.73	.75	1.37	.62	.65	.35	.37	.37
10343	♂	7.30	11.80	3.87	2.80	.90	1.30	.95	.90	1.12	.95	1.28	.87	.87	1.37	—	—	.33	.34	.37
5585	♂	7.35	11.55	3.80	2.66	.97	1.40	—	.83	1.15	.98	1.27	.93	.87	1.35	.62	.62	.35	.36	.36
2295	♂	7.50	11.50	3.71	2.73	1.05	1.33	.93	.90	1.00	.92	1.18	.85	.85	1 37	.62	.62	.35	.36	.36
119	♂	7.25	11.65	3.82	2.57	.78	1.23	—	.80	1.00	.83	1.12	.76	.78	1.34	.60	.60	.35	.38	.37
5743	♂	7.35	11.75	3.65	2.68	1.03	1.33	—	.80	1.10	.92	1.13	.78	.80	1.38	.60	.63	.36	.37	.40
9901	♂	6.65	11.50	3.70	2.53	.82	1.25	.95	.90	1.00	.85	1.07	.70	.76	1.35	.57	.60	.35	.35	.36
389	♂	7.20	11.20	3.55	2.50	.85	1.20	.95	.87	1.08	.86	1.10	.75	.78	1.40	.58	.62	.35	.37	.37
9854	♂	6.80	11.15	3.53	2.57	.98	1.14	1.03	.82	.98	.83	1.17	.82	.82	1.37	.60	.62	.35	.38	.38
2298	♂	7.70	11.80	3.75	2.78	1.03	1.35	1.07	.95	1.05	.90	1.12	.82	.85	1.37	.62	.64	.40	.38	.38
5741	♂	7.15	11.65	4.00	2.72	1.20	1.40	.97	.82	—	.87	1.13	.83	.82	1.36	.58	.60	.37	.38	.37
2296	♂	7.15	11.50	3.80	2.75	.98	1.42	.98	1.00	1.05	.82	1.20	.85	.88	1.33	.57	.63	.37	.38	.37
9893	♂	7.35	11.75	3 90	2.73	.98	1.37	1.15	.92	1.10	.95	1.27	.85	.85	1.36	.58	.65	.35	.38	.37
9892	♂	7.25	11.90	3.86	2.82	.97	1.35	1.10	.90	1.04	.87	1.23	.82	.83	1.33	.57	.62	.35	.37	.38
1482	♂	7.10	11.90	3.85	2.47	1.00	1.35	1.10	.95	1.05	.90	1.20	.88	.88	1.35	.60	.64	.35	.38	.37
9896	♂	7.25	12.15	3 90	2.67	1.05	1.40	1.08	.91	1.07	.85	1.17	.78	.78	1.36	.60	.60	.35	.36	.35
9894	♂	6.90	11.75	3.75	2.70	.95	1.32	.90	1.00	1.00	.83	1.00	.81	.82	1.35	.62	.64	.38	.39	.39
10219	♂	7.55	12.00	3.83	2.75	.98	1.33	1.23	1.05	1.03	.98	1.25	.76	.76	1.33	.60	.60	.37	.35	.39
5744	♂	7.45	11.35	3.85	2.82	1.08	1.43	1.00	1.05	1.10	.95	1.13	.82	.83	1.35	.60	.62	.37	.37	.39

Table J. — Pipilo erythrophthalmus *Vieillot.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus	Hind. Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill. Culmen.	Bill. Commissure.	Bill. Gonys.	Bill. Height.	Bill. Width.
350	♂	7.80	10.50	3.20	3.35	.33	.43	2.05	2.25	1.05	.76	1.12	.84	.82	1.37	.60	.67	—	.37	.37
1366	♂	8.25	10.65	3.43	3.70	.40	.50	2.25	2 15	1 03	.78	1.02	.85	.80	1.47	.56	.73	.40	.40	.37
1543	♂	8.00	11.00	3.60	3.90	.43	.48	2.35	2.27	1.05	.77	1.08	.88	.88	1.50	.60	.68	.40	.42	.34
1476	♂	7.80	10.30	3.20	3.40	.45	.45	2.38	2.18	1.10	.75	1.03	.78	.77	1.50	.60	.72	.37	.39	.35
1397	♂	8.25	10.25	3.45	3.70	.53	.58	2.60	2.13	1.12	.80	1.10	.82	.77	1.48	.53	.67	.34	.34	.38
1421	♂	8.10	10.60	3.17	3.48	.30	.20	—	1.85	1.07	.80	1.00	.78	.73	1.45	.53	.66	.40	.40	.33
349	♂	8.15	10.70	3.50	3.75	.43	.50	—	1.82	1.08	.80	1.00	.78	.77	1.46	.55	.70	.36	.38	.30
1399	♂	7.75	10.00	3.35	3.57	—	—	—	2.15	1.05	.80	1 05	.78	.77	1.46	.57	.70	.37	.35	.35
2985	♂	8.35	11.05	3 43	3.65	.35	.52	2.23	2.00	1.13	.75	1.00	.80	.80	1.50	.53	.72	.37	.35	.35
2965	♂	8.25	10.50	3.50	3.70	.45	.55	2.40	2.40	1.06	.81	1.08	.83	.78	1.49	.60	.70	.35	.37	.35
4009	♂	8.55	12.25	3.57	3.85	.47	.47	2.58	2.20	1.07	.77	1.04	.83	.78	1.40	.56	.70	.35	.35	.35
1783	♂	8.25	11.20	3.54	3.68	.45	.53	2.20	2.15	1.05	.80	1.04	.76	.68	1.50	.55	.73	.42	.35	.35
1612	♂	8.00	10.45	3.22	3.45	.30	.41	2.20	2.50	1.10	.80	1.10	.75	.72	1.50	.62	.73	.37	.32	.37
1771	♂	7.75	10.85	3 38	3.70	.35	.50	2.35	2.85	.98	.73	.95	.80	.73	1.45	.57	.68	.35	.33	.32
1784	♂	7.90	10.80	3.43	3.62	.40	.57	2.30	2.17	1.10	.78	1.08	.78	.73	1.50	.59	.72	.38	.38	.35
81	♂	8 25	11.15	3.54	3.80	.40	.45	2 53	2.30	1.08	.80	1.04	.80	.75	1.45	.55	.66	.38	.34	.35
83	♂	8.50	11.15	3 52	3.75	.42	.53	2.22	2.18	1.06	.80	1.05	.82	.75	1.50	.60	.73	.37	.41	.42
10151	♂	7.50	10.20	3.34	3.60	.46	.55	2.58	1 93	1.08	.75	1.12	.77	.75	1.45	.53	.62	.35	.37	.35
9696	♂	8.20	11.00	3.68	3.93	.50	.50	2.25	2.05	1.10	.78	1.07	.82	.82	1.50	.60	.73	.37	.42	.39
84	♂	8.15	10.25	3.30	3.70	.38	.47	—	2.06	1.02	.75	1.00	.83	.80	1.40	.60	.67	.37	.37	.35

Table K. — SIALIA SIALIS *Hald.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus.	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill.				
																Culmen.	Commissure.	Gonys.	Height.	Width.
2331	♂	7.00	12.30	4.00	2.50	1.00	1.20	1.30	1.20	.75	.63	.87	.68	.60	1.48	.48	.77	.30	.18	.35
1945	♂	6.75	12.20	3.90	2.60	1.03	1.11	1.56	1.04	.77	.56	.85	.72	.65	1.48	.50	.70	.33	.20	.34
2378	♂	7.00	12.25	4.10	2.60	1.20	1.26	1.27	1.05	.77	.60	.85	.64	.65	1.45	.50	.76	.32	.21	.33
2479	♂	6.10	11.35	3.87	2.50	1.10	1.20	1.25	1.05	.78	.60	.87	.65	.58	1.50	.56	.77	.30	.18	.35
1946	♂	6.85	12.10	4.03	2.58	1.03	1.20	1.33	1.13	.80	.77	.84	.61	.50	1.50	.53	.80	.32	.18	.37
1883	♂	6.85	12.55	4.07	2.56	1.17	1.26	1.20	1.15	.80	.77	.91	.65	.60	1.48	.50	.80	.30	.20	.38
10292	♂	6.45	11.75	3.90	2.60	.95	1.15	—	—	.76	.85	.82	.62	.55	1.35	.49	.72	.30	.20	.38
1881	♂	6.70	11.65	3.82	2.43	.98	1.13	1.20	1.08	.77	.67	.85	.56	.50	1.50	.56	.80	.33	.20	.33
72	♂	6.80	12 00	3.87	2.33	1.03	1.12	1.17	1.03	.75	.60	.85	.68	.62	1.50	.55	.78	.33	.20	.33
10226	♂	6.75	12.40	4.00	2.77	1.15	1.25	1.50	1.08	.77	.62	.83	.63	.58	1.50	.52	.80	.34	.20	.33
10231	♂	6.75	12.10	3.90	2.50	1.10	1.30	1.37	1.23	.75	.55	.80	.60	.54	1.42	.48	.76	.27	.18	.32
1456	♂	6.50	11.10	3.75	2.45	1.00	1.10	1.15	.95	.74	.62	.84	.65	.60	1.53	.55	.80	.35	.20	.35
5605	♂	6.70	12.00	3.85	2.35	1.10	1.25	1.08	.82	.77	.57	.77	.58	.54	1.50	.47	.77	.30	.18	.35
5763	♂	6 68	12.25	4.03	2.63	1.10	1.25	1.15	.90	.78	.55	.83	.58	.53	1.53	—	—	.32	—	—
5765	♂	6.65	11.80	3.90	2.63	1.05	1.17	1.58	1.23	.76	.57	.80	.61	.56	1.50	.55	.80	.31	.17	.30
5606	♂	6 50	11.65	4.05	2.68	1.25	1 40	1.27	1.18	.78	.60	.85	.63	.60	1.47	.53	.83	.32	.17	.34
338	♂	6 40	11.10	4.07	2.63	1.30	1.30	1.25	1.07	.80	.60	.88	.68	.62	1.50	.45	.77	.30	.21	.35
5760	♂	7 00	12.25	3.85	2.50	1.15	1.30	1.20	1 05	.80	.60	.83	.60	.55	1.45	.45	.70	.29	.18	.32
5766	♂	6.80	12.00	3.85	2 48	1.00	1.20	1.20	1.12	.83	.56	.80	.60	.58	1.45	.52	.70	.32	.16	.35
77	♂	6.75	11.75	3.95	2.55	1.15	1.30	—	—	.82	.60	.87	.65	.62	1.45	.45	.77	.30	.18	.34

Table L. — GALEOSCOPTES CAROLINENSIS *Cab.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill. Culmen.	Bill. Commissure.	Bill. Gonys.	Bill. Height.	Bill. Width.
5858	?	8.75	11.35	3.55	3.75	.35	.57	2.20	2.05	1.08	.75	1.04	.77	.73	1.75	.80	1.00	.45	.23	.37
1790	?	8.75	11.75	3.75	3.85	.55	.70	2.50	1.85	1.10	.70	1.06	.76	.72	1.90	.73	.98	.43	.24	.37
10132	?	7.80	10.50	3.35	3.70	.42	.55	—	—	1.10	.73	1.03	.76	.73	1.67	.65	.92	.40	.24	.38
10014	?	8.75	11.25	3.85	4.10	.70	.75	2.20	1.95	1.12	.71	1.10	.77	.74	1.80	.78	1.00	.45	.27	.38
2273	?	8.50	11.25	3.40	3.65	.48	.65	—	1.85	1.15	.70	.98	.74	.70	1.75	.74	1.00	.45	.25	.37
234	?	8.40	10.80	3.60	3.68	.45	.62	2.10	1.87	1.10	.70	.96	.75	—	1.75	.75	1.00	.43	.24	.37
257	?	9.00	11.75	3.75	4.10	.58	.67	2.40	2.05	1.10	.72	1.03	.74	.70	1.73	.78	.96	.45	.24	.37
2229	?	8.65	10 75	3.65	3.90	.50	.62	2.35	2.00	1.07	.68	.93	.67	.64	1.70	.80	.95	.47	.24	.39
2734	?	8.00	10.50	3 25	3.35	—	—	—	—	1.15	.70	1.05	.70	.65	1.65	.70	.92	.43	—	—
10356	?	8.35	11.00	3.35	3.57	.53	.65	—	—	1.00	.70	1.00	.73	.70	1.68	.72	.95	.42	.23	.36
1754	?	8.80	11.45	3.62	3.87	.65	.70	2.40	1.75	1.08	.69	1.02	.73	.71	1.70	.73	.93	.45	.23	.36
2274	?	9.00	11.85	3.75	4.00	.67	.70	2.40	1.20	1.12	.70	1.00	.73	.70	1.76	.78	.97	.50	.25	.37
256	?	8.25	11.25	3.37	3.55	.55	.50	—	1.60	1.10	.68	.97	.72	.68	1.75	.80	.97	.45	.26	.35
1638	?	8.80	11.40	3 55	3.70	.47	.60	—	—	1.06	.70	1 00	.77	.73	1.75	.75	1.00	.46	.24	.36
2281	?	8.85	11.50	3.75	3.80	—	—	—	—	1.10	.71	1.04	.74	.71	1.70	.75	.98	.47	.24	.32
5857	?	8.75	10.75	3.42	3.78	.46	.52	—	1.82	1.18	.70	1.08	.75	.72	1.75	.76	1.00	.46	.23	.37
235	?	8 62	11.20	3 50	3.63	—	—	—	—	1.05	.72	1.07	.75	.70	1.75	.73	.96	.44	.23	.35
1481	?	8.80	11.25	3.63	3.95	.53	.45	2.50	2.00	1.13	.71	1.05	.75	.72	1.75	.80	.94	.46	.21	.33
254	?	8.70	10.90	3.40	3.67	.40	.53	—	—	1.10	.66	1.00	.70	.67	1.72	.67	.97	.48	.23	.37
2986	?	8.50	10.75	3.40	3.45	.55	.60	—	—	1.05	.66	1.02	.75	.70	1.62	.63	.93	.37	.22	.37

Table M. — TYRANNUS CAROLINENSIS *Temm.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus.	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill.				
																Culmen.	Commissure.	Gonys.	Height.	Width.
1071	?	8.00	13.50	4.37	3.25	1.00	1.40	1.50	1.30	.75	.50	.80	.62	.56	1.67	.80	1.00	.44	.32	.53
10027	?	8.20	14.25	4.63	3.20	.87	1.42	1.70	1.30	.80	.55	.85	.61	.58	1.67	.80	1.02	.47	.30	.54
10026	?	7.85	14.20	4.67	3.50	1.05	1.53	1.80	1.46	.70	.55	.77	.60	.56	1.66	.77	.98	.47	.27	.45
10023	?	8.00	14.25	4.55	3.50	1.06	1.48	1.78	1.50	.70	.53	.87	.57	.53	1.58	.77	.92	.46	.28	.37
5546	?	8.15	14.15	4.63	3.43	1.09	1.56	1.62	1.36	.70	.60	.80	.60	.57	1.71	.83	1.02	.51	.27	.43
114	?	8.00	14.10	4.45	3.22	1.03	1.40	1.77	1.38	.80	.54	.77	.55	.50	1.73	.80	1.05	.50	.30	.50
112	?	8.20	13.50	4.47	3.33	.95	1.44	1.71	1.40	.70	.53	.77	.60	.56	1.60	.74	.98	.42	.30	.47
10025	?	7.00	13.00	4.17	3.15	.96	1.22	1.80	1.43	.67	.53	.73	.54	.50	1.58	.70	.97	.42	.28	.44
10376	?	7.75	13.75	4.42	3.25	.90	1.38	1.77	1.57	.70	.55	.77	.60	.53	1.68	.80	1.02	.50	.27	.47
10029	?	8.00	13.80	4.45	3.25	.90	1.30	1.73	1.73	.70	.72	.85	.62	.60	1.72	.78	1.05	.50	.27	.47
284	?	8.00	13.50	4.30	3.15	.85	1.15	1.70	1.47	.75	.67	.75	.60	.58	1.63	.67	1.00	.40	.28	.46
113	?	8.25	14.15	4.60	3.20	.90	1.45	1.55	1.20	.78	.58	.85	.70	.65	1.68	.80	1.05	.46	.27	.45
1317	?	7.40	12.50	4.25	2.93	.76	1.10	1.55	1.20	.73	.57	.78	.62	.55	1.57	.62	.90	.37	.20	.46
4008	?	8.20	14.15	4.60	3.30	1.35	1.62	1.78	1.42	.71	.57	.87	.65	.58	1.68	.82	1.04	.48	.26	.49
285	?	7.80	13.00	4.38	3.25	.83	1.15	1.77	1.45	.73	.54	.77	.64	.60	1.73	.82	1.05	.45	.29	.50
1318	?	7.85	13.25	4.20	3.25	.87	1.22	1.68	1.10	.75	.54	.78	.60	.53	1.63	.73	.95	.37	.27	.43
1758	?	8.10	13.80	4.50	3.30	.95	1.43	1.75	1.68	.70	.55	.77	.58	.55	1.68	.83	1.00	.50	.28	.46
1568	?	8.40	14.80	4.85	3.54	1.05	1.47	1.83	1.30	.76	.62	.83	.66	.60	1.70	.80	1.00	.45	.30	.45
283	?	8.65	14.25	4.58	3.47	.98	1.45	1.75	1.37	.70	.58	.82	.57	.63	1.75	.84	1.07	.48	.25	.48
4003	?	8.30	13.50	4.60	3.45	1.00	1.40	1.97	1.44	.73	.56	.77	.62	.60	1.63	.75	.90	.45	.28	.45

Table N. — PYRANGA RUBRA *Vieillot.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus.	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill.				
																Culmen.	Commissure.	Gonys.	Height.	Width.
——	♂	6.75	11.75	3.57	2.62	.80	1.13	—	—	.77	.52	.75	.53	.45	—	.58	.73	.44	.33	.38
10300	♂	6.90	11.30	3.75	2.75	.85	1.25	1.50	1.05	.82	.60	.70	.57	.50	1.53	.58	.75	.45	.35	.37
2929	♂	7.25	11.30	3.65	2.62	.75	1.12	1.23	.85	.73	.56	.67	.53	.47	1.48	.62	.75	.45	.33	.36
9795	♂	7.25	11.30	3.70	2.55	.92	1.12	1.41	1.13	.86	.60	.80	.57	.57	1.50	.64	.76	.40	.35	.40
10119	♂	7.25	11.60	3.80	2.73	.95	1.25	1.25	1.00	.68	.57	.80	.57	.53	1.48	.65	.73	.42	.35	.40
589	♂	7.30	11.75	4.00	2.73	1.07	1.30	1.35	1.00	.72	.57	.75	.58	.52	1.52	.63	.76	.47	.37	.40
10366	♂	7.30	11.75	3.85	2.85	1.00	—	—	—	.76	.58	.76	.53	.51	1.52	.63	.75	.45	.36	.39
10388	♂	7.20	11.60	3.87	2.75	.95	1.20	1.25	1.33	.77	.53	.79	.55	.50	—	—	—	—	—	—
10133	♂	7.00	11.00	3.77	2.77	.85	1.00	1.45	.88	.78	.58	.75	.55	.53	1.48	.57	.73	.40	.35	.36
1834	♂	6.75	11.30	3.60	2.50	.85	1.17	1.12	1.12	.70	.60	.73	.56	.54	1.46	.62	.73	.45	.37	.42
190	♂	6.75	10.75	3.80	2.64	.90	1.20	1.50	1.60	.67	.55	.70	.56	.56	1.38	.64	.70	.42	.33	.38
1833	♂	6.90	11.25	3.70	2.55	.85	1.05	1.33	1.05	.73	.55	.70	.57	.52	1.50	.65	.77	.43	.35	.40
1642	♂	7.00	10.65	3.85	2.75	1.07	1.23	1.50	1.10	.75	.53	.76	.55	.48	1.50	.65	.77	.45	.33	.37

Table O. — Hedymeles ludovicianus *Cab.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus.	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill. Culmen.	Bill. Commissure.	Bill. Gonys.	Bill. Height.	Bill. Width.
1438	♂	7 50	12.25	3.87	3.05	.80	1.17	1.25	1.00	.92	.70	.75	.75	.70	1.50	.72	.78	.43	.54	.45
590	♂	7.75	12.30	4.00	3.00	.90	1.25	1.55	1.24	.93	.70	.74	.74	.72	1.55	.77	.80	.48	.55	.47
9787	♂	7.75	11.75	3.83	2.95	.85	1.13	1.50	1.40	.90	.70	.67	.67	.62	1.53	.73	.75	.45	.50	.43
2882	♂	8.30	12.50	4.15	3.05	.93	1.15	1.45	1.15	.88	.70	.75	.75	.74	1.55	.73	.77	.45	.51	.46
9935	♂	7.55	11.90	4.00	3.02	.60	1.06	1.28	.95	.87	.67	.75	.75	.70	1 55	.70	.78	.48	.56	.45
9580	♂	8 12	12.50	4.25	3.05	1.06	1.24	1.30	1 00	.88	.72	.65	.65	.55	1.58	.75	.88	.50	.60	.50
1518	♂	7.75	11.80	3.85	2.75	.70	1.00	1.20	1.00	.80	.70	.65	.65	.60	1.54	.75	.82	.40	.55	.45
1065	♂	7.60	12 00	3.83	2.88	.82	.97	1.24	.98	.90	.60	.65	.65	.58	1.55	.70	.81	.45	.55	.43
1547	♂	7.50	12.10	3 86	2.70	.95	1.10	1.36	—	.82	.67	.63	.63	.56	1.50	.65	.75	.44	.51	.45
187	♂	7.75	11.50	3.85	2.77	.80	1.07	1.40	1.42	.82	.65	.67	.67	.63	1.52	.70	.77	.45	.53	.45
9581	♂	7.85	12.50	3.95	2.82	.77	1.00	—	1.12	.84	.67	.68	.68	.61	1.42	.66	.70	.43	.53	.42
5591	♂	7.75	11.90	4.00	3.08	.82	1.00	—	1.18	.87	.67	.68	.68	.58	1.50	.73	.82	.45	.54	.44
5592	♂	8.10	12.90	4 15	3.00	.75	1.15	1.70	1.35	.92	.65	.72	.72	.65	1.55	.70	.77	.45	.54	.43
2942	♂	7.85	12.15	3.97	2.93	.80	1 08	1.92	1.10	.90	.68	.65	.65	.60	1.50	.68	.72	.45	.55	.50
9934	♂	8.10	12.75	4.00	3.00	.83	1.05	1.40	1.22	.83	.70	.67	.67	.57	1.58	.75	.77	.46	.52	.47
1823	♂	7.15	12.00	4.05	2.85	.90	1.07	1.25	1.00	.70	.62	.78	.78	.74	—	—	—	—	—	—
10107	♂	7.65	11.75	4.20	2.93	.90	1.05	1.05	1.10	.86	.70	.73	.73	.60	1.57	.75	.73	.45	.50	.48

Table P. — Geothlypis trichas *Cab.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill.				
																Culmen.	Commissure.	Gonys.	Height.	Width.
9976	♂	5 00	7.00	2.10	2.00	.35	.42	.92	—	.82	.55	.68	.52	.51	1.20	.45	.57	.31	.17	.22
358	♂	5.17	7.25	2.20	2.07	—	—	—	—	.80	.53	.75	.54	.53	1.20	.47	.53	.30	.17	.27
1808	♂	5.25	7.25	2.25	2.05	.36	.32	1.04	.75	.77	.53	.68	.50	.48	1.17	.48	.59	.30	.17	.27
2534	♂	5.15	7.20	2.12	1.88	.35	.35	—	.64	.74	.55	.75	.55	.52	1.25	.55	.67	.30	.18	.26
9775	♂	4.65	6.75	2.37	2.05	.25	.33	—	—	.78	.52	.73	.54	.53	1.13	.43	.55	.27	.15	.24
1809	♂	5 25	6.75	2.20	2.00	.26	.33	.87	1.00	.77	.52	.72	.51	.51	1.28	.48	.58	.31	.16	.27
2997	♂	5.25	7.10	2.18	1.95	.22	.35	—	.70	.78	.53	.73	.55	.53	1.22	.45	.57	.31	.17	.26
9858	♂	4.88	6.45	2.20	2.10	—	—	1.06	.82	.77	.52	.72	.55	.53	1.22	.47	.57	.34	.18	.27
7515	♂	5.37	7.25	2.27	2.10	—	—	—	—	.74	.50	.72	.53	.51	1.18	.50	.60	.32	.18	.22
330	♂	5.10	6.75	2.13	2.10	.33	.37	—	—	.72	.47	.68	.48	.48	1.22	.50	.60	.32	.18	.27
1444	♂	5.63	7.50	2.32	2.17	.35	.40	—	—	.77	.52	.75	.55	.53	1.26	.52	.65	.32	.17	.28
1971	♂	4.60	6.30	1.95	1.78	—	—	—	—	.75	.51	.62	.46	.44	1.16	.45	.54	.28	.15	—
2996	♂	5.37	7.30	2.27	2.08	.32	.38	.97	.70	.78	.54	.73	.53	.52	1.22	.48	.60	.32	.18	.25
2361	♂	4.87	6.75	2.12	1.82	—	—	—	—	.82	.44	.70	.52	.52	1.18	.43	.60	.31	.13	.26
2427	♂	4.88	6.75	2.03	1.88	—	—	—	—	.79	.50	.66	.47	.45	1.15	.43	.58	.30	.15	.28
9669	♂	5 05	6.75	2.13	2.05	—	—	—	—	.80	.48	.73	.53	.51	1.22	.48	.57	.32	.15	.22
9836	♂	5.00	6 85	2 05	1.85	—	—	—	—	.76	.51	.66	.52	.50	1.15	.48	.57	.30	.14	.21
2398	♂	5.20	7.00	2.25	2.00	—	—	—	—	.76	.50	.70	.53	.51	1.20	.49	.59	.32	.15	.23
1445	♂	5.33	6.90	2.15	2.05	—	—	—	—	.78	.48	.73	.55	.54	1.23	.48	.57	.32	.16	.24
2436	♂	5.10	6.80	2.10	1.95	—	—	—	—	.74	.52	.67	.52	.50	1.15	.44	.56	.27	.15	.24

Table Q. — HARPORHYNCHUS RUFUS *Cab.*

M. C. Z. Number.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Extent of Primaries beyond Inner Secondaries.	Extent of Primaries beyond Outer Secondaries.	Extent of Tail beyond Upper Coverts.	Extent of Tail beyond Lower Coverts.	Tarsus.	Hind Toe.	Middle Toe.	Outer Toe.	Inner Toe.	Head.	Bill.				
																Culmen.	Commissure.	Gonys.	Height.	Width.
1752	?	11.85	14 00	4.25	5.05	.50	.65	—	3.20	1.42	.93	1.25	.85	.80	2.30	1.13	1.25	.70	.35	.45
1625	?	10.55	12.75	3.90	4.60	.43	.60	3.15	2.95	1.27	.90	1.25	.84	.77	2.15	1.00	1.24	.60	.28	.41
237	?	11.00	12.55	3.80	4.78	.38	.56	3 13	2.75	1.33	.84	1.17	.86	.80	2.30	1.06	1.33	.76	.27	.38
10320	?	11.25	13.30	3.95	4.95	.43	.68	3.35	2.95	1.42	.87	1.22	.78	.72	2.25	1.05	1.34	.72	.29	.43
1670	♂	11.50	13.25	4.15	5.18	.47	.60	3.60	3.20	1.36	.93	1.25	.85	.80	2.18	—	1.28	.65	.27	.44
2585	?	10 85	12.90	3.95	4.86	.50	.65	—	2 65	1 25	.87	1.17	.80	.70	2.26	1.03	1.35	.68	.28	.40
1439	♂	11.10	12.80	4.00	4.93	.36	.56	3.17	2.95	1.35	.92	1.28	.90	.85	2.25	1.12	1.33	.67	.27	.43
1067	?	10.85	13 35	4.15	5.00	.32	.55	3.38	3.05	1.32	.86	1.25	.90	.78	2.30	1.06	1.35	.73	.30	.45
8887	♂	11.21	13.50	4.20	4.50	—	—	—	—	1.25	.79	1.25	.75	.73	2.25	1.05	1.35	.74	.30	—
8886	♂	11.41	13.00	4.07	4.59	—	—	—	—	1.30	.85	1.23	.82	.75	2 15	1.00	1.23	.67	.27	.40
8888	♀	11.31	13.30	4.16	5.00	—	—	—	—	1 30	.82	1.23	.85	.82	2.23	1.00	1.25	.65	—	—
8889	♀	11.30	13.00	5.00	5.10	—	—	—	—	1.20	.78	1.25	.90	.84	—	1.00	1.28	.72	.27	.40
8385	♂	11.35	13.35	4 11	5.00	—	—	—	—	1.22	.85	1.30	.87	.78	2.22	1.04	1.33	.70	.27	.37
8891	♂	11.60	13.55	4.25	5.00	—	—	—	—	1.27	.85	1 24	.87	.77	—	1.00	1.26	.67	.25	.38
8996	♂	11.50	13.25	4.10	5.00	—	—	—	—	1.35	.87	1.25	.86	.78	2.23	1.05	1.32	.72	.27	.38
8897	♂	11.75	13 35	4.32	5.30	—	—	—	—	1.24	.85	1.30	.83	.79	2.22	1.05	1 28	.73	.28	.36
8896	♂	11.60	13.00	4.15	5.20	—	—	—	—	1.35	.85	1.27	.83	.75	—	.94	1.30	.68	.25	.40

Individual Variation in the Size and Form of the Bill. — That considerable variation occurs in the size and shape of the bill, in specimens of the same sex and species living together at the same locality, is evident from a glance at some of the preceding tables of measurements. The variation in this organ is further illustrated in the accompanying plates (Plates IV – VIII), in which are given figures of the bills of several specimens of each of a number of species. Much greater differences are here shown to exist in cospecific specimens of the same sex and from the same locality than occur between those supposed to be distinct, of which comparative figures of the bills have been published with a view of demonstrating their specific diversity. In only a few groups in fact, and mainly in the long-billed *Grallæ*, is the bill generally admitted to be too variable to afford an important basis for the discrimination of species.

The principal points of variation in the form of the bill consist in variations in its general size, without corresponding variations in the general size of the individual, and in the details of its form in regard to thickness and length. There are also other variations in respect to the emargination or dentation of the terminal portion, especially in the vast group of the insectivorous species, and in the "festooning" of the bill in many of the hawks.* In respect to the size of the bill, it is a noteworthy fact that birds specifically and sexually identical vary in such a way that specimens much below the average size possess bills above the average size for their respective species, and, conversely, that specimens above the average size have bills much smaller than the average for their respective species, the general proportions of the bill in each case being essentially the same. In such cases, with the increase or decrease in length, there are corresponding differences in the thickness of the bill, both in the vertical and transverse directions. In other cases with the increase in length there is no corresponding increase in thickness, such a differentiation thus resulting in a relatively attenuated form of the bill. In other cases the bill is shortened without a corresponding decrease in its thickness, from which results a short, thick, or robust bill. The variation in thickness is again sometimes relatively greater in the vertical

* In respect to this point, see Dr. Henry Bryant's paper on "Variations in the Plumage in *Buteo borealis* auct. and *B. Harlani* Aud.?" (Proc. Boston Soc. Nat. Hist., Vol. VIII, p. 107 *et seq.*, 1861, where the variation in this feature is especially noticed.

than in the transverse direction, and sometimes the reverse, thus giving in some cases a deep, narrow bill, and in others a broad, depressed bill. In the latter case the differences are especially important, as will be more fully shown later. In regard to the tooth-like indentation near the tip of the bill in so many of the insectivorous birds, it is found that in some species which usually have it strongly developed, specimens occasionally occur with the indentation nearly or quite obsolete. Again in other cases where this feature is usually but slightly developed, some specimens have the notch at the tip of the bill exceedingly prominent. Similar variations occur in regard to the development of the so-called "festoon" of the upper mandible in the hawks, as Dr. Bryant has already sufficiently shown.

The greatest range of individual differentiation in any given organ occurs, as would be naturally expected, in those species which have that organ more than ordinarily developed, and also in species of a low grade of structure. In the long-billed *Grallæ* both these conditions exist, and it is in such genera as *Numenius*, *Gambetta*, *Limosa*, *Scolopax*, *Philohela*, and *Gallinago*, that the maximum of bill variation is seen. It is less marked in the song-birds, though in many members of this group the variation is by no means small. In the typical woodpeckers, on the other hand, which have the bill especially adapted to a peculiar function, that of digging into wood, the variation is scarcely appreciable, since any considerable variation from its usual form would seriously impair its efficiency. In the semi-frugivorous and terrestrial *Picidæ*, however, we again meet with the usual range of variation.

In the accompanying plates illustrative of variation in the bill, representatives from the higher types of the *Oscines* have mainly been chosen, several representatives from widely different families having been selected. Plate IV, figures 1 and 1*a*, 2 and 2*a*, give a view of the bills of two specimens of the common king-bird (*Tyrannus carolinensis*), from Eastern Massachusetts, which differ from each other as much as the bills of different genera sometimes do. One of them, as will be seen, is so much narrower and deeper than the other as to give very different proportions and outlines. The skulls of these two specimens vary in the same manner as do the bills, the one having a broad, flat skull, and the other a narrow, high one. Two specimens of *Myiarchus crinitus*, one of which is from South Carolina and the other from Western New York, differ as much from each other, and in nearly the same way, as do those of the king-bird. Similar and nearly as great variations occur also between different specimens of *Contopus borealis*, *C. virens*, *Empidonax minimus*, *E. flaviventris*, *Sayorius fuscus*, and in several species of the South American *Tyrannidæ*. But between these two extremes are found in other specimens nearly every possible degree of gradation.

Figures 3 and 3*a* to figures 7 and 7*a* (same plate) represent different forms of the bill in *Troglodytes aëdon*. Between these specimens there are great differences both in respect to absolute size and to general form, greater than would be deemed necessary by most ornithologists for the differentiation of species. These examples are all from Florida, and essentially from the same locality. Other specimens in the Museum come between these extremes in such a way as to show the inconstancy of all these forms. The variation in color, which is considerable in this species, does not accord with the variation in the bill, specimens exhibiting the extremes of color as often having the bills alike as otherwise, and, conversely, those with bills alike differ widely in color.

Figures 8 and 8*a* to 11 and 11*a* (same plate) indicate the variability of the bill, especially in respect to length, in Massachusetts specimens of *Seiurus noveboracensis*. The first corresponds essentially with, and unquestionably is, an example of the so-called *Seiurus ludovicianus*, which, in all probability, is but the darker colored, longer-billed southern form of *S. noveboracensis*. This species varies also remarkably in color, but the variation in color, as in the case of *Troglodytes aëdon*, and as is commonly the case in other species, does not accord with the variation in the bill, some of the long-billed specimens being in color almost undistinguishable from some of the short-billed ones, while some of those with medium bills present the extreme degrees of variation in respect to color.

Figures 12 and 12*a* to 14 and 14*a* (same plate) represent the bills of three male specimens of *Mniotilta varia* from the vicinity of Cambridge, which present as great differences as modern ornithologists would ordinarily deem sufficient, if the specimens had come from Mexico instead of from Massachusetts, to warrant their recognition as types of three distinct species. The correspondingly great variations in color in this species have already been adverted to (p. 190). The bill, however, in specimens presenting extreme forms of color variation, unfortunately for ultra-divisionists, may be either of the ordinary form or of either of the forms figured, or of any intermediate form, as exemplified by the specimens of this species in the collection of the Museum. Figure 15 and 15*a* and 16 and 16*a* (same plate) are accurate representations of the bills of two Massachusetts males of *Dendrœca striata*. The differences between these specimens, though so great, are not greater than occur in different cospecific examples of several other species of this genus contained in the Museum.

Massachusetts specimens of *Certhia familiaris* differ even more in the form of the bill than do the specimens above figured of either *Troglodytes aëdon* or *Mniotilta varia*. They also present a similar range of color variation in the plumage, and one equally at variance with the variation in the bill.

Figures 19 and 19*a*, 20 and 20*a* (same plate), show how widely two Florida specimens (both males) of *Pyranga æstiva* vary in respect to the size of the bill, the specimens in question differing but little in general size. If these figures are compared with the figures recently published of the bills of certain supposed species of *Pyranga*,* they will be found to vary more than some of the latter do, and indicate how unsatisfactory the nature of species must be when based mainly upon differences in the bill. Other cospecific specimens of *Pyranga* in the Museum exhibit great difference in the size, form, and position of the tooth-like processes of the upper mandible, and in the color of the bill, — differences that have been regarded as specific characters. The color of the bill in many species of birds, in fact, varies greatly in specimens of the same species taken at the same season, and generally in those taken at different seasons; yet it is a character that has been relied upon for the distinction of species.

Figures 1 and 1*a*, 2 and 2*a*, 4 and 4*a*, and 5 and 5*a*, Plate V, illustrate variations in the bill in Massachusetts representatives of *Ægiothus linarius*. Figures 3 and 3*a*, and 5 and 5*a*, are drawn from specimens from Arctic America, the first being an original specimen of the *Æ. fuscescens* Coues ex auct., and the other a similar specimen of the *Æ. exilipes* Coues. Figures 7 and 7*a* to 10 and 10*a*, inclusive (same plate), represent variations of the bill in male specimens of *Chrysomitris tristis*, a species allied to *Æ. linarius*. It will be seen that the two series are nearly parallel in respect to the amount and character of the variations in the bill. Figures 11 and 11*a* and 12 and 12*a* indicate similar variations in an-

* Proceed. Phil. Acad. Nat. Sci., June, 1869, pp. 130–133.

other allied species, the *Chrysomitris pinus*, and figures 13 and 13*a* to 15 and 15*a*, inclusive (same plate) similar variations in another species (*Curvirostra americana*), of the same sub-family. In the latter case the specimens are also all males, and all from the vicinity of Cambridge, they having been killed in fact from the same flock. In the *Ægiothus* group numerous so-called "species" have been described by different writers, six or seven of which were recognized by Dr. Coues a few years since in his monograph of that genus.* A considerable number of these species have been generally looked upon as equivocal, and the exact number in the group and their distinctive characteristics have been a matter of much uncertainty. Recently the writer above referred to has again revised the group,† and arrives at the conclusion that if more than one species exists, all the forms previously recognized by him as species are valid species. I can readily grant this alternative, being fully convinced that the genus consists of but a single known species, which has a circumpolar distribution. The alleged specific distinctions have consisted in differences in general size, in the relative size of the bill, the length of the tarsus, wing, and tail, and in color. Some of these differences are doubtless climatic and local, while others may be due to age, but the greater part I believe to be to a great degree purely individual, inasmuch as they are paralleled in allied species, whose standing has not been and cannot reasonably be questioned. But the special consideration of the variations presented by the *Ægiothi* and similar groups will be reserved till after the facts relating to geographical variation have been presented, since they can then be more appropriately discussed.

Figures 16 and 16*a* to 18 and 18*a*, inclusive (Plate V), represent the bills of three male specimens of *Passerculus savanna*, from different localities on the Atlantic coast. The specimen represented in figures 18 and 18*a*, has the bill of minimum size, being in bulk less than half that of the one represented in figures 17 and 17*a*.‡ Figure 17, it will be observed, corresponds nearly with the so-called *P. sandwichensis* § of

* A Monograph of the genus *Ægiothus*, etc., Proc. Phil. Acad. Nat. Sci., Vol. XII, p. 373, 1861, Vol. XV, p. 40, 1863.

† On variations in the plumage of the *Ægiothi*, Ibid., Vol. XXI, p. —, 1869.

‡ Other specimens received from Grinnell, Iowa, from Professor H. W. Parker, since the above was written, have bills still smaller than any of those here figured.

§ Baird's Birds of N. Amer., p. 444, 1858.

the Pacific coast, and figure 17 with the so-called *Passerculus alaudinus*,* also of the Pacific coast.

Plate VI, although designed more especially to illustrate local variation, indicates to some extent the individual variation existing in *Agelæus phœniceus.* Figures 1 and 1*a* represent the average type of the bill in this species in Massachusetts, and figures 3 and 3*a*, and 4 and 4*a*, unusually long and unusually short forms of the bill found at the same locality. Figures 2 and 2*a*, 5 and 5*a*, and 6 and 6*a*, represent a similar series from the St. John's River, Florida. All the specimens of the two series are adult males.

Plate VII represents similar variations of the bill in *Quiscalus purpureus.* Figures 1 and 1*a*, 3 and 3*a*, 4 and 4*a*, and 6 and 6*a*, represent the average and the extreme types of the bill met with in Massachusetts males. The latter also represents an inflexed type of bill, a modification seen in many species, it being especially common in the *Quiscali* and other genera having the bill of a similar form. It is unmistakably an individual peculiarity, evidently depending mainly upon age, and resulting from the upper mandible outgrowing and overhanging the lower. In *Quiscalus purpureus* such specimens are more or less frequent at probably all localities, they having been received at the Museum from Maine, Massachusetts, New Jersey, Florida, and Illinois, and I have seen them from the West Indies. It often gives rise to the name *inflexirostris*, which is found so frequently a synonyme.† The figures of the bills of four females of *Sturnella ludoviciana* (Plate VIII), from Florida, indicate the character of the bill variation exhibited by different individuals of this species at the same locality, independently of any variation attributable to sex. Figures 5 and 5*a*, and 6 and 6*a* (same plate) show that like variations occur in *Colaptes auratus*, the figures being drawn from two Massachusetts females.

Similar comparisons, with similar results, might be made with scores of other species, but the above illustrations will doubtless suffice to show that individual variation in the form of the bill is not only great, but that it exists in groups having a high grade of structure. Other groups might have been chosen in which the individual variation in the form of the bill, as already stated, is far greater than in the instances above

* Bonaparte, Comptes Rendus, Vol. XXXVII, p. 918, 1853.

† Concerning *Quiscalus inflexirostris* Swainson, see below (Part IV), under *Q. purpureus.*

cited. The *Grallæ* have already been referred to as presenting remarkable examples of bill variation. In some of the *Anatidæ*, however, it is scarcely less, whilst it is especially great among many of the *Longipennes*. Hence some authors evidently attach too high importance to the exact form of the bill in these groups.

All the illustrations referred to above have been drawn, with one or two exceptions, from fully adult specimens. One of these is a specimen of *Passerculus savanna* (Plate V, fig. 18), which is a bird of the year, killed in Labrador in August, before it had quite completed its first moult. Another is the smallest billed specimen of *Chrysomitris tristis* (Plate V, fig. 10), which is also evidently a bird of the year. The other is an autumnal specimen of *Dendrœca striata* (Plate IV, fig. 15). They all, however, would be ordinarily considered as adult in size.

Variations in the Size and Form of the Bill, Wing, etc., resulting from Age.

In the foregoing remarks on the variations in general size, in proportions, and in the form of different parts, exclusive reference has been had to adult specimens. It is easy, however, to confound difference depending upon age with those strictly resulting from individual differentiation. The form of the bill is especially subject to variation by age in specimens that upon casual inspection would seem to be full-grown In long-billed birds the bill increases in length for several months after the bird is full-fledged, and even after it has once moulted. In short- and thick-billed birds, the bill increases considerably in thickness as well as in length after the individual seems to have acquired its adult size and proportions. As a general rule, then, "birds of the year" possess a relatively shorter and thicker bill than those fully adult, or three or four years of age. In old age an abnormal elongation of the upper mandible occasionally occurs, especially in species in which the tip of the upper mandible is decurved and projects slightly beyond the lower, as in *Corvus*, *Quiscalus*, *Vireo*, *Turdus*, *Larus*, etc. Since, however, great differences occur in the form of the bill in specimens of the same age, in birds of the year as well as in those unquestionably adult, it is sometimes difficult to determine how much of the difference in certain cases is to be considered as due to age and how much to individual variation.

The wing also varies considerably in form with age. In many of the song-birds, at least, and also in the raptorial birds, the wing becomes more pointed with the second and third moultings of the remiges. Birds of the first year hence have, even after the flight feathers are fully grown, a shorter and more rounded fore-wing, as a general rule, than birds of two or three years of age. These differences of course result from variations in the relative length of the primaries, the outer primaries being the last to acquire their ultimate proportions, as they are also the last primaries to be renewed in the annual moult. A similar change with age occurs in the form of the inner point of the wing, or that formed by the inner secondaries. These, like the primaries, are subject to a gradual increase in length for a time with each moult, they likewise being the latest of the secondaries to acquire their mature size, as they are also the last of the secondaries changed in each normal moult. Thus, through the gradual elongation of the outer primaries and the inner secondaries, a slight change is produced in the general form of the wing. It is, however, only slight, and since some young birds have as pointed wings as any of the same species which are fully adult, and some adult birds have wings as much rounded as the full-grown young, the rule is subject to many exceptions. The sexes of the same species also often differ similarly with the young and old in respect to the form of the wing. This is more especially the case in those species in which the female is much smaller and much duller colored than the male, the structural inferiority of the female to the male being thus evident in various features.

While the wing may be regarded, as already stated, as generally smaller and more rounded in the younger individuals, it not unfrequently happens that the specimens having the greatest alar extent are immature birds. This has been particularly noticed in the eagles and hawks, as well as in some of the gulls, in which it is so frequent as to have attracted the attention of numerous observers.* The feathers of the wings and tail are not only longer, but they are also broader, and hence in the expanded wing present a greater resisting surface to the air. Two explanations of this fact present themselves. First, in the cases referred to, the birds may have been born at a very northern locality, whence only the younger birds ever descend so far south. Second, the greater lack of power in the muscles of flight in the young birds, as

* See American Naturalist, Vol. III, 1869, p. 517.

compared with those fully mature, may be counterbalanced by a relatively larger supporting surface in the wings and tail. Whatever the explanation may be, the facts seem to be unquestionably as above stated.

Other variations in the plumage and in other characters depending upon age, but which are liable to be confounded with individual differentiation, might be cited, but none seem to be of sufficient importance to require a special description.

General Remarks on Individual Variation.

After the preceding remarks on this subject, I should perhaps state expressly what I regard to be the bearing of the facts above discussed, otherwise I might be understood as in a great measure discarding the majority of the characters used in the diagnoses of species and genera. Nothing, however, is further from my purpose. What I urge is simply this: that the extent of purely individual variation is far greater than has usually been recognized, and that as a result numerous strictly nominal species have found their place in our systems, from naturalists having mistaken these differences for true specific characters. Individual variation, however, is so complicated with geographical variation, that the general bearings of the whole subject will be deferred till the end of the discussion of the latter topic.

As regards the general cause of individual differences in animals, it is too evidently constitutional to allow of any other hypothesis, and akin to that seen in domestic animals, and which in man gives to each individual his unlikeness in temperament and physical structure to all other men. While individuality is so patent and so universal in the human species, and scarcely less so in domesticated animals, it is one of the most surprising facts in zoölogy that so many naturalists should have entertained the idea that there is an almost total absence of it in feral animals, and that the description of a single specimen will suffice for that of its species. Practically, however, this has been the fact, and eminently so with that large class of "species hunters," who have not inaptly been characterized as "closet naturalists"; for to this class and not to the field naturalists are we mainly indebted for the long lists of synonymes that form so vexatious a burden to zoölogical science.

Certain secondary causes that share in producing individual variation are doubtless more or less obscurely traceable. Among these are certain circumstances attending the time of hatching, as well as, of course, the vigor of the parent. Not unfrequently the first attempts of birds to rear their brood are unsuccessful, from their eggs or young being destroyed by their enemies. Persisting, however, in their efforts, it is late in the season before their brood is fledged, several sets of eggs or young having been previously destroyed. The birds of such broods are found to be smaller and paler colored than those hatched earlier in the season. In cases where several broods are reared each year, as a general rule the birds of the earlier brood seem in all respects the most perfect and vigorous. Various other causes operating during their infancy doubtless more or less affect their general size, their proportions, and colors when mature. Food has doubtless much to do with variation in color, though but few facts bearing upon this point have been yet recorded. Professor Agassiz informs me, however, that many years since, in Switzerland, he raised many *Pyrrhula vulgaris*, and found that by feeding them on the seeds of hemp the red on the breast changed to black. The well-known fact that certain brightly colored birds, as the purple finch (*Carpodacus purpureus*) and the crossbills (*Curvirostra*), change, when kept in cages, from bright red to dull olive with their first moult, and never again, or at least so long as kept in confinement, regain their original color, shows how susceptible the color of birds is to the influences of food and artificial conditions of life.

Climatic Variation.

Climatic variation involves as completely all parts of the animal as does individual variation. It is more marked, however, in some features than in others. The three most prominent phases of climatic variation in birds are the following: variation in general size, variation in the size and form of the bill, variation in color.

Climatic Variation in Size. — Variation in the size of individuals of the same species with differences in the latitude and altitude of their respective places of birth is a fact already so well known as to be quite generally recognized; hence any demonstration of such a variation is in the present connection unnecessary. A few tables of comparative measurements of New England and Florida specimens given in Part IV serve to illustrate its general character and extent. Similiar illustrations are abundantly afforded by the tables of measurements published in Professor Baird's Birds of North America,* in the text of which work frequent reference is made to the differences in size between northern and southern specimens of the same species. The same author also subsequently called attention to the subject, and explicitly announced a general law of geographical variation in size; namely, a gradual decrease in size in individuals of the same species with the decrease in the latitude and altitude of their birth-places.†

In some species, and throughout some entire families, climatic variation is more marked than in others; generally, however, it is very appreciable, and amounts, in respect to size, not unfrequently to from twelve to twenty per cent ‡ of the average dimensions of the species.

Climatic Variation in the Bill. — The climatic variation in the size of the bill is, in general, inverse to that of the general size of the individual. In some species, as in the *Sittæ* and the typical members of the *Picidæ*, I have as yet been unable to trace an independent variation in the size of the bill to that of the body; but in many species there is not only a marked *relative* increase in the size of the bill to the southward, but, in some, an *absolute* increase, especially in its length.

* Pacific Railroad Explorations and Surveys, Vol. IX, Birds. By Professor S. F. Baird, with the co-operation of Mr. John Cassin and Mr. George N. Lawrence. 1858. Subsequently republished under the title of "The Birds of North America," with an Atlas of one hundred plates.

† Proc. Phila. Acad. Nat. Sci., Vol. XI, p. 300, November, 1859. Also in Am. Journ. Sci. and Arts, 2d Ser., Vol. XLI, p. 190, March, 1866.

‡ Variation in size with differences in habitat is by no means confined to birds. In mammals it is well known to be as great, if not greater, than among birds. In some wide-ranging species of mammals there appears to be a double decadence in size, — a diminution to the northward, in those non-migratory species whose habitats extend into the arctic regions, as well as a diminution to the southwards of the point where in general the maximum of size is attained, — as I have elsewhere had occasion to remark. (Bull. Mus. Comp. Zoöl., Vol. I, p. 199.) But in these exceptional cases of a decline in size to the northward, the cause of such a decline must result from climatic conditions the reverse of those producing the decline at the southward, — from the excessive rigor of the arctic climate instead of from the enervating influence of warm temperate and sub-tropical latitudes.

In the case of reptiles, the larger representatives of a given species are generally found at the North, as has also been observed to be the case with the edible marine and fluviatile fishes. (I am credibly informed that this is markedly the case with the codfish and the halibut.) In some groups of crustacea and mollusca the same fact has been repeatedly observed; but in insects, as in plants, the increase in size is generally to the southward, as is especially noticeable in the diurnal Lepidoptera. In plants, however, the increase is a purely vegetative one, the northern representatives of a given species being generally far the most prolific, in proportion to the size of the plant, near the northern limit of their respective habitats.

An increase in the length of the bill is most frequent in long-billed species, while in short-billed ones the increase is in general size, without material change in its proportions. With the increased length and slenderness of the bill there is in many cases also a tendency to greater curvature.

An increase in the length of the bill is quite marked in the genera *Quiscalus*, *Agelæus*, *Geothlypis*, *Troglodytes*, *Seiurus*, *Harporhynchus*, *Galeoscoptes*, etc. *Quiscalus purpureus* and *Agelæus phœniceus* afford good illustrations of geographical variation in the size and shape of the bill. Notwithstanding that the northern specimens are the larger, the southern ones have, in the average, bills as long, though slenderer, than the northern, and occasionally even longer. These differences are shown to some extent in Plates VI and VII, where the figures of the bills of Massachusetts and Florida specimens of these species are given side by side. In Plate VI, figures 1 and 1*a* represent the bill of an average Massachusetts male *A. phœniceus*, and figures 2 and 2*a* the bill of an average Florida male of the same species. The latter, while much less thick, is fully as long as the former. Figures 4 and 4*a* represent the shortest bill of a considerable series of Massachusetts specimens, and figures 6 and 6*a* the shortest or thickest bill of a similar series of Florida specimens. Figures 3 and 3*a* give the longest bill of the Massachusetts series, and figures 5 and 5*a* the longest of the Florida series, the specimens being in each case adult males. Plate VII, figures 3 and 3*a* represent the bill in average Massachusetts males of *Quiscalus purpureus*, and figures 2 and 2*a* that of average Florida specimens, while figures 1 and 1*a*, and 4 and 4*a*, show respectively the longest and the shortest bills of a considerable series of Massachusetts specimens. Figures 5 and 5*a* are from a New Jersey specimen, and figures 6 and 6*a* from a Florida specimen, the latter showing an inflection of the upper mandible more or less frequent in the various species of *Quiscalus*. The figures, as in the previous plate, were all drawn from adult males. In each of these species the average difference in the bills of Florida and Massachusetts birds is as great as is frequently considered to be sufficient to constitute specific differentiation, and between the extremes, especially of *A. phœniceus*, even subgeneric. Yet specimens from intermediate localities present such a gradual and complete transition between the two forms as to render their specific identity unquestionable.

A similar difference between Massachusetts and Florida examples, with a gradual transition from the one to the other, through specimens from intermediate localities, is seen in *Troglodytes aëdon*, *Geothlypis trichas*, and *Sciurus noveboracensis*. In *Pipilo erythrophthalmus*, *Ortyx virginianus*, *Corvus americanus*, and *Cyanura cristata* the bill is appreciably larger in the Florida than in the northern form. In *Corvus americanus* this difference was long since noticed by Professor Baird, the larger bill of South Florida specimens having led him to recognize a variety *floridanus* of this species, based chiefly on this difference.* The same author has also referred to the larger size of the bill in Florida specimens of *Ortyx virginianus*.†

In some species individual variation is so great that it is unsafe to draw conclusions respecting geographical variation from the examination of a small number of specimens. This is notably the case in *Sturnella ludoviciana*, in which the bill varies greatly in size and form, as does the bird in general bulk, at all localities. In the average, however, Florida specimens of this species seem to have a relatively longer and slenderer bill than those from the Northern States.

As already noticed, variation in the bill is not equally marked in all species, but it occurs in too many to admit of the supposition that the numerous cases wherein it is clearly marked are exceptional, or that it does not follow a general law of geographical variation. The observations above detailed are based on specimens collected on the Atlantic coast, from New England southward to Florida, and refer exclusively to species breeding within that range. But specimens of species which breed entirely to the northward of this range, collected during their semi-annual migrations, corroborate the law already stated, namely, an increase in the size of the bill to the southward in specimens of the same species from different breeding stations. In the *Anatidæ* and *Tringæ*, which breed far to the northward and pass the winter in lower latitudes, it is noticeable that, while those which arrive first in the fall, and those which return north latest in the spring, are smaller than those that arrive later and depart earlier, they have, nevertheless, relatively larger bills. This has been especially noticed in species of *Fulix*, *Bernicla*, *Actodromas*, and *Macrorhamphus*. Professor Baird has also referred to the larger size of the bill of the southern representatives of *Lagopus albus* as compared with those from further north,

* Birds of North America, p. 568, 1858.

† Am. Journ. Sci. and Arts, 2d Ser., Vol. XLI, p. 191, 1866.

"those from Eastern Labrador and Newfoundland," he says, appearing "to have decidedly broader, stouter, and more convex bills than those from the Hudson's Bay and more northern countries." * In the writings of various authors on the birds of Southern Mexico, Central America, Southern Asia, and Northern Africa, frequent mention is incidentally made of the larger size of the bills of southern representatives of northward ranging species. Although such statements record what have been apparently regarded as only isolated facts, their frequency indicates that the increase in the size of the bill to the southward is not confined to the birds of Eastern North America, nor exclusively to those of temperate and sub-tropical countries, but that it is a general geographical law, similar to that of the variation with locality in the general bulk of the individual.

Geographical Variation in Color. — Geographical variation in color in birds may be regarded as of two kinds, which may be termed, from their different geographical relations, latitudinal variation and longitudinal variation. The first is coincident with differences in latitude, and the second with differences in longitude. Both are due, however, to climatic peculiarities, and are hence, strictly speaking, climatic. The latitudinal is perhaps at present the best known, and will be first considered.

(*a*) *Latitudinal Variation.* — In those species of North American birds whose breeding range extends over a wide range of latitude, the southern-born specimens are, as a general rule, appreciably darker or brighter, or more intensely colored, than northern-born ones of the same species; in many instances the difference being so great as to impress even the casual observer. Dark colored birds, like the *Quiscali*, *Agelæus phœniceus*, etc., become blacker towards the southern limit of their respective habitats, where those with metalic reflections have the iridescence more intense and of a darker hue, greenish and bronzy reflections changing to purple. The slaty, ferruginous, and olive tints, and the various shades of red and yellow of others, become also far more intense. In species barred transversely with dark and light colors, the dark bands, as a general rule, become broader, and the light ones narrower. Those with white spots on a black ground have the spots reduced in size and number, the smaller ones becoming obsolete. White bars on the wings and terminal white spots on the tail feathers

* Birds of N. Amer., p. 634.

are also of less extent in southern specimens. There hence results, as already observed, a generally darker aspect in the plumage of the southern representatives of wide-ranging species; the bill and the feet also usually sharing in the general accession of coloring matter in the integuments. The difference in color between the extremely northern and the extremely southern representatives of a given species is often so great that, taken in connection with other differences, as in general size and in the size and form of the bill, the two extremes might be excusably taken for distinct species, especially if viewed aside from the connecting series between the two types formed by specimens from successively intermediate points, which beyond question show their specific identity.

As in the case of climatic variation in the bill and in general size, the variation in color differs greatly in degree in different species. Climatic difference in color is particularly striking in *Agelæus phœniceus*. In the males the black is greatly intensified and more lustrous at the South, and the red on the shoulders becomes equally heightened. Instead of the *light* red shoulder-patch, bordered externally with *whitish or pale yellowish-whitish*, seen in Massachusetts specimens, the shoulder-patch in the Florida males is of a brilliant *dark* red, with a *rich cream-colored or orange-yellow* border. While the differences in the bills of the two types might in extreme cases be taken as indicative of different sub-genera, the difference in color is as great as occurs between the northeastern type of *A. phœniceus*, and either the so-called *A. tricolor* or *A. gubernator* of the Pacific slope, or between any of these *inter se*. *Quiscalus purpureus* also affords a similar example of climatic variation, as well in color as in the bill and general size. In the males the change in general tint is in the black becoming more intense at the South, and the iridescence being dark purple or bluish instead of bronzy or greenish. The change in the females is as great as that in the males. At the North their plumage is nearly lustreless brownish-black, but at the South it becomes nearly as black as that of the northern males, and has considerable iridescence, so that the northern collector, judging from color alone, would at first be likely to mistake the southern females for males.

In *Ortyx virginianus*, through the increased breadth of the transverse bars of black at the South, on the dorsal as well as on the ventral surface, the general aspect of the plumage is very much darker in Florida specimens than in New England ones. In *Sturnella ludoviciana* the yellow of the ventral surface in Florida specimens is far more intense than it is in northern ones; the slate color of *Galeoscopies carolinensis* is correspondingly darker, and the ferruginous of *Harporhynchus rufus* is much redder. In *Centurus carolinus* not only are the black transverse bars on the back broader and darker, but the red on the head and abdomen becomes more extended and lustrous. In *Picus pubescens* the white spots on the wings become smaller and fewer, with a greater tendency to black streaks on the sides of the breast, a variation in the direction of *P. Gairdneri* and *P. Harrisi*, as will be noticed at length in the remarks on *P. pubescens* and *P. villosus* in Part IV. Similar differences occur between northern and southern specimens of *Picus borealis*, which are so great as to have led Mr. Cassin to regard the southern type as specifically distinct from the northern. Similar differences to those above described occur between northern and southern specimens of *Thryothorus ludovicianus*, *Troglodytes aëdon*, *Geothlypis trichas*, *Colaptes auratus*, *Buteo lineatus*, and various other species, as will be described more in detail in Part IV.

The climatic variation in respect to the relative size of the white spaces on the rectrices and primary remiges may be illustrated by a single example. In northern specimens of *Pipilo erythrophthalmus* the terminal white spots of the tail feathers are found on the *four* outer feathers of each side; but in Florida-born ones they occur on only the *three* outer feathers on each side; and are correspondingly reduced in length. The white area on the tail of Florida specimens hence has only about the extent that would be presented in northern specimens if the outer pair of feathers were removed. The extent of the white space at the base of the primaries is correspondingly reduced in size in the southern type.

Extending the examination to northern species, it is found that similar color differences with the latitude of the birthplace are of frequent occurrence. In *Bernicla brenta* and *Bernicla canadensis* the smaller southern-born birds are, as a general rule, considerably darker than the larger northern-born ones. The same is true of *Fulix marila* and *Bucephala americana*, the so-called *Bucephala islandica* being the larger northern type of *B. americana*, in which the white markings on the wings and head occupy a somewhat larger area. It is altogether probable also that the so-called *Anser frontalis* holds a similar relation to *A. Gambeli* (= *A albifrons ?*), and the *Anser cærulescens* to the *A. hyperboreus*, though by some the former has been regarded as the young of the later. In *Larus argentatus* the southern specimens are not only smaller, with the " mantle " somewhat darker, but as a general rule the white spots at the tips of the first and second primary quills are more restricted.

The changing of the pelage to white in winter in certain northern mammals, and of the plumage in certain birds, as the ptarmigans, correlates perfectly with these geographical differences in color; and since in some species of mammals only the northern representatives change to white in winter, while the southern ones are of the same color throughout the year, this seasonal change seems evidently to come under the above-stated general law of geographical or climatic color variation, namely, a *gradual increase in color to the southward in individuals of the same species.*

A comparison of Florida birds with West India specimens of the same species shows that the difference between them in color (and, it may be added, in size and other general features) are generally not greater, and in some cases far less, especially between Cape Florida and Cuba specimens, than obtains between Florida and Massachusetts examples, and that it is of precisely the same character. West Indian specimens of course differ more from Massachusetts examples of the same species than the latter do from others from East Florida, yet by means of the South Florida specimens, which differ but slightly from the Cuba type, a gradual transition is evident from the extreme northern to the extreme southern forms. Of late many Jamaican, Porto Rican, and Cuban forms have been regarded, by many writers, as specifically distinct from their representatives in the Northern States, and in many cases they might well be so regarded, were there not a succession of intermediate forms connecting them, — a fact which seems to have been hitherto overlooked. The earlier writers considered the *Ortyx*, the *Sturnella*, the *Strix*, the *Circus*, several of the *Buteos*, etc., of the West Indies as specifically identical with the *Ortyx virginianus*, *Sturnella ludoviciana*, *Strix flammea*, *Circus hudsonius*, *Buteo borealis*, etc., of the United States, and doubtless justly, notwithstanding that the comparison of specimens reveals certain relatively slight but constant differences in color and size, and to some extent in other features.

(*b*) *Longitudinal Variation.* — In comparing the birds of the Atlantic States with specimens specifically identical from the interior of the continent, one is soon struck with the brighter colors of the latter, and especially with a tendency, in many species, to more ferruginous tints, and to melanism in others. In comparing again the birds of the Mississippi valley with those of the Pacific slope, especially that portion north of the fortieth parallel, a similar difference is also noticeable, the extremes of color variation in truly continental species being met with (especially to the northward of this parallel) at the Atlantic seaboard on the one hand, and the Pacific on the other, between which there is a gradual and, with an exception soon to be noticed, a uniform increase in intensity of color to the westward. This tendency to more ferruginous and melanic colors to the westward is especially marked in *Falco peregrinus*,* *Accipiter fuscus*, *Circus hudsonius*, *Buteo lineatus*, *Buteo borealis*, *Archibuteo lagopus*, *Hypotriorchis columbarius*, *Otus vulgaris*, and other species of *Strigidæ*, *Tetrao canadensis*, *Bonasa umbellus*, *Bernicla canadensis*, *Bernicla brenta*, *Larus argentatus*, *Parus atricapillus*, *Carpodacus purpureus*, etc., etc. The western representatives of *Melospiza melodia*, *Passerella iliaca*, *Junco hyemalis*, *Pipilo erythrophthalmus*, *Parus hudsonicus*, etc., differ mainly from their Eastern congeners in their more ferruginous or darker colors, according to the species.

While the general tendency from the East westward is thus to darker or deeper colors in specimens of the same species, and in representative species of the same genus, the rule is not without exceptions, nor is the transition quite uninterrupted. On the arid sterile plains the representatives of not a few, and probably of most, species are much lighter colored than their relatives either to the eastward or to the westward. Also at the southward on the Pacific slope there is not the tendency to deeper colors seen farther to the northward, specimens from Northwestern Texas, New Mexico, much of the Colorado basin and Lower California, being lighter than others of the same species from Northern California, Oregon, and Washington, an explanation of which will be suggested later.†

In comparing again the European representatives of circumpolar species with their representatives in Eastern North America, a difference

* For the synonymy and other remarks on these species, see Part IV.

† See below, p. 239 *et seq.*

similar to, but hardly so great as, that between the Atlantic and Pacific coast examples of indentical species is likewise seen, the American being in general several shades darker than the European. In certain cases there is also a difference in the markings, as in some of the hawks, in which in the European the transverse bars are broader and better defined, and the longitudinal ones less so than in the American. This is illustrated in *Astur palumbarius* and *A. atricapillus*, in *Accipiter nisus* and *Ac. fuscus*, etc. In many instances the only tangible differences between so-called representative American and European species consists in the darker, brighter, or intenser color of the American, the differences being oftentimes less than that between specimens of the same species from the Atlantic States and the Mississippi valley, or between those from the Mississippi valley and the Pacific coast. Not unfrequently, however, are American and European specimens so nearly alike, even of species that have rarely been considered as identical, that without a knowledge of the locality whence they came it would be impossible to confidently refer them to the one species rather than to the other.

There are also indications of various local differences in color in specimens specifically identical within the larger areas above considered, and which are in a measure exceptional to the general law of a westward increase in color. The data at hand are at present too few either to limit these exceptional areas or to indicate to what extent they are exceptional. They appear, however, to be coincident with peculiar climatic conditions, the exact nature and extent of which are likewise imperfectly known.*

Variation in the Length of the Tail and in other Characters. — At certain localities, and more especially to the southward, there are well-known instances of an increase in the length of the tail, without an appreciable modification of other parts. Marked examples of this are seen in *Icteria virens*, *Harporhynchus rufus*, and *Mimus polyglottus*, as has been pointed out by Professor Baird and other writers,† each of which species has a western long-tailed variety. The *Quiscalus macrura* is also little else than a long-tailed variety of *Q. major*. A tendency is seen to this variation in *Geothlypis trichas* at the southward,

* See on this point below, p. 239 *et seq.*

† See especially Prof. Baird in Amer. Journ. of Science and Arts, 2d Series, Vol. XLI, p. 191.

while it seems to be a marked characteristic of many of the birds of Lower California. The tendency in southern forms to an elongation of the tail seems, however, less general than the southward decrease in size and the increase in color, or the tendency to an elongation of the bill.

Among other local variations may be mentioned the white instead of a red iris in the South Florida representatives of *Pipilo erythrophthalmus ;* the yellow instead of a black bill in the magpies of the coast of California ; the white basal half of the feathers of the neck of the raven of Southwestern Texas and Mexico, by which it is chiefly distinguished from the common species ; the greater continuation anteriorly of the superciliary stripe in the western forms of *Zonotrichia leucophrys*, by which alone it is distinguishable from the eastern form ; the white frontlet of one of the western forms of the *Parus atricapillus* group, etc. There appears frequently to be also a locally greater development of the foot in western and southern forms of wide-ranging species, and occasionally an exceptional increase in general size under identical isothermes.

Causes of Climatic Variation. — The facts respecting climatic variation are at present too imperfectly known to be fully explained. There are, however, certain peculiarities of climatic variation, especially in color, coincident with certain meteorological peculiarities of the regions where they occur, that demand attention. The increase in color to the southward, especially the tendency to darker tints above shown to be so general, coincides with the increase in the intensity of the solar rays to the southward, and in the humidity of the climate. The southward increase in depth of color and in iridescence in birds specifically identical coincides also with the general increase in brilliancy of color in birds, taken as a whole, in the lower latitudes (as well as in insects and animals generally), the maximum being reached in the tropics.

The longitudinal variation, or the westward increase in color, seems to be also coincident with the increased humidity to the westward, the darker representatives of any species occurring where the annual rainfall is greatest, and the palest where it is least. This coincidence is clearly illustrated in the birds of the United States, where the darkest representatives of a species, as a general rule, (indeed without exception so far as known to me,) come from regions of maximum annual rainfall, and the palest from those of minimum annual rain-fall. In the Northeastern States the amount of rain is only one half to two thirds what it is in the Northwestern States, while on the Great Plains it is less than one half what it is in the Northeastern States. In the lower part of the Mississippi basin and in the Southeastern States it is much greater than to the northward under the same meridians. Within the tropics, in America and Asia at least, the humidity, as well as the intensity of the solar rays, reaches the maximum, as does the intensity of color in both birds and other animals. In Europe, as is well known, the birds from near the Scandinavian coast, where the annual rain-fall reaches forty inches, are darker than in Central Europe, where the yearly rain-fall is only half this amount. So much darker, in fact, are the Scandinavian forms, that by some writers they have been regarded as specifically distinct from their representatives in Southern Germany, the Scandinavian forms of circumpolar species being as dark as their Eastern North American allies. There is again a striking parallelism between the relative humidity of Western Europe and Eastern North America, and the relative depth of color in the representatives of circumpolar species living in these two countries, the rain-fall of the latter region being double that of the former, and the birds of darker and livelier colors. As already intimated, this coincidence is not confined to the birds of these different regions, the same correlation of livelier, brighter, deeper tints with increased humidity being also exhibited by the mammals of these various districts, the Europeo-North American species being higher colored, as a general rule, in Eastern North America than in Europe, as the western forms of the continentally distributed American species are often higher colored than the eastern.

It is a most striking fact that the birds, and even the mammals and reptiles, of the almost rainless districts of Lower California, the Gila and Colorado deserts, are almost all so much paler in color than their relatives of the better-watered neighboring districts, that many of them have been described as distinct species, and the others referred to as strongly marked varieties, they all being characterized to a greater or less degree by a faded or bleached aspect. The birds and mammals of the arid plains of the middle region of the continent exhibit also the same bleached appearance, but in a somewhat less degree.

I had long suspected that hygrometric conditions had much to do with local variations in color in individuals of the same species, but I was not a little surprised when I came to compare the known areas most prolific of dark and light local forms with rain-fall charts, — which may be assumed as indicating relatively the hygrometric conditions of different regions, — to find the distribution of the light-colored races so strictly coincident with the regions of minimum mean annual rail-fall, and the dark forms with those of maximum mean annual rain-fall, as seems to be the case.

Humidity has hence apparently far more to do with climatic variation in color than solar intensity, though the latter has undoubtedly an influence upon color. The occurrence of a light-colored race of *Arvicola riparius* on Muskeget Island and the sandy sea-beaches of the coast of Massachusetts shows clearly that the intense light caused by reflection from a sandy surface tends to the diminution rather than to an increase of color in animals, and even plants, since the foliage of the latter in arid districts so commonly assumes a dull grayish tint. The capture on Muskeget Island last season (July, 1870), by Messrs. Maynard and Brewster, of two pairs of the short-eared owl (*Otus brachyotus*) with the color of the plumage so pale as at first to suggest their being albinos, is additional evidence of the bleaching effect of strong light upon the colors of animals. Such facts render it doubtful whether the increased intensity of the light in the tropics has really much to do with the brighter colors of tropical birds and insects, and suggest that humidity alone may be the principal agent in producing this accession of color.

In regard to the cause of other climatic variations, certain other facts are naturally recalled. In the remarks on the climatic and faunal peculiarities of East Florida,* attention was called to the less degree of vivacity and energy exhibited by the southern as compared with the northern members of the same species, and the general higher physiological development of essentially extra-tropical species in the temperate portions of their habitats. Is it hence improbable that the southward deterioration in size seen in such species is directly related to the enervating influence of increased heat? And why is it that so large a proportion of the birds pre-eminently singing-birds are found in temperate latitudes?

In the increased size of the bill and tail to the southward, especially of the former, we have a fact somewhat parallel to what is not unfrequently seen in mammals. The ears, for example, of the arctic repre-

* See above, p. 166.

sentatives of species ranging to warm-temperate latitudes are smaller at the northward than at the southward, as is seen in the native dogs, the foxes, and the wolves, and in the arctic races of man. The explanation generally given of this seems possibly applicable to the beaks of birds, namely, a greater activity in the circulation of the blood in the peripheral parts of the body in the temperate latitudes.

Species, Varieties, and Geographical Races.

The foregoing remarks on individual and geographical or climatic variation necessitates a brief consideration of the character of species, varieties, and races, and the propriety of applying binomials to such forms as can be clearly shown to be connected by intergrading links with others previously known. As preparatory to what follows, it seems proper to refer briefly to the origin of the excessive synonymy with which our descriptive ornithological works are burdened.

Ornithological synonymes may be arranged, as regards their origin, under four primary heads, namely: (1) Those arising from the description of immature and adult birds of the same species for different species, (2) from authors mistaking sexual for specific differences, (3) individual variation for specific differentiation, and (4) climatic differentiation for specific. A fifth source of error, and one which has given rise to a large class of synonymes, results from a combination of the causes indicated under (3) and (4).

Synonymes arising from the first two causes mainly preceded the others in regard to the relative frequency of their occurrence, especially so far as regards the birds of this continent. During the previous century, and the first two decades of the present, our birds were mainly described by European naturalists, who had no acquaintance with them in life, and whose resources often consisted of single and imperfect specimens received from chance travellers, without any indication of their sex or age. Later they were studied by resident naturalists, by whom the mistakes of their predecessors in this respect were to a great extent corrected. The laws of sexual and age variation becoming gradually known, errors from this source were soon far less frequent than in earlier times. When at a comparatively recent date critical comparisons were made of specimens from distant localities before regarded as specifically identical, it was found that occasionally distinct species had been confounded. Such results led in the end to undue importance being attached to trivial differences, so that assumed species were frequently based solely on either individual or climatic variation, but oftener on both combined.

As the rage for describing new species increased, differences seemed alone to be sought ; and so long as a given species was usually deemed sufficiently represented, even by the best ornithologists of the day, by a single pair,* the subject of individual and climatic variation was necessarily almost wholly neglected, the custom of many naturalists being to describe species from single specimens, as though all the representatives of a species were cast after an unvarying pattern. As the number of specimens of well-known species increased in our large museums, it was soon seen that some of the supposed most reliable diagnostic features were subject to considerable variation. The collections brought together from various parts of the continent by the Pacific Railroad surveying parties and from other sources, and the reports published thereon, formed the beginning of a new era in the history of the ornithology of North America, and in ornithological science. The facts thus disclosed in respect to geographical range, and individual and climatic variation, opened new fields of inquiry. Old theories and blind adherence to authorities, however, still impeded progress and led to frequent inconsistencies, which only time and further investigations could correct. Hence has gradually dawned the fact of the existence of a range of individual variation previously unsuspected, and of general laws of climatic variation, the full scope of which, as bearing upon the character of species, is yet to be determined.

Nearly half a century since it was discovered that the North American representatives of what were then commonly regarded as circumpolar species could not in all cases longer be regarded as identical with the European. Further comparisons showed that in most cases of the supposed circumpolar distribution of species, specimens from the Old World and the New could be more or less readily distinguished, yet the differences were in most cases slight, more or less inconstant, and not unfrequently due more to differences in the latitude whence the specimens came than to other causes. Yet a precedent for specific

* Not many years since amateur ornithologists were kindly informed, by one of the leaders in the science of ornithology, that his collection of the birds of a certain country, numbering over two thousand species, required for their convenient storage a space equal to only about one hundred cubic feet, the specimens averaging less than two to a species!

separation in such cases having been established by recognized authorities, it was followed till all the land-birds and a large proportion of the water-birds of the two continents were separated, in many cases, it would appear, on purely theoretical or geographical grounds.* When the comparison was carried to specimens of continentally distributed species from distant localities, differences between these were also detected, and the theory of specific diversity assumed, till the Pacific representatives of such species were separated from the Atlantic ones, and in like manner the southern from the northern, and those of particular areas, as insular, peninsular, and interior basins, from the others. In some cases such separations were of course properly made, but a high percentage of such forms are now found to intergrade through specimens from the intermediate localities.

Not a few of the species of our faunal lists have been based on, and are still only known from, single specimens, and often on differences manifestly within the range of individual variation; others represent local races, which only appear distinct when extremes alone are considered, the intermediate stages being unknown or ignored. The increase of synonymes from this fruitful source appears to have not yet culminated, a large proportion of the "new species" now annually described being but slight local differentiations of previously known specific forms, from which they often differ only in being a little smaller, a little darker or brighter colored, and in the individual peculiarities of the single specimens on which some of them are based. In many cases this process of ultra subdivision has furnished stepping-stones to later generalizations; in too many other cases it has been in its results only unmitigatedly injurious.

So large a proportion of the commonly recognized species are virtually nominal, or rest on a false basis, it is not surprising that in the reaction consequent upon a fuller knowledge of the birds of this continent, which has already commenced, the reality of species should be to some extent ignored. Whether, however, species are considered as entities or only as arbitrary inventions, convenience demands some established definition of them.

* Audubon, writing in 1838 (Orn. Biog., Vol. IV, p. 608), refers to the Prince of Musignano (by whom a large part of the circumpolar and cosmopolitan species were separated into numerous assumed species) as "having altered his notions so far as to seem desirous of proving that the same species of birds cannot exist on both the continents"; and there seems to have been good reason for the remark, only instead of *proving* them distinct, he in most cases merely *assumed* them to be so.

Not a few naturalists have hence adopted the test of intergradation, which seems a reasonable and an unobjectionable one. The question of species and of specific synonymy is thus simplified to this: that whenever two forms which have both received names are found to intergrade, the more recent name shall become a synonyme of the older. Some, however, still urge that every recognizable form, however closely allied to others, and even intergrading, should be recognized by a binomial epithet, and that whether we call them species, or varieties, or races, or simply *forms*, that such names are none the less convenient expressions for certain facts. It seems to me, however, that there are insuperable objections to this course; for however distinct the extreme geographical forms of a species may be, a vast proportion of its representatives are intermediate to them, and could never be but doubtfully referred to the one rather than to the other. Ordinarily, for instance, in the birds of the Atlantic slope, the representatives of a given species at the extreme north of its breeding range almost always differ very tangibly from its representatives at the extreme southern limit, sometimes more, sometimes less, according to the species. Those living only a little to the northward of the middle region differ less from the extreme southern type than the extreme northern type does, and those a little to the southward of the middle region differ still less from the southern type, and are quite distinguishable from the extreme northern form. In other words, in species ranging from Southern Labrador or Northern New England to Florida, of which there are numerous unquestioned instances, specimens from Southern New England differ somewhat from the more northern ones; those from Southern New England from those of Southern New Jersey and Eastern Maryland, and these latter from those of Georgia and Florida. It hence depends entirely upon individual predilection whether two, three, or four "species" or "binomial forms" shall be recognized; and in either case there is the same difficulty in disposing of the intermediate types. Again, specimens from the Mississippi valley differ more or less from their relatives from the Atlantic coast, the central plains, and the Pacific slope. Here again similar difficulties are encountered. Hence it is necessary to decide between recognizing a single binomial form, with a considerable but definite range of climatic variation, or three, or six, or nine, or even more, which cannot be rigidly defined, and between each of which will always be found a greater or less proportion of intermediate types, doubtfully referable to one of the binomial forms rather than to another. Another important objection may be urged against giving binomial names to intergrading forms. In faunal and nominal lists of the species of a large or continental area, scarcely distinguishable forms take equal rank with the most distinct congeneric species. For instance, in a list of the birds of North America, *Turdus Aliciæ* and *Turdus Swainsoni*, *Turdus Auduboni* and *Turdus Pallasi*, stand side by side with *Turdus mustelinus* and *Turdus fuscescens*, though in the former cases *Turdus Aliciæ* and *T. Auduboni* are founded at best on slight, and in the one case on inconstant individual or local differences, while in the latter no two congeneric species need be more distinct. In the one case only experts can distinguish the forms, and frequently they only by an actual comparison of specimens, and then too frequently but doubtfully, while in the other case a casual observer need not mistake them. The names alone give no clew to their real character, and are hence in a great measure meaningless when separated from the most explicit diagnoses, and whose affinities can frequently only be settled by the arbitrary criterion of locality. But it is urged that cognizance should in some way be taken of these differences; and "How can they be better recognized," it may be asked, "than in the way proposed?"

As already shown, and as I trust a large proportion of ornithologists are willing to admit, these local forms occur in accordance with recognizable laws of climatic variation, similar variations with locality occurring, to a greater or less extent, in all species having nearly the same geographical range. Eventually, then, will not the recognition of these laws be sufficient, and should not a statement of the tendencies to variation with locality, and the degree to which it is developed, be embraced in the specific diagnosis of each species as a part of its specific description? Is not this, in fact, actually essential to the proper characterization of a species? The average characters being given, a line or two would suffice for a statement of its variations, both geographical and individual. Then only in one case where now there are hundreds would there be instances of doubtful identification. Till within a very recent period, perhaps, no other course could have been pursued than that of giving binomial names to each apparently distinct form, however slightly it may have differed from others previously known. In many cases, indeed, the differences between strictly intergrading geographical forms are very great, — greater, indeed, if they were not thus serially connected, than would be deemed necessary for specific separation; and so long as the extremes only were known, no one could have regarded them otherwise than as well-defined species. But the time has already come, it seems to me, for a different and a more philosophic method, and that to further increase synonymy by giving new names to slightly different local forms of the same species is worse than useless.

It is important. in this connection, to observe that the species occurring at any point on the Atlantic coast, or on the Pacific coast, or in the Mississippi valley, or on the Great Plains, in short, at any restricted locality, have, as compared with each other, with scarcely an exception, an unequivocal character; they are based on differences that place them beyond controversy. It is not so, however, when we compare the species of distant localities with each other, whether the localities differ in latitude or longitude. In such cases we constantly meet with controverted species. At the South are species admitted as doubtfully distinct from others found farther north; at the West, those holding the same relation to others of the East; while at intermediate points either both the disputed forms occur with greater or less frequency, or there is a gradual transition of the one into the other, neither form being typically represented. This is evidently what should be expected to occur, if what has been said above in respect to climatic variation be correct, and is evidently a suggestive and important fact. Is the theory of hybridization, so often appealed to in such cases, necessary to explain these facts? and is it, in fact, true? By uniting the intergrading forms, the number of species occurring at any single locality is not essentially reduced, but such a union would considerably reduce the total number recognized, as well as the number usually assigned to the several continents, as at present not a few are repeatedly counted.

The many facts bearing upon individual and geographical variation, presented in the foregoing pages form but an imperfect exposition of the subject. They are, nevertheless, eminently suggestive of interesting results, and the conclusions above deduced I can but believe will be only the more fully confirmed by further research. Additional details are given in the general remarks embraced in Part IV, where various facts merely hinted at above are more fully presented, and an application is made in many cases of the pinciples deducible from them.

As previously stated, individual and geographical variations are in some cases difficult to distinguish. They can be satisfactorily investigated only from extensive suites of specimens taken from the same locality in the *breeding season*, and sufficiently extensive suites of this character are, with rare exceptions, still wanting. In specimens taken during migration it is difficult to determine what share of the variation is due to birthplace and what to individuality. Whilst, however, the variations noticed cannot be always traced with certainty to their origin, their bearing upon the general subject of variation within specific limits is in no way vitiated. In considering hypothetical species, it is frequently clearly evident that they are based in part upon slight and tolerably constant climatic differences, and in part and sometimes wholly upon the individual peculiarities of the single specimen upon which the original description of the species was based; in part, too, upon seasonal differences, and upon characters of immaturity. It seems to me that in the numerous closely allied species of the *Ægiothus* group, to cite a case in point, some are based in part upon one and in part upon other of these differences of a single circumpolar species. As already shown, the bill in different specimens of *Æ. linarius* varies greatly in size, yet an examination of a considerable series of specimens of several of its allies shows an amount of variation in the bill closely approximate to that seen in the specimens of the various assumed species of *Ægiothus*. Much of the variation in color seen in the flocks of *Ægiothi* that visit the Northern States in winter is due to age, yet it has been taken as characteristic of different species. These birds only visiting us in winter, those inhabiting widely distant localities in the breeding season are probably then more or less associated. The light-colored specimens are doubtless in part old or fully mature birds, or inhabitants in summer of more northern districts than the browner or more fulvous ones, a large portion of which, however, are unquestionably young birds. The short-billed ones have also relatively longer setæ at the base of the bill, which, by concealing a large portion of it, give it the appearance of being shorter than it really is. Analogy would lead us to infer that those with the shorter and more heavily clothed bills have a more northern habitat than the others.

The persistency with which nominal species when characterized by "authorities" are retained in our literature is not a little remarkable. If specimens from the original localities cannot be found to exactly fit the descriptions, the diagnosis is slightly amended to suit examples that somewhat approach them, and the name retained. In other cases the species is retained without its character being questioned, the name and the original description being copied by succeeding writers, till the species becomes traditionally accepted without its claims to recognition having been critically examined.

Another noteworthy coincidence in regard to nominal species is the fact of their most frequent occurrence in obscurely known groups, which obscurity usually results from the difficulty of obtaining specimens of the forms in question, — either from the remoteness of their habitat, their scarcity, or the peculiarities of their habits, — or from preconceived notions of the intimate relationship of the species of such groups.

Since the above was put in type, I have for the first time met with some important and timely remarks by an eminent English botanist concerning variation within specific limits in plants, which are so apropos to what has been said above in regard to individual and climatic variation in birds, and contains, moreover, such judicious strictures on various practices indulged in by botanists, and of which zoölogists are equally guilty, that a short abstract of them forms a fitting conclusion to the present paper. Says Dr. J. D. Hooker, in the introductory essay to his "Flora Novæ-Zelandiæ" (Part I, pp. xii, xiii, xv, 1853): —

> "Some naturalists consider every minute character, if only tolerably constant or even prevalent, as of specific value; they consider two or more doubtful species to be distinct till they have been proved to be one; they limit the ranges of distribution, and regard plants from widely severed localities as almost necessarily distinct; they do not allow for the effects of local peculiarities in temperature, humidity, soil, or exposure, except they can absolutely trace the cause to the effect; and they hence attach great importance to habit, stature, color, hairiness, period of flowering, etc. These views, whether acknowledged or not, are practically carried out in many of the local floras of Europe, and by some of the most acute and observant botanists of the day; and it is difficult to overestimate the amount of synonomy and confusion which they have introduced into some of the commonest and most variable of plants. . . . . In working up incomplete floras especially, I believe it to be of the utmost importance to regard dubious species as varieties, to take enlarged views of the range of variation in species, and to weigh characters not only *per se*, but with

reference to those which prevail in the order to which the species under consideration belong; and to resist steadily the temptation to multiply names; for it is practically very difficult to expunge a species founded on an error of judgment or observation. The state of the British flora proves not only this, but further, that one such error leads to many more of the like kind; students are led to overestimate inconstant characters, to take a narrow view of the importance and end of botany, and to throw away time upon profitless discussions about the differences between infinitely variable forms of plants, of whose identity really learned botanists have no doubt whatever. There is, further, an inherent tendency in every one occupied with specialties to exaggerate the value of his materials and labors. . . . .

"To the amateur these questions are perhaps of very trifling importance, but they are of great moment to the naturalist who regards accurately defined floras as the means of investigating the great phenomena of vegetation; he has to seek the truth amid errors of observation and judgment, and the resulting chaos of synonomy which has been accumulated by thoughtless aspirants to the questionable honor of being the first to name a species. The time, however, has happily passed when it was considered to be an honor to be the namer of a plant; the botanist who has the true interests of science at heart not only feels that the thrusting of an uncalled-for synonyme into the nomenclature of science is an exposure of his own ignorance and deserves censure, but that a wider range of knowledge and a greater depth of study are required to prove those dissimilar forms to be identical, which any superficial observer can separate by words and a name."

The above remarks are as strictly applicable to zoölogy and zoölogists as they have ever been to botany and to botanists. The present state of ornithology, and the tendency the majority of ornithologists have to multiply species on improper grounds, find here a fitting rebuke.

PART IV.

*List of the Winter Birds of East Florida, with Annotations.**

TURDIDÆ.

1.† **Turdus migratorius** *Linné.* ROBIN.

Seen daily, sometimes in considerable flocks, till about the first of March, after which time few were observed. It was shot by me at

* An asterisk (*) prefixed to the name of a species indicates that it is a constant resident; an obelisk (†), that it is a winter visitor.

Jacksonville, April 1st, but according to general report it does not breed in the State.

In this species the females are commonly supposed to be paler colored than the males, which is undoubtedly usually the case, but specimens as brightly colored as any I ever saw proved on dissection to be *females*, and other specimens as palely colored as any I ever met with have likewise proved on dissection to be *males*. This shows the importance of determining the sex in all cases by dissection, and not from external appearances. It also indicates a wide range of variation in color in the present species, as great as is seen between typical representatives of the so-called *Turdus Swainsoni* and *T. Aliciæ*, and which is, moreover, of the same character, namely, simply a variation in intensity.

2.† **Turdus Swainsoni** *Cabanis*. OLIVE BACKED THRUSH.

Turdus minor GMELIN, Syst. Nat., I, 817, 1788; in part only. — VIEILLOT, Ois. Am. Sept., II, 7, pl. lxiii, 1807; in part only. — BONAPARTE, Geog. and Comp. List, 1838.

Turdus solitarius WILSON, Am. Orn., V, pl. xiii, fig. 2; not the text.

Turdus nanus AUDUBON, Birds of Amer., III, pl. cxlvii; * not the text. — SAMUELS, Am. Nat., II, 218, 1868

Turdus olivaceus GIRAUD, Birds of Long Island, 92, 1843-44. Not the *T. olivaceus* of Linné.

Turdus Swainsonii CABANIS, "in Tschudi's Fauna Peruana, 188, 1844-46." — BAIRD, Birds N. Am., 216, 1858. — SCLATER, Cat. Am. Birds, 2, 1862. — ALLEN, Proc. Essex Inst., IV, 56, 1864. — BAIRD, Rev. Am. Birds, I, 19, 1864. — ALLEN, Mem. Bost. Soc. Nat. Hist., I, 514, 1868. — RIDGWAY, Proc. Phil. Acad. Nat. Sci., XXI, 128, 1869.

Turdus Aliciæ BAIRD, Birds N. Am., 217, 1858. — COUES and PRENTISS, Smithsonian Rep., 1861, 405. — COUES, Proc. Phil. Acad. Nat. Sci., XIV, 217, 1861. — BAIRD, Rev. Am. Birds, I, 21, 1864. — RIDGWAY, Proc. Phil. Acad. Nat. Sci., XXI, 128, 1869.

Merula Wilsonii SWAINSON, Faun. Bor. Am., I, 182, 1831.

Merula olivacea BREWER, Proc. Bost. Soc. Nat. Hist., I, 191, 1844.

Rare. Given on the authority of Mr. Boardman, who writes me he obtained one specimen at Enterprise, February 18th, and another at St. Augustine, in the same month. The greater part pass the winter farther south.

* The plates in "Birds of America" are too poorly colored, as is well known, to be recognizable representations of the species whose names they bear, including all those representing wood-thrushes, they having but little resemblance to those of the folio edition. The figures of "*Turdus nanus*," *Turdus solitarius*, and *Turdus mustelinus*, might all pass for the *Turdus Swainsoni*, so far as the color of the dorsal surface is concerned.

In my "Catalogue of the Birds of Massachusetts,"* published in 1864, I first advanced the opinion that the so-called *Turdus Aliciæ* Baird was the paler form of *T. Swainsoni.* To this view other writers have taken exception. Professor Baird, in his "Review of American Birds" (p. 21), summarily disposes of the matter by presuming that I had not seen what *he* called *T. Aliciæ.* In 1868, in my "Notes on the Birds of Iowa, Illinois," etc.,† I again reviewed the subject, having in the mean time examined some twenty specimens sent out by the Smithsonian Institution to different scientific institutions, labelled respectively, "*Turdus Aliciæ*," "*Turdus Aliciæ?*" "*Turdus Aliciæ?* hybrid?" "*Turdus Swainsoni*," "*Turdus Swainsoni?*" "*Turdus Swainsoni?* hybrid?" After having examined these authentic specimens of the bird in question, and also large numbers of Massachusetts examples of what I called *Turdus Swainsoni*, — among which are a considerable number that correspond in every particular respectively with the typical, authentic specimens of "*Turdus Swainsoni*" and "*Turdus Aliciæ*" of Baird, the larger number, however, being intermediate in character between them, and agreeing with specimens sent out from the Smithsonian Institution as "*T. Swainsoni?*" "*Turdus Aliciæ?*" "*Turdus Aliciæ?* hybrid?" etc., — I state in this paper that the opinion I had previously expressed in respect to *Turdus Swainsoni* and *Turdus Aliciæ* was fully confirmed. In this paper I discussed at some length the variations presented, not only by this species, but by *Turdus Pallasi* and *Turdus fuscescens*, and the character of their supposed allies, *T. Auduboni, T. nanus,* and *T. ustulatus*, and their supposed respective habitats. I gave also some details in respect to the variations in general size, form of the bill, proportions of the primary quills of the wing, etc., as well as in color, and concluded that *Turdus Aliciæ* was based on simply individual variation in color, the other differences, as of size, form of bill, etc., supposed at first to characterize it, being rarely coincident with the variations in color, they occurring as frequently in the one type of coloration as in the other. *Turdus nanus* and *Turdus ustulatus* I also deemed to hold the same relationship to *T. Pallasi* and *T. fuscescens* that *T. Aliciæ* does to *T. Swainsoni.* Though described as exclusively western, I stated I had found specimens in Massachusetts that accorded with them in every particular. After having given the subject still further attention, I am but the more fully confirmed in these opinions.

Dr. Coues, thus far one of the most strenuous advocates of the validity of these nominal species, in a somewhat recent paper of his,‡ after stating

* Proceedings of the Essex Institute, Vol. IV, p. 56.

† Memoirs of the Bost. Soc. Nat. Hist., Vol. I, p. 507.

‡ "A List of the Birds of New England," Proceedings Essex Institute, Vol. V, p. 267, 1868.

that he had shown the *T. Aliciæ* to be "a very common eastern bird, having a range of habitat as extensive as, and nearly identical with, that of *T. Swainsoni*," says, in referring to my earlier remarks on this subject, that they "illustrate very fully the well-known seasonal and other variations to which *T. Swainsoni* and *T. fuscescens* are subject," and adds that I appear to have been "autoptically unacquainted" with *T. Aliciæ* at the time of writing them. In respect to this supposition of Dr. Coues, I will merely add that one of the numerous specimens considered by me to typically represent the supposed *T. Aliciæ* has been sent to the Smithsonian Institution, and pronounced by Professor Baird himself to "typically represent the *T. Aliciæ*."

The measurements given below of this species and the two following indicate the average size and the usual range of variation in this respect in these species as represented in the Atlantic States. These measurements embrace twenty-four specimens of *Turdus Swainsoni*, nearly fifty of *T. Pallasi*, and about forty of *T. fuscescens*, nearly all of which are from New England, and by far the greater part from Eastern Massachusetts.

The following is the range of variation in the series of twenty-four specimens of *T. Swainsoni*: Length, 6.62 to 7.75; alar extent, 10.75 to 12.65; wing, 3.47 to 4.30; tail, 2.40 to 3.40 (4.00 ?); tarsus, 1.02 to 1.27. The average dimensions are as follows: Length, 7.17; alar extent, 11.65; wing, 3.86; tail, 2.88; tarsus, 1.15.

Measurements of New England Specimens of Turdus Swainsoni.

M. C Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
2877	—	—	Springfield, Mass.	May 14, '63	J. A. Allen	6.75	11.90	3.19	2.78	1.12
——	—	—	" "	May 14, '63	"	6 62	11 40	3.80	2.83	1.11
——	18	—	" "	May 27, '61	"	6.75	——	3.92	2.78	1 10
——	19	♂	" "	May 27, '61	"	6.98	——	4.30	3.40	1.22
2930	—	—	" "	May 25, '63	"	7.60	12.50	4 12	3.10	1.20
——	37	—	" "	May 25, '63	"	7.06	11.40	3 65	2.86	1.13
2940	—	—	" "	May 29, '63	"	7.10	12.00	4.00	2.83	1.13
——	44	♂	" "	May 29, '63	"	7.25	12.00	4 00	2.95	1.10
2827	—	—	" "	May 14, '63	"	7.15	11.10	3 90	2.70	1.05
1829	29	—	" "	May 30, '62	"	6.90	11.20	3.55	2.58	1.02
1830	23	—	" "	May 30, '62	"	7.75	12.20	3.95	3.07	1.17
1831	1	—	" "	May 30, '62	"	7.35	11.50	3.80	2.73	1.10
2930	—	—	" "	May 25, '63	"	7.75	12.20	3 95	3.07	1.17
2940	—	—	" "	May 29, '63	"	7.38	11.37	3.93	2 87	1.14
5757	—	—	Concord, "	———	H. Mann	7.25	12.15	4.10	2.95	1.16
8844	646	♂	Belmont, "	May 27, '68	C. J. Maynard	7.76	12.65	4.20	4.00	—
4999	1326	—	" "	Sept. 21, '68	"	7.75	——	4.05	3 07	1 20
——	17	♀	Watertown, "	Oct. 2, '69	Wm. Brewster	7.12	12.00	3.94	3.00	1.19
——	213	♀	" "	May 24, '69	"	7.12	——	4.00	2 87	1.27
282	—	—	Malden, "	———	D. Higgins	7.10	11.00	3.70	2 48	1.08
307	—	—	Norway, Maine	———	A. E. Verrill	7.24	11 00	3.47	2.73	1.14
308	—	—	" "	———	"	7.00	10.75	3.48	2.40	1.12
5963	—	—	Upton, "	———	J. G Rich	7.30	11 10	3.71	2 68	1.03
1520	—	—	Glen House, W. Mts.	———	S. H. Scudder	7.00	11 50	3.84	2.74	1.10

3.† **Turdus Pallasi** *Cabanis.* Hermit Thrush.

Turdus solitarius Wilson, Am. Orn., V, 95, 1812. Not the figure (pl. xliii, 2), which is of *T. Swainsoni.* Not *T. solitarius* Linné. — Bonaparte, Geog. and Comp. List, 17, 1838. — Audubon, Synop., 91, 1839. — Ibid., Birds of Amer., III, 29, pl. cxlvi, 1841.

Turdus minor Bonaparte, Obs. on Wilson's Nomenclature, Journ. Phil. Acad., IV, 33, 1824. — Nuttall, Man. Am. Orn., I, 346, 1830. — Audubon, Orn. Biog., I, 303, pl. lviii, 1831. — Ibid., V, 445, 1839. — Gambel, Proc. Phil. Acad. Nat. Sci., III, 113, 1846. — Giraud, Birds of Long Island, 90, 1843-44.

Turdus Pallasi Cabanis, Wiegm. Archiv, I, 205, 1847. — Baird, Birds N. Am., 212, 1858. — Sclater, Cat. Am. Birds, 2, 1862. — Baird, Review Am. Birds, Part I, 14, 1864. — Allen, Mem. Bost. Soc. Nat. Hist., I, 514, 1868. — Ridgway, Proc. Phil. Acad. Nat. Sci., XXI, 128, 1869.

Turdus nanus Audubon, Orn. Biog., V, 201, pl. ccccxix, 1839 (*T. minor* on the plate). — Ibid., Birds of Am., III, 32, 1841. — Baird, Birds N. Am., 213, 1858. — Sclater, Cat. Am. Birds, 2, 1862. — Baird, Rev. Am. Birds, I, 15, 1864. — Ridgway, Proc. Phil. Acad. Nat. Sci., XXI, 129, 1869. — Cooper and Baird, Orn. Cal., I, 4, 1870.

Turdus Audubonii Baird, Rev. Am. Birds, I, 16, 1864. — Ridgway, Proc. Phil. Acad. Nat. Sci., XXI, 129, 1869.

Merula solitaria Swainson, Faun. Bor. Amer., II, 184, pl. xxxvii, 1831. — Brewer, Proc. Bost. Soc. Nat. Hist., I, 191, 1844.

Merula silens Swainson, Faun. Bor. Amer., II, 186, 1831. — Sclater, Cat. Am. Birds, 2, 1862.

Common. Last seen about March 25th.

As already observed in the remarks under *Turdus Swainsoni*, I regard the *Turdus nanus* of authors as identical with *T. Pallasi.* The assumed differences are slight and inconstant, and seem to be principally individual variation in color. Although of late supposed to be exclusively western, representing on the Pacific slope the *T. Pallasi* of the Atlantic and Central States, Audubon's original specimen came from Pennsylvania, though he subsequently received it from the valley of the Columbia River. In his "Synopsis" he gives its habitat as "Columbia River. Accidental in the United States." His description of its color is identical with that he gives of *T. Pallasi* (*T. solitarius* Aud.), even the words used being almost entirely the same throughout each description. In size, however, he gives *T. nanus* as being one inch less in length and one inch less in extent than *T. Pallasi.* Since Professor Baird, in 1858, recognized the *T. nanus* as a valid species and its habitat as "Pacific coast of North America to the Rocky Mountains," and restricted the *T. Pallasi* to "Eastern North America to the Mississippi River," the validity of *T. nanus* has been generally accepted. Professor Baird himself, however, speaks of it in this work as though it was in his opinion doubtfully distinct, and observes that, "if really distinct, is so closely allied to *T. Pallasi* as to render a separation of the two exceedingly difficult." The *T. Pallasi* was formerly recognized as inhabiting California by good authorities. Dr. Gambel, in his "Remarks on the Birds of Upper California," etc.,* after stating that "the dwarf thrush of Audubon was founded upon specimens from the Atlantic States, and no doubt upon the true hermit thrush," remarks: "An examination of specimens of the *T. minor* [=*T. Pallasi*] from the Atlantic and Pacific coasts of North America shows no difference in any way, except that perhaps the western one is somewhat smaller, yet the difference is scarcely appreciable. From the measurement of many western specimens I found its length to be $6\frac{1}{4}$ inches, and the extent of wings $10\frac{1}{2}$ inches; the tail, wings, and relative length of quills the same as in our eastern one, and, in fact, I think it can in no possible way be distinguished as specifically different." California specimens, however, seem to average a little smaller than New England ones, so that the *T. nanus* seems best entitled to recognition of any of the several disputed forms of this group.

The habits of *T. nanus*, as described by Dr. Cooper, are exactly like those of the *T. Pallasi* of the East, except in regard to the situation of its nest, *his account of its nest and eggs according exactly with those of T. Swainsoni*, and not at all with those of *T. Pallasi*, its nearest ally.†

The *Turdus Auduboni* of Baird, of the Rocky Mountains, I have already also referred to *T. Pallasi*, from average specimens of which it differs only in being slightly larger. My reasons for this opinion have been given with sufficient detail elsewhere.‡

It is difficult to reconcile the account given by Wilson,§ and corroborated by Audubon,‖ of the breeding habits of this species with what is now known of the distribution in the breeding season of this group (subgenus *Hylocichla*) of thrushes. The account given by these authors of the situation and structure of the nest is applicable to only *T. Swainsoni*, which, as well as the *T. Pallasi*, is not known to breed so far south by several hundred miles as the localities they give. The only species which may probably breed there is the *T. fuscescens;* but this species does not nest on trees. To determine to which species of thrush these authors refer

* Proc. Phil. Acad. Nat. Sci., Vol. III, p. 14, October, 1844. Also Journal Phil. Acad. Nat. Sci., 2d Series, Vol. I, p. 41, 1847.

† According to Professor A. E. Verrill, the *T. Pallasi* nests on the ground, and lays "bright-blue" eggs. *Proc. Essex Inst.*, Vol. III, p. 145.

‡ Mem. Bost. Soc. Nat. Hist., Vol. I, p. 512.

§ Am. Orn., Vol. V, p. 91.

‖ Orn. Biog., Vol. I, p. 303; Birds of America, Vol. III, p. 30.

as breeding in this manner on the Lower Mississippi would solve an interesting problem.

The following table will indicate the average size of *Turdus Pallasi* in the Atlantic States. The extremes in size of forty-six specimens are as follows: Length, 6.50 and 7.65; alar extent, 10.00 and 12.25; wing, 3.30 and 3.90; tail, 2.47 and 3.17; tarsus, 1.12 and 1.33. The average dimensions of these specimens are as follows: Length, 7.04; alar extent, 11.17; wing, 3.79; tail, 2.72; tarsus, 1.15.

Measurements of Specimens of TURDUS PALLASI.

M. C. Z. No.	Collector's Number.	Sex	Locality.		Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
9835	—	—	Milltown,	Maine	June —, '64	G. A. Boardman	6.98	——	3.50	2.68	1.17
4071	—	—	Upton,	"	June —, '65	J. G. Rich	6.88	10.00	3.48	2.67	1 16
1990	—	—	Norway,	"	——	A. E. Verrill	6.90	10.50	3.30	2.51	1.15
1991	—	—	"	"	——	"	7.00	10.60	3.55	2.65	1.17
5610	—	—	"	"	——	S. I. Smith	7.25	11.55	3.73	2.93	1.20
5611	—	—	"	"	——	"	6.80	10.95	3.45	2.78	1.12
312	—	—	"	"	——	"	7.15	11 50	3.70	2 92	1.15
321	—	—	"	"	——	"	7.32	11.00	3.59	2.98	1.17
1897	—	—	Waterville,	"	Apr. 20, '62	C. E. Hamlin	7.20	10.77	3.66	2.93	1.07
1943	—	—	"	"	Apr. 14, '62	"	6.80	10.75	3.49	2.65	1.18
4235	—	—	"	"	Oct. 21, '63	"	6.90	10.25	3.37	2.60	1.18
4251	—	—	"	"	Oct. 24, '63	"	6.80	10.75	3.57	2.93	—
5754	—	—	Concord,	Mass.	——	H. Mann	7.50	11.82	3.83	2.95	1.23
5755	—	—	"	"	——	"	7.15	10.15	3.45	2.57	1.14
4060	—	—	"	"	——	"	7.25	11.62	3.77	2.94	1 18
2584	—	—	Woburn,	"	——	J. G. Shute	6.80	10.25	3.36	2.57	1.17
2862	—	—	Springfield,	"	May 8, '63	J. A. Allen	7.25	10.70	3.52	2.83	1 20
9690	1002	—	"	"	Oct. 17, '63	"	7.10	11.20	3.57	2.70	1.13
9691	1021	—	"	"	Oct. 29, 63	"	7.00	10.50	3.47	2.74	1.18
——	49	♂	Watertown,	"	Dec. 10, '69	Wm. Brewster	7.00	11.63	3 63	2 63	1.33
——	58	♂	"	"	Nov. 6, '69	"	6.87	11.19	3.61	2.52	1.20
——	60	♂	"	"	Nov. 10, '69	"	7.12	11.12	3.74	2 58	1.27
——	62	♂	Belmont,	"	Nov. 22, '69	"	7.12	11.50	3.80	2 71	1.20
——	363	♂	Cambridge,	"	Apr. 16, '70	"	7.23	11.94	3.71	2.85	1.29
——	59	♀	Waltham,	"	Oct. 26, '69	"	7.20	11.12	3.74	2.58	1.27
——	61	♀	"	"	Nov. 1, '69	"	7.06	11.37	3.72	2.59	1.25
——	62	♀	Watertown	"	Oct. 26, '69	"	6.50	10.50	3 50	2.37	1.15
——	283	♀	"	"	Nov. 22, '69	"	6.56	11.00	3.50	2.58	1.16
——	353	♀	"	"	Apr. 26, '70	"	6.75	11.30	3.45	2 50	1.17
8845	8	♀	Newton,	"	Oct. 12, '67	C. J. Maynard	6.83	11.00	3.32	2.65	—
——	13	♀	"	"	Oct. 12, '67	"	7.00	10.77	3.37	2.47	—
8848	250	♀	"	"	Apr. 18, '68	"	7 21	11.32	3 60	2 80	—
8852	322	♀	"	"	Apr. 25, '68	"	7.27	11.00	3.50	2.60	—
8847	368	♀	"	"	May 5, '68	"	7.00	11.30	3.50	2.73	—
——	24	♂	"	"	Oct. 19, '68	"	7.00	11.47	3.45	2.75	—
——	14	♂	"	"	Oct. 16, '68	"	7.00	11.43	3.50	2.74	—
8846	26	♂	"	"	Oct. 16, '68	"	6.80	11.28	3.57	2.75	—
8849	301	♂	"	"	Apr. 25, '70	"	7.60	11.75	3 43	3.17	—
——	314	♂	"	"	Apr. 25, '70	"	7.38	12.83	3.80	2.83	—
8853	338	♂	"	"	Apr. 28, '70	"	7.45	11.86	3.90	2.90	—
5129	—	?	Jacksonville,	Fla.	Jan. 21, '68	J. A. Allen	7.40	12.25	3.85	—	—
5145	—	?	"	"	Jan. 25, '68	"	7.00	11.60	3 60	—	—
5146	—	?	"	"	Jan. 25, '68	"	6.75	11.10	3.45	—	—
5147	—	?	"	"	Jan. 25, '68	"	7.00	11.50	3.60	—	—
5197	—	?	Hibernia,	"	Feb. 3, '68	"	7.65	11 87	3.65	—	—
5320	—	?	Enterprise,	"	Mar. 1, '68	"	6.75	10.90	3 40	—	—

4.† **Turdus fuscescens** *Stephens.* WILSON'S THRUSH.

Turdus mustelinus WILSON, Am. Orn., V, 98, pl. xliii, 1812. (Not *T. mustelinus* GMELIN.)

Turdus fuscescens STEPHENS, Shaw's Gen. Zoöl., X, i, 182, 1817. — G. R. GRAY, Gen. Birds, 1849. — BAIRD, Birds N. Am., 214, 1858. — SCLATER, Cat. Am. Birds, 2, 1862. — BAIRD, Rev. Am. Birds, I, 17, 1864. — ALLEN, Mem. Bost. Soc. Nat. Hist., I, 514, 1868. — RIDGWAY, Proc. Phil. Acad. Nat. Sci., XXI, 127, 1869.

Turdus Wilsonii BONAPARTE, Obs. on Wilson's Nomenclature. — NUTTALL, Man. Am. Orn., I, 349, 1832. — AUDUBON, Orn. Biog., II, 362, pl. clxvi, 1834. Ibid., V, 446. — GIRAUD, Birds L. Island, 89, 1843-44.

Turdus ustulatus NUTTALL, Man. Am. Orn., I, (2d ed.) 400, 1840. — BAIRD, Birds N. Am., 215, 1858. — IBID., Rev. Am. Birds, I, 18, 1864. — RIDGWAY, Proc. Phil. Acad. Nat. Sci., XXI, 127, 1869. — COOPER & BAIRD, Orn. Cal., I, 5, 1870.

Merula minor SWAINSON, Faun. Bor. Am., II, 179, pl. xxxvi, 1831.

Merula Wilsonii BREWER, Proc. Bost. Soc. Nat. Hist., I, 191, 1844.

Not common, the greater part passing the winter in the tropics. A few specimens were taken by Mr. Boardman at Green Cove Springs, February 20th and 22d. I did not meet with it.

The considerable variation in color exhibited by different specimens of this species have perhaps been already sufficiently adverted to. It may be added that some of the brightest colored specimens of this species proved on dissection to be females, as well, also, as some of the palest. As in *T. migratorius*, *T. Swainsoni*, etc., these variations in color do not depend entirely upon sex, age, nor season. The latter, however, doubtless has much to do with it, as has also age, as already explained; * but the variation is in the main strictly the result of individual differentiation.

Dr. Cooper says † that in habits this species is the "exact counterpart of *T. nanus*," the resemblance extending to the situation and structure of the nest, and also to the color of the eggs. In this connection it may be remarked that it is not a little remarkable that the eggs and nests of both the so-called *T. ustulatus* and *T. nanus* should so exactly coincide with those of *T. Swainsoni* (which breeds where the other species are said to), when the birds themselves are scarcely distinguishable respectively from *T. fuscescens* and *T. Pallasi*, both of which nest on the ground and lay unspotted eggs, while *T. Swainsoni* nests in trees and lays spotted eggs. The nests and eggs I have seen purporting to be those of *T. ustulatus* and *T. nanus* (and also of *T. Aliciæ*) were so closely like those of *T. Swainsoni*, — not differing more from those of this species than those of the same species usually differ, — as to at once raise the suspicion in my mind that they might all be really those of *T. Swainsoni*, and that they may have been in some accidental way wrongly identified by the collector.

* In Part III, pp. 193 *et seq.*

† Ornithology of California, Vol. I, p. 5.

In the following table are given the measurements of forty specimens, some twenty-five of which were taken in Massachusetts during the breeding season. The extremes of the series are as follows: Length, 6.95 and 7.87; alar extent, 11.05 and 12.70; wing, 3.55 and 4.16; tail, 2.63 and 3.02; tarsus, 1.06 and 1.18. The average dimensions are as follows: Length, 7.38; alar extent, 11.83; wing, 3.82; tail, 2.88; tarsus, 1.13.

Measurements of Specimens of TURDUS FUSCESCENS.

M. C. Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
2272	—	—	Waterville, Maine	June 2, '62	C. E. Hamlin	7.12	11.25	3.90	2 87	1.10
2275	—	—	" "	June 5, '62	"	7 39	11 90	3 79	2.84	1.18
2276	—	—	" "	June 2, '62	"	7.53	11 73	3.86	2.88	1.06
2277	—	—	" "	June 2, '62	"	7.40	12.00	3 83	2 87	1.13
9607	—	—	Canton, St. Lawrence Co., N. Y.	June —, '60	J. S Foley	7.36	11.40	3.72	2.92	1.12
9608	—	—	"	June —, '60	"	7.50	11.75	3 93	3 00	1.10
9609	—	—	"	June —, '60	"	7.50	——	3.92	2 93	1.18
10382	—	—	"	June —, '60	"	7.30	11 43	3.77	2 97	1.13
10383	—	—	"	June —, '60	"	6 95	11.05	3 55	2 63	1.09
10384	—	—	"	June —, '60	"	7.45	11 75	3 69	2.80	1 12
10385	—	—	"	June —, '60	"	7.12	11.75	3.68	2.67	1.11
8830	367	♂	Newton, Mass.	May 5, '68	C. J. Maynard	7.81	12.70	4.16	3.00	—
8831	382	♂	" "	May 6, '68	"	7.75	12.55	4 10	3.00	—
8841	495	♂	" "	May 15, '68	"	7.87	11 91	4 00	3.00	—
8832	528	♂	" "	May 16, '68	"	7.70	12.45	4.00	3.00	—
8833	538	♂	Wayland, "	May 18, '68	"	7.35	11.91	3 91	2.73	—
8834	556	♂	Weston, "	May 20, '68	"	7.00	11.95	3 55	2.55	—
8835	581	♂	Newton, "	May 22, '68	"	7.41	12 50	4.15	2 90	—
8337	611	♂	" "	May 25, '68	"	7.50	12.45	3.80	2.90	—
8838	683	♂	" "	May 28, '68	"	7.50	12.30	4.15	3 17	—
8839	692	♂	" "	May 28, '68	"	7.45	12.16	3 76	2.85	—
8336	610	♀	" "	May 25, '68	"	7 30	11.36	3.55	2 60	—
8840	768	♀	" "	June 5, '68	"	7.50	12 15	3.90	2.89	—
2876	2876	—	Springfield, "	June 14, '62	J. A. Allen	7.00	11.70	3 75	2.80	1.17
1749	1749	—	" "	June 14, '62	"	7 00	11.35	3 63	2.65	1.10
1828	1828	2	" "	May 29, '62	"	7.50	11.50	3 99	2.86	1.08
1832	1832	3	" "	May 29, '62	"	7.50	11.55	3 79	2.80	1.12
——	408	—	Newton, "	May 18, '70	Wm. Brewster	7.50	12 00	3.74	2 74	1.14
2873	2873	—	Springfield "	May 12, '63	J. A. Allen	7 75	12.40	3.98	3.02	1.08
2876	2876	—	" "	May 14, '63	"	7.12	11.30	3.73	2 91	1.12
2937	2937	—	" "	May 29, '63	"	7.45	11.80	3.65	2.78	1.12
2938	2938	—	" "	May 29, '63	"	7 65	11.50	3.86	2.99	1.15
1431	—	—	Malden, "	May 22, '62	"	7.15	11.87	3.75	2 93	1.14
1432	—	—	" "	May 22, '62	"	7.52	11.80	3 93	3.00	1 15
280	—	—	" "	——	D. Higgins	7.35	11.75	3.76	2.89	1.10
281	—	—	" "	——	"	7.25	11 90	3.68	2.73	1.15
143	—	—	" "	June —, '61	"	7.30	11 72	3.72	2.83	1.12
144	—	—	" "	June —, '61	"	7.25	11.75	3.78	2.70	1.15
145	—	—	" "	June —, '61	"	7.00	11 40	3.63	2 68	1.11
146	—	—	" "	June —, '61	"	7.45	11 75	3.69	2.80	1.12

5.* **Harporhynchus rufus** *Cabanis.* BROWN THRUSH.

Very abundant. The specimens examined were smaller and much brighter colored than any I have seen from the Northern States. Commences nesting the last week in March.

6.* **Galeoscoptes carolinensis** *Cabanis.* CAT-BIRD.

Abundant. Smaller and darker colored than at the North. Some evidently remain and breed. Audubon states that none breed so far south as South Carolina, and that few remain so far north as Florida in winter; but Dr. Coues, in his "Synopsis of the Birds of South Carolina,"* gives it as abundant and resident in that State.

7.* Mimus polyglottus *Boie.* Mocking-Bird.

Common. Contrary to my anticipations, I failed to hear this bird sing during my three months' stay in Florida, except in a few instances near Jacksonville early in April, at which time they were nesting, although everywhere more or less common. It was more frequent along the borders of the forest and about clumps of bushes in the pine barrens than in the hummocks. It differed from its relatives, the brown thrush and cat-bird, in avoiding the denser thickets, which are the favorite resorts of the latter. The resemblance of the mocking-bird to the loggerhead shrike, in mode of flight and general appearance, which must strike every observer, has been properly referred to by Dr. Coues. †

Different specimens of the mocking-bird from Florida differ considerably from each other in intensity of color, some being much darker than others, and in the extent of the white on the outer tail feathers, and also in the length, thickness, and curvature of the bill. Some have the commissure but slightly curved and the tip of the bill moderately depressed; others have the commissure much arched and the tip much decurved. Several specimens before me from Cape Florida are smaller than those from the St. John's River, with longer, slenderer, and more curved bills. There seems to be as much difference between specimens from South Florida and the Middle States, as between the numerous so-called species of the West Indies, which, many of them at least, are scarcely more than local forms of the original or first-described *M. polyglottus.*

The following measurements of forty-four Florida specimens of this species indicates its usual range of variation in size and proportions. The extremes of this series are as follows: Length, 9.25 and 11.00; alar extent, 13.00 and 14.75; wing, 4.00 and 4.75; tail, 4.10 and 5.15. The average dimensions are as follows: Length, 9.91; alar extent, 13.69; wing, 4.28; tail, 4.87.

* Proc. Bost. Soc. Nat. Hist., Vol. XII, p. 113.

† "Synopsis of the Birds of South Carolina," Proc. Bost. Soc. Nat. Hist., Vol. XII, p. 113, October, 1868.

Measurements of Florida Specimens of MIMUS POLYGLOTTUS.

M. C. Z. No.	Original No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent	Wing.	Tail.
5118	—	♂	Jacksonville, Fla.	Jan. 19, '68	J. A. Allen	9 75	14.00	4.60	
5124	—	♂	" "	Jan. 21, '68	"	9.75	14 35	4 50	
5350	—	♂	Enterprise, "	Nov. 4, '69	"	10 00	14.15	4 25	
—	—	♂	Hawkinsville, "	Mar. 15, '69	"	10.60	14 75	4 50	
5415	—	—	" "	Mar. 15, '69	"	9.85	14.00	4 40	
5395	—	—	" "	Mar. 14, '69	"	9.85	14.00	4.30	
5355	—	♀	" "	Mar 10, '69	"	10.12	13 00	4.26	
5185	—	♀	Hibernia, "	Jan. 30, '69	"	10.30	14.15	4 30	
10586	1955	♀	Jacksonville, "	Dec. 31, '68	C. J. Maynard	10.00	13 00	4.05	4.65
—	2005	♂	" "	Jan. 10, '69	"	10.20	14.00	4 50	4.70
—	2407	♂	Dummitt's, "	Mar. 2, '69	"	11.00	14 65	4.50	4.60
—	2614	♂	" "	Mar 13, '69	"	10.15	14 00	4.40	4.90
10589	2341	♂	" "	Feb. 16, '69	"	9.75	13.50	4.25	4.75
—	2449	♂	" "	Feb. 24, '69	"	9.25	14.00	4.35	4.35
—	2613	♂	" "	Mar. 13, '69	"	10.20	14.00	4.40	4.75
—	2374	♂	" "	Mar. 13, '69	"	9.80	14.00	4 30	4.10
—	2370	♂	" "	Feb. 17, '69	"	9.50	13.25	4.25	4.40
10592	2372	♂	" "	Feb. 17, '69	"	9.75	13.75	4.20	4.50
—	2528	♂	" "	Mar. 5, '69	"	10 30	14.00	4.45	4.95
—	2474	♂	" "	Feb. 16, '69	"	10.15	14.30	4 60	5.15
10595	2486	♂	" "	Feb. 16, '69	"	10.00	13.00	4.00	4.38
10596	2518	♀	" "	Mar. 2, '69	"	9.75	13 50	4.75	4 50
—	2428	♀	" "	Mar. 2, '69	"	10.00	13 50	4.50	4.45
—	2429	♀	" "	Mar. 2, '69	"	10.00	13 50	4 35	4.35
—	2478	♀	" "	Mar. 11, '69	"	10.50	13.50	4.18	4.75
—	2419	♀	" "	Mar. 11, '69	"	10.00	13 35	4.25	4.75
10590	2340	♀	" "	Mar. 13, '69	"	9 60	14 35	4.40	4.50
10594	2346	♀	" "	Mar. 16, '69	"	9.75	13 60	4.25	4.35
10597	2569	♀	" "	Mar. 11, '69	"	9.30	13.00	4.00	4.17
—	2507	♀	" "	Mar 11, '69	"	9.60	13 35	4 10	4 60
10587	2339	♀	" "	Feb. 10, '69	"	9.40	13.50	4 05	4.20
10588	2333	♀	" "	Feb. 17, '69	"	9.75	13.50	3 40	4.50
10591	2509	♀	" "	Mar. 13, '69	"	9.50	13.25	4 20	4.30
—	2560	♀	" "	Mar. 8, '69	"	9 50	13.20	4.15	4 35
10593	2375	♀	" "	Feb. 17, '69	"	9.80	13.00	4 10	4.60
—	2478	♀	" "	Feb. 16, '69	"	9.50	13 50	4.40	4.20
—	2485	♀	" "	Feb. 16, '69	"	10.00	13.00	4.00	4.38

SAXICOLIDÆ.

8.* **Sialia sialis** *Haldemann.** BLUE-BIRD.

Common. In this species the smaller size of the Florida specimens, as compared with those from Massachusetts, is very marked, as is also the greater intensity of color.

SYLVIADÆ.

9.† **Regulus calendula** *Lichtenstein.* RUBY-CROWNED KINGLET.

Abundant. One of the most numerous of the winter birds. Chiefly confined to the swamps and hummocks.

10.† **Regulus satrapa** *Lichtenstein.* GOLDEN-CRESTED KINGLET.

Not common. A single pair was collected by Mr. Maynard at Jacksonville in January.

* *Sialia sialis* HALDEMANN, Trego's Geography of Pennsylvania, p. 77, 1843. —BAIRD, Birds of N. Am., 222, 1858. See American Naturalist, Vol. III, p. 159, 1869.

11.* **Polioptila cærulea** *Sclater.* Blue-gray Gnatcatcher.

Common. Generally seen in the same situations as *R. calendula.*

PARIDÆ.

12.* **Lophophanes bicolor** *Bonaparte.* Crested Titmouse.

Common.

13.* **Parus atricapillus** *Linné.* Black-capped Titmouse. Chickadee.

Parus atricapillus Linné, Syst. Nat., I, 341, 1766. — Wilson, Am. Orn., I, 137, 1808. — Bonaparte, Obs. Nom. Wils. Orn., Journ. Phil. Acad. Nat. Sci., IV, 254, 1825. — Rich. & Swain., Faun. Bor. Am., II, 226, 1831. — Audubon, Birds Am., II, 146, pl. cxxvi, 1841. — Cassin, Ill. Birds Cal., I, 17, 1853. — Baird, Birds N. Am., 390, 1858. — Sclater, Cat. Am. Birds, 13, 1862. — Baird, Rev. Am. Birds, I, 80, 1864.

Parus palustris Nuttall, Man. Orn., 241, 1832.

Parus carolinensis Audubon, Orn. Biog., II, 341, 1837; V, 474, pl. clx, 1839. — Audubon, Birds Am., II, 152, pl. cxxvii, 1841. — Cassin, Ill. Birds Cal., I, 17, 1853. — Baird, Birds N. Am., 392, 1858. — Sclater, Cat. Am. Birds, 14, 1862. — Baird, Rev. Am. Birds, I, 81, 1864.

Parus septentrionalis Harris, Proc. Phil. Acad. Nat. Sci., II, 300, 1845. — Cassin, Ill. Birds Cal., I, 17, 80, pl. xiv, 1853. — Baird, Birds N. Am., 389. — Sclater, Cat. Am. Birds, 14. — Baird, Rev. Am. Birds, I, 82.

Parus meridionalis Sclater, Proc. Lond. Zoöl. Soc., 1856, 293. — Baird, Birds N. Am., 392. — Sclater, Cat. Am. Birds, 14. — Baird, Rev. Am. Birds, I, 81.

Parus occidentalis Baird, Birds N. Am., 391, 1858. — Sclater, Cat. Am. Birds, 14, 1862. — Baird, Rev. Am. Birds, I, 81, 1864.

Pœcila atricapilla Bonap., Consp. Av., 230, 1850.

Pœcila carolinensis Bonap., Ibid.

Seen by Mr. Marcy at Jacksonville, where also specimens of it were collected by Mr. Maynard. Not observed by any of us up the river. Audubon speaks of having found it abundant in the Floridas in the winter of 1831 and 1832, and "breeding in the swamps as early as the middle of February." *

The common titmouse (*P. atricapillus*), although not more subject to geographical variation than many other birds, is one of the species in which such differences were first detected, though not recognized at the time as such. Audubon, in 1833, upon returning to Charleston, South Carolina, from a visit to the Eastern States, the British Provinces, and Labrador, noticed a considerable difference in size between the examples of this bird he met with at the North, and those of the lowlands of the

* Birds of America, Vol. II, p. 153.

Carolinas. Though no other difference was appreciable, he and his friend Bachman thought this was sufficient to warrant the description of the southern form as specifically distinct from the northern. He accordingly thus separated them in the second volume of his "Ornithological Biography." But if the black-capped titmice of the Carolinas, the lower parts of Virginia, Maryland, and Southern New Jersey are distinct from those of Massachusetts, on precisely the same grounds are those of Massachusetts distinct from those of Northern Maine. Even the titmice of Massachusetts are not just the same in winter that they are in summer, those which breed here doubtless mainly going south in winter, while their place is filled by others that spend the summer more to the northward. This at least is what the slight average difference in size between summer and winter specimens seems to indicate. But the Carolina titmouse (*P. carolinensis*) has been recognized as valid by most subsequent writers, and in accordance with the principle upon which this supposed species was admitted, several others have been added by other authors.

The titmice from the middle, elevated regions of the continent, in accordance with a general law of geographical variation among both birds and mammals, are a little larger than those of either the Mississippi valley or the Pacific coast, and have also, apparently, a relatively slightly longer tail and paler colors, — variations which occur in a number of other birds that have a similar distribution. The titmice of this region form the *Parus septentrionalis* of authors. Specimens labelled "*Parus septentrionalis*," collected near Chicago, have been received at the Museum of Comparative Zoölogy from the Chicago Academy. They do not differ, however, from numerous others collected in Massachusetts, though the true *P. septentrionalis*, or the black-capped titmice of the Rocky Mountains, does have a slightly longer tail than those from the other parts of the continent.

Those which occur on the Pacific slope of the continent, though forming the *P. occidentalis* of authors, are admittedly the same in size and general appearance as the *P. atricapillus* of the Atlantic States, this species having been introduced to the world with the following suggestive remarks: "It is rather a hazardous undertaking to add another to the list of North American black-capped and throated titmice; but if we have three good species now, instead of one, then the present is equally entitled to specific distinction with *carolinensis* and *septentrionalis*."

The *P. meridionalis* was first made known from a single specimen from Mexico, and of which very few specimens seem to have been recognized as belonging to it. The original type certainly recalls only a worn summer specimen of the common titmouse, though its darker color may be due to its southern habitat. Towards the end of the breeding season specimens of *P. atricapillus*, more especially females, have the plumage, particularly that of the lower surface of the body, much darker than in fall and winter, simply from the wearing off of the rufous and ashy extremities of the feathers, July specimens generally differing much in color from winter ones.

In respect to *P. carolinensis*, as already observed, the only difference urged as distinguishing it from *P. atricapillus* is that of its smaller size. Yet this difference is so slight that it is admitted that if *P. carolinensis* and *P. atricapillus* were " separated by a wide interval of locality, it might be a question whether it [*P. carolinensis*] might not be a variety. As, however," it is urged, "both are found together in the Middle States, and preserving together their characteristics, there will be little risk in considering them distinct." Since the larger birds are, in the main, either northern or occupy the elevated regions of the Alleghanies, the two forms must necessarily be found associated together, especially in winter, through their migrations. Unfortunately, in the work where this group has been most elaborately considered,* but two examples of each are cited, with a statement of their measurements; the two of *P. atricapillus* being from Carlisle, Pennsylvania, and the two of *P. carolinensis* from Washington, D. C. From the annexed table of measurements of *P. atricapillus* from Massachusetts and Maine, it will be seen that a few are small enough to be regarded as belonging to the *P. carolinensis*. There is, also, a larger amount of seasonal difference in the color and general character of the plumage than has been either admitted or suspected, as well as in size. No one who has previously written on this group appears yet to have compared many specimens of these supposed two species, or to have examined a sufficiently large number of either to become aware of the wide differences that exist between specimens from the same locality.

Variations similar to those assumed to specifically distinguish *P. carolinensis* from *P. atricapillus* occur in *P. hudsonicus* between specimens from localities quite distant in latitude. Dr. Bryant has already called attention to such differences in the *P. hudsonicus*, and at the same time proposed for the southern " variety " the name of "*P. hudsonicus* var. *littoralis*." Concerning this variety and the general subject in question, he remarks as follows: "The specimens of *Parus hudsonicus* from Yarmouth [Nova Scotia] and those from the Hudson Bay territory present as great, if not greater, differences in size than exist between *P. carolinensis* and *P. atricapillus*, and in color, between *P. septentrionalis* and *P. atricapillus*. I am inclined myself to consider *P. atricapillus*, *septentrionalis*, *meridionalis*, and *occidentalis* as varieties of one species; but, if they are considered as specifically distinct, there can be little question of the propriety of

* Baird's Birds of North America.

separating the Yarmouth bird from those found in the Hudson Bay territory." *

In the following table of measurements of twenty-seven specimens, all taken within ten miles of Cambridge, and all but two in December and January, the extremes of size are as follows: Length, 4.70 and 5.75, both specimens being females; alar extent, 7.50 and 8.60, both specimens being also females; wing, 2.33 and 2.63, also both females; tail, 2.15 (female) and 2.67 (male); tarsus, .62 (male) and 77 (female). The average size of these specimens is as follows: Length, 5.38; alar extent, 8.37; wing, 2.47; tail, 2.50; tarsus, .70. The females average a little smaller than the males, but the difference is only slight.

The largest specimen of the group of black-capped and black-throated titmice cited by Professor Baird † measures as follows: Length, 5.75; alar extent, 8.37; wing, 2.75; tail, 2.86 (*Parus septentrionalis*, from the Black Hills, Neb., Sm. Inst. No. 8827). A specimen of the *P. carolinensis*, cited by the same author, measures as follows: Length, 4.62; alar extent, 7.00; wing, 2.50; tarsus, .60 (Sm. Inst. No. 706, from Washington, D. C.). So far as the length of the wing and tail are concerned, specimens are fre-

Measurements of Massachusetts Specimens of PARUS ATRICAPILLUS.

M. C. Z. No.	Collector's Number.	Sex.	Locality.		Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
11703	52	♂	Cambridge,	Mass.	Dec. 10, '69	Wm. Brewster	5.38	8.12	2.62	2.67	.75
11704	86	♂	"	"	Dec. 14, '69	"	5.25	8.12	2.55	2.37	.75
11705	87	♂	"	"	Dec. 14, '69	"	5.06	7.88	2.62	2 50	.62
11708	96	♂	"	"	Dec. 14, '69	"	5.00	7.50	2.44	2.30	.75
11707	94	♂	"	"	Dec. 17, '69	"	5.06	7.87	2.50	2.50	—
——	99	♂	"	"	Dec. 17, '69	"	5.12	8.12	2.55	2.43	.72
——	104	♂	"	"	Dec. 20, '69	"	5.25	8.00	2.55	2.50	.70
11711	103	♂	"	"	Dec. 20, '69	"	5.06	8.00	2.62	2.43	.75
11710	101	♂	"	"	Dec. 20, '69	"	5.12	8.06	2.55	2.43	.75
——	153	♂	"	"	Jan. 7, '70	"	4.94	7.80	2.43	2.25	.69
——	112	♂	"	"	Dec. 24, '69	"	5 50	8 12	2.62	2.56	.69
——	206	♂	"	"	Jan. 20, '70	"	5.40	8.21	2.58	2.55	.70
11706	88	♀	"	"	Dec. 14, '69	"	4.94	7 50	2.43	2.31	—
——	95	♀	"	"	Dec. 17, '69	"	5.00	8.00	2.50	2 37	.75
11709	97	♀	"	'	Dec. 17, '69	"	5.06	7.83	2.43	2.42	.—
11712	105	♀	"	"	Dec. 20, '69	"	5.19	7.75	2.50	2.25	.67
——	100	♀	"	"	Dec. 20, '69	"	5.19	8.12	2.56	2.50	.75
11713	114	♀	"	"	Dec. 24, '69	"	5.75	7.88	2.50	2.33	.63
——	161	♀	Watertown,	"	Jan. 7, '70	"	5.45	8.00	2.63	2 64	.69
——	163	♀	"	"	Jan. 7, '70	"	4.94	7.50	2.33	2 25	.69
——	179	♀	Belmont,	"	Jan. 13, '70	"	4.84	7.55	2.35	2.15	.77
——	205	♀	"	"	Jan. 20, '70	"	5.41	8.17	2.54	2.42	.70
——	239	♀	"	"	Jan. 26, '70	"	5.25	7.52	2.35	2.30	.67
——	203	♀	Arlington,	"	Jan. 20, '70	"	4.70	7.75	2.45	2.40	.68
4946	268	♀	Newton,	"	Apr. 21, '68	C. J. Maynard	5.00	8.60	2.58	2.30	—
5011	1216	♀	"	"	Sept. 8, '68	"	5.35	7.85	2.50	2.40	.65
4945	269	♂	"	"	Apr. 21, '69	"	5.00	8.00	2.41	2.35	—

* Proc. Bost. Soc. Nat. Hist., Vol. IX, p. 368, April, 1865.

† Birds of North America, p. 390.

quently taken in Massachusetts (and of which I have measurements before me) that are considerably smaller than this one from Washington, or than any given in the above table.

SITTIDÆ.

14.* **Sitta carolinensis** *Gmelin.* White-breasted Nuthatch.

Common; especially in the pineries.

15.* **Sitta pusilla** *Latham.* Brown-headed Nuthatch.

Common in the pineries; rarely seen elsewhere.

TROGLODYTIDÆ.

16.* **Troglodytes aëdon** *Vieillot.* Common Wren.

Troglodytes aëdon Vieillot, Ois. Am. Sept., II, 52, pl. cvii, 1807. — Bonaparte, Richardson & Swainson, Audubon. — Baird, Birds N. Am., 367, 1858. — Ibid., Rev. Am. Birds, I, 138, 1864. — Maynard, Naturalist's Guide, Part II, p. 95, 1870.

Troglodytes fulvus, Nuttall, Man. Am. Orn., I, 422, 1832.

Troglodytes americanus Audubon, Orn. Biog., II, 452, pl. clxxix, 1834. — Baird, Birds N. Am., 368. — Ibid., Rev. Am. Birds, I, 141.

Troglodytes Parkmani Audubon, Orn. Biog., V, 310, 1839. — Baird, Birds N. Am., 367. — Ibid., Rev. Am. Birds, I, 140.

Troglodytes sylvestris Gambel, Proc. Phil. Acad. Nat. Sci., III, 113, 1864.

Sylvia domestica Wilson, Am. Orn., I, 129, pl. viii, fig. 3, 1808.

Abundant, occurring everywhere. It keeps so closely concealed that it is difficult to shoot, except when on the wing. Both this and the Carolina wren are exceedingly quick in their movements, and if they are watching the collector when he is about to shoot at them, they are pretty sure to dodge the charge; although he finds the bushes and foliage where the bird sat riddled by the shot, he usually searches in vain for the specimen he is sure he ought to have killed. When approached in old grassy fields or pine openings, they will allow one to almost tread on them before attempting to get away, and then, instead of taking to wing, often seek to escape by running off like a mouse beneath the grass. The term "house" wren, usually applied to this bird, is decidedly a misnomer, since it frequents the fields, the thickets, and even the forest, as much as the vicinity of houses. In the wilds of Florida, where human habitations are few, there is nothing whatever in its habits to suggest this name.

The "wood wren," *Troglodytes americanus* of Audubon, I am sure is only the brighter colored form of *T. aëdon;* in size or proportions there is nothing, though the contrary has been claimed, to distinguish them. Specimens equally large and equally small occur in each state of plumage, in which the same general range of variation in proportions is presented. There is also an intergradation in color, and no observable difference in habits. Both forms were common in Florida; both also occur in New England, whence Audubon obtained the first specimen of his supposed new species. Audubon admits that it "can hardly be distinguished in description" from the house wren. The large size assumed by him as characterizing it may be readily accounted for by the fact of his obtaining his first specimens at Eastport in Maine, which is the extreme northern limit of the habitat of this species.

The following measurements of fifteen Florida specimens indicates the usual range of variation in respect to size and proportions found in specimens from the same locality. The extremes of this series are as follows: Length, 4.30 and 5.10, both specimens being females; alar extent, 6.10 and 6.95, both specimens being males; wing, 1.90 and 2.44; tail, 1.30 and 2.40; tarsus, .50 and .68; bill, .47 and .60 (.80?). The differences between these extremes, it will be noticed, are very great, considering the small size of the bird. The average dimensions are as follows: Length, 4.89; alar extent, 6.61; wing, 2.05; tail, 1.80; tarsus, .52.

Measurements of Florida Specimens of TROGLODYTES AËDON.

M. C. Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.	Bill.
10681	1900	♂	Jacksonville	Jan. 1, '69	C. J. Maynard	4.70	6.60	2 44	2.40	.50	.47
—	1942	♂	"	Jan. 1, '69	"	5.00	6 50	2.00	1.70	.57	.50
—	1966	♂	"	Jan. 3, '69	"	5.00	6.75	2.05	1.75	.65	.50
10682	1967	♂	"	Jan. 3, '69	"	4.75	6.75	2.05	1.95	.55	.52
—	1968	♂	"	Jan. 3, '69	"	4.50	6.50	2.05	1.65	.61	.50
—	2790	♂	"	Mar. 20, '69	"	5.65	6.95	2.00	1.64	.54	.51
—	2576	♂	Dummitt's	Mar. 10, '69	"	5.00	6.50	2.10	2.00	.62	.50
—	4	♂	Jacksonville	Mar. 29, '69	"	4.60	6.10	2.00	1.80	.61	.60
—	2033	♀	"	Jan. 5, '69	"	5.70	6.75	2.10	1.75	.60	.80
—	1979	♀	"		"	4.30	6 50	2 00	1.30	.60	.56
—	2588	♀	Dummitt's	Mar. 11, '69	"	5.00	6.70	1.90	1.70	.65	.50
5178	—	—	Hibernia	Jan. 20, '69	J. A. Allen	5.20	6.75	2.03	1.70	.65	.60
5179	—	—	"	Jan. 20, '69	"	4.75	6.50	2.00	1.65	.67	.55
—	—	—	Hawkinsville	Mar. 10, '69	"	5.00	6.50	2.00	—	—	—
5361	—	—	"	Mar. 10, '69	"	4.87	6.75	2.00	—	.68	—

17.* **Thryothorus ludovicianus** *Bonaparte.* CAROLINA WREN.

Common. Rarely seen outside of thickets.

In few species is the difference in color between northern and southern specimens greater than in this. Florida specimens have the reddish-brown of the dorsal surface many shades deeper than Maryland ones, and the under surface strongly rufous. The tail and wings, besides being much darker, have the dark bars black, they being deep black on the tail, and consequently far more conspicuous. The crissum, however, is lighter than in the Maryland specimens, with the black bars broader. The Florida specimens have also a much longer bill, they closely agreeing in every particular with the so-called *Thryothorus Berlandieri* of Northeastern Mexico, the Florida specimens even possessing the interrupted black bars on the sides of the body said to occasionally characterize that species as distinguished from the *T. ludovicianus.* The differences between Florida and Maryland specimens of *T. ludovicianus* in the length of the bill, as well as in color, are very striking. They are paralleled, however, in *Harporhynchus rufus* and in other species. The *T. Berlandieri* hence appears to be only the smaller, darker form of *T. ludovicianus,* — the Mexican homologue of the Florida representatives of this species.

The *Thryothorus Bewickii,* from what is known of its range, doubtless occurs as a resident bird in Florida, but is probably rare there, as it generally is elsewhere.

18.† **Anorthoura hyemalis** *Rennie.* WINTER WREN.

Rare. — *Boardman.*

19.† **Cistothorus stellaris** *Cabanis.* SHORT-BILLED MARSH WREN.

Rare. Enterprise, February. — *Boardman.*

The *Telmatodytes palustris* doubtless also occurs as a winter resident.

MOTACILLIDÆ.

20.† **Anthus ludovicianus** *Lichtenstein.* TITLARK.

Common. Several were usually seen in company, but along the river I saw no large flocks. According to Mr. Maynard, however, they occurred in large flocks in the "old fields" away from the river.

SYLVICOLIDÆ.

21.† **Mniotilta varia** *Vieillot.* BLACK AND WHITE CREEPER.

Not uncommon throughout the winter, but much more numerous in March.

22.† **Parula americana** *Bonaparte.* BLUE YELLOW-BACKED WARBLER.

Occasional during the winter months, but very numerous after the 1st of March, soon after which time they were in full song.

23.† **Helminthophaga celata** *Baird.* Orange-crowned Warbler.

"Enterprise, 15th of February. Rare." — *Boardman.*

24.* **Dendrœca pinus** *Baird.* Pine Warbler.

Abundant. Is much on the ground at this season, as it sometimes is at the north in spring; on the whole, however, it is much less terrestrial in its habits than is *D. palmarum.* In full song in February.

25.† **Dendrœca palmarum** *Baird.* Yellow Redpoll Warbler.

Extremely abundant. Probably the most numerous of the winter birds in East Florida, where it is more or less common in all situations. Exceedingly terrestrial in its habits, being generally seen hopping along the ground or fallen timber. At the 1st of April they had considerably decreased in numbers, but many were at that time observed at Jacksonville.

There is some indication that the males and females, and possibly the adult and young, frequent separate districts at this season. When at Jacksonville in January I saw only males; on the Upper St. John's, in February and March, only females or immature males; but these were in excessive abundance, as were also the males at the earlier date around Jacksonville. Is it not probable that the old males either do not go quite so far south as the females and immature males, or that the species was already on its way north? As is well known, the males in the species of this family, as probably in most other birds, precede the females in their journey northward.

26.† **Dendrœca coronata** *Gray.* Yellow-crowned Warbler.

More or less common till the 1st of April, and probably some remained still later. During the last half of March they began to moult, but at the end of the month a large part were still in winter dress. The same remarks in respect to moulting apply also to *D. palmarum.*

27.* **Dendrœca dominica** *Baird.* Yellow-throated Warbler.

Seen at Jacksonville in January, but much more abundantly up the river in February and March. March 5th I found them in great numbers in the cypress and maple swamps near Lake Munroe, at which time the spring migration had commenced.

28.* **Dendrœca discolor** *Baird.* Prairie Warbler.

Abundant at Jacksonville, April 1st, and occasionally seen at earlier dates. This species is undoubtedly resident in Florida the whole year.

29.† **Seiurus aurocapillus** *Swainson.* GOLDEN-CROWNED WAGTAIL.

Not common. A few were seen in February, as well as later.

30.† **Seiurus noveboracensis** *Nuttall.* WATER WAGTAIL.

Rare. Found at Dummitt's by Mr. Maynard in Februrary.

31.* **Geothlypis trichas** *Cabanis.* MARYLAND YELLOW-THROAT.

Abundant. Though somewhat brighter colored throughout, they differ mainly from the northern type in the greater breadth of the black facial band. There is but little difference in general size, that is, so far as I have had an opportunity of observing; occasionally a Florida example has a bill considerably longer than the average in northern examples, but this does not appear to be a very constant difference between the southern and northern specimens. It would probably be more marked in specimens from South Florida.

Other species of this family were seen in March that are not to be reckoned as winter residents. Among them are the following: *Dendrœca maculosa, D. virens,* and *D. pennsylvanica, Euthlypis canadensis, Setophaga ruticilla,* and *Helminthophaga ruficapilla,* all of which began to appear on the Upper St. John's, near Enterprise, about the middle of March, and most of them were also seen later at lower points on the river. *Helmitherus vermivorus* and *H. Swainsoni* were taken at St. Augustine, by Mr. L. L. Thaxter, in April.

HIRUNDINIDÆ.

32.† **Tachycineta bicolor** *Cabanis.* WHITE-BELLIED SWALLOW.

More or less numerous, but observed at irregular intervals. Large flocks were seen near the St. John's River in January. It probably does not breed in Florida.

33.† **Cotyle riparia** *Boie.* BANK SWALLOW.

Not observed by either Boardman, Maynard, or myself prior to the last of March, but Mr. Audubon saw it in immense flocks "in winter," first at St. Augustine, and afterwards in other parts of the State.*

The *Stelgidopteryx serripennis* was seen about Jacksonville the first week in April, and specimens of it were obtained. Several pairs were seen flying about some bluffs a few miles below the town, apparently with the intention of selecting breeding-places.

* Birds of America, Vol. I, p. 187.

VIREONIDÆ.

34.† **Lanivireo solitarius** *Baird.* SOLITARY VIREO.

Rather common. In full song early in March.

35.* **Vireo noveboracensis** *Bonaparte.* WHITE-EYED VIREO.

Common. In full song in March.

36.† **Vireosylvia olivacea** *Bonaparte.* RED-EYED VIREO.

"A few all winter." — *Boardman.* Common after the 1st of March, on the Middle St. John's.

The Yellow-throated Vireo, *Lanivireo flavifrons,* was quite common early in March, and is undoubtedly a winter resident in South Florida.

AMPELIDÆ.

37.† **Ampelis cedrorum** *Baird.* CEDAR BIRD.

Common. Perhaps resident.

LANIIDÆ.

38.* **Collurio ludovicianus** *Baird.* LOGGERHEAD SHRIKE.

Lanius ludovicianus LINNÉ, Syst. Nat., I, 184, 1766. — BONAPARTE, NUTTALL, AUDUBON. — GAMBEL, Proc. Phil. Acad. Nat. Sci., III, 200, 1847.

Lanius garrulus BARTRAM, Travels, 289, 1791 (no description).

? *Lanius ardosiaceus* VIEILLOT, Ois. Am. Sept., I, 81, pl. li, 1807. — BONAPARTE, Obs. on Wils. Nomenc., Journ. Phil. Acad. Nat. Sci., III. 358, 1824.

Lanius carolinensis WILSON, Am. Orn., III, 57, pl. xxii, fig. 5, 1811.

Lanius excubitoroides SWAINSON, Faun. Bor. Am., II, pl. xxxiv, 1831.

Lanius elegans SWAINSON, Ibid., 122. — NUTTALL, Man. Am. Orn., I, 2d ed., 287, 1840. — GAMBEL, Proc. Phil. Acad. Nat. Sci., I, 261, 1843.

Lanius mexicanus BREHM, Cab. Journ. für Orn., II, 145, 1854. — SCLATER, Catal. Am. Birds, 46, 1861.

Collurio ludovicianus BAIRD, Birds of N. Am., 325, 1858. — ALLEN, Amer. Nat., III, 579, 1869. — BAIRD, Rev. Am. Birds, I, 443, 1866.

Collurio excubitoroides BAIRD, Birds N. Am., 337. — BAIRD, Rev. Am. Birds, I, 445. — COOPER & BAIRD, Orn. Cal., I, 138, 1870.

Collurio elegans BAIRD, Birds N. Am., 328. — BAIRD, Rev. Am. Birds, I, 444. COOPER & BAIRD, Orn. Cal., I, 140, 1870.

Not very numerous.

I have already referred to the questionable distinctness of the so-called *C. excubitoroides* from the present species.* Further examination of the

* See a series of articles in the "American Naturalist," entitled "Notes on some of the Rarer Birds of Massachusetts," Vol. III, 1869.

subject has only confirmed me in the opinion that they are not distinct, and that in all probability the *C. elegans* of California should also be referred to the *C. ludovicianus*.*

TANAGRIDÆ.

The *Pyranga æstiva* became common on the Lower St. John's April 1st to 5th, but was not observed previously. *P. rubra* was not seen at all.

A considerable number of specimens of this species (*P. æstiva*) in the Museum, from the Atlantic States, present great differences in the size of the bill in respect to vertical and lateral thickness, as well as in the position and distinctness of the "tooth" of the bill, and in the curvature of the commissure, as indicated by the accompanying figures (Plate IV, figs. 19, 20). They also vary greatly in intensity of color, both of the bill and plumage, as do different specimens of *P. rubra* from Massachusetts. Hence species based solely on such distinctions should be accepted, if at all, with great hesitancy.†

FRINGILLIDÆ.

39.† **Chrysomitris tristis** *Bonaparte.* Yellow Bird.

Common throughout the winter, and as numerous the first week in April as earlier.

I am sure I heard the notes of the Pine Finch (*Chrysomitris pinus*), but as I obtained no specimens of it and do not find it reported by others, I do not include it in the present list. It is not improbable that this species and the Purple Finch (*Carpodacus purpureus*) are occasional winter visitors.

* Since writing the above I have met with the following observations on this group, made by Dr. Gambel, in his "Remarks on the Birds observed in Upper California" (Proc. Phil. Acad. Nat. Sci., Vol. III, p. 200, 1847): "In the shrikes we are presented with a group of birds closely allied to each other, and undergoing such changes in plumage as renders them difficult to discriminate. Although examined with great care by Swainson in the Fauna Boreali-Americana, yet he appears to have laid too much stress upon characters subject to great variation, as size, relative length of quills, and color. . . . . The relative length of quills in the shrikes is an uncertain character, and differs very much according to age. In the young of this species the second quill is generally much shorter than the sixth, but in the adult equals and may even exceed the sixth in length; the proportion of the third, fourth and fifth to each other is also exceedingly various, and indeed in each wing of the same bird it is very common to find the proportions of the quills differing very materially. This I have found to be the case in the European and both American species [*Collurio ludovicianus* and *C. borealis*]."

† See some remarks on the "Uniformly red species of *Pyranga*," in Proceed. Phil. Acad. Nat. Sciences, p. 127, June, 1869.

40.† **Passerculus savanna** *Bonaparte.* SAVANNA SPARROW.

Emberiza sandwichensis GMELIN, Syst. Nat., I, 875, 1788.

Emberiza arctica LATHAM, Ind. Orn., I, 414, 1790.

Emberiza chrysops PALLAS, Zool. Rosso-Asiat., II, 45, pl. xlviii, fig. 2, 1811.

Fringilla savanna WILSON, Am. Orn., III, 55, pl. xxii, fig. 2, 1811.

Passerculus savanna BONAPARTE, Geog. and Comp. List., 33, 1838.—BAIRD, Birds N. Am., 442, 1858.—SCLATER, Cat. Am. Birds, 112, 1862.

Passerculus alaudinus BONAPARTE, Compte Rendu, XXXVII, 918, 1853.—BAIRD, Birds N. Am., 446, 1858.—SCLATER, Cat. Am. Birds, 112, 1862.—COUES, Proc. Phil. Acad. Nat. Sci., XVIII, 84, 1866.—COUES, Proc. Essex Inst., V, 281, 1868.—COOPER & BAIRD, Orn. Cal., I, 181, 1870.

Passerculus anthinus BONAPARTE, Compte Rendu, XXXVII, 919, 1853.—BAIRD, Birds N. Am., 445, 1858.—SCLATER, Cat. Am. Birds, 112, 1862.—COOPER & BAIRD, I, 183.

Passerculus sandwichensis BAIRD, Birds N. Am., 444, 1858.—SCLATER, Cat. Am. Birds, 112, 1862.—COOPER & BAIRD, Orn. Cal., I, 180.

Abundant, especially on the savannas, where it was the principal sparrow seen.

This species, like all the sparrows, varies considerably in color with the season of the year. Fall specimens, and especially the young of the year, have the yellow superciliary stripe very indistinctly defined, it being in numerous cases entirely obsolete. The general plumage is also much browner, with the streaks on the dorsal surface suffused and obscured with ferruginous, and those below, as in fall specimens of *Melospiza melodia*, bordered with the same tint. Different individuals also vary considerably in the breeding season, some being much grayer above than others; the superciliary line varies from bright yellow to grayish white, with the yellow either entirely wanting or limited to a slight wash on the part anterior to the eye. This grayer plumage and faded condition of the superciliary stripe is more especially seen towards the end of the breeding season. The spots below also vary so much in size as to give very different aspects to the plumage of the lower surface of the body in different specimens. In some they form little more than a narrow line along the middle of the feathers of the breast and sides of the body; in others they are quite broad, occupying relatively a much larger surface; occasionally, also, they are aggregated on the lower part of the breast, forming a large conspicuous patch, as distinct as is ever seen in *Melospiza melodia*. The general size of the bird also varies considerably, as is indicated in the accompanying table of measurements, and the bill is subject to very marked variations in respect to length, size, thickness, and slenderness, as substantiated by a series of nearly one hundred specimens now before me, including some thirty specimens taken at Ipswich, Massachusetts, in the breeding season.

These specimens are separable to some extent into several series, which may be based either upon difference in general size, the character of the bill, or upon coloration; but these several kinds of variation fail to corroborate each other. If separated upon differences in size, the two or more series thus separated embrace every combination of the other differences; and similar incongruities result when the separation is made upon differences in coloration or other characters. Yet the Massachusetts specimens present among themselves differences as well marked and of the same character as is assumed to distinguish several of the so-called species from the Pacific coast, that have been proposed and adopted by different authors.

Alexander Wilson was the first naturalist who gave any adequate description of the species in question, though the *Emberiza sandwichensis* of Gmelin unmistakably refers to this bird, and this name having been given long before that of Wilson, should, in accordance with the rule of priority, supplant Wilson's more euphonious and familiar one of *savanna*. The first supposed species recognized by modern writers after the well-known one of Wilson was the *P. alaudinus*, described by Bonaparte in 1853, in his notes on the Delattre collection,* from a specimen from California. He says it is not easily distinguished from *P. savanna*, but differs from it in being smaller, with the bill shorter and slenderer, and in wanting the yellow superciliary line.† Professor Baird redescribed it in his Birds of North America in similar language, and cites under it five specimens, which came respectively from Brownsville, Texas; Tamaulipas, Mexico; Petaluma, Cal., and Shoalwater Bay, W. T. He remarks respecting it as follows: "This species, if really distinct from *P. savanna*, differs in the rather smaller size, although the difference is not great, and in the considerably paler colors. The superciliary stripe shows a very faint trace of yellow, especially anteriorly near the bill. In some specimens, as 4342, there is none at all." Bonaparte, in his paper just cited, added another "new species" from Kodiak, Alaska, which he called *Passerculus anthinus*, and described as follows: "*Passerculus anthinus*, Bp., ex Kadiak, Am. Ross. *Simillimus præcedenti, sed rostro etiam graciliore et capite flavo induto; subtus albo-rufescens magis maculatus.*" He says it is still smaller and has the bill slenderer even than the other, and that it appears to live farther north. Professor Baird also redescribes this species, and is much more explicit in his account of it. He says: "Similar to *P. savanna*, but smaller. . . . . Breast and upper part of belly thickly spotted with sharply defined sagittate brown spots, exhibiting a tendency to aggregation on the

* Compte Rendu, Tome XXXVII, p. 918.

† "*Passerculus alaudinus*, Bp., ex Wils., mais plus petite sans jaune aux sourcils et à bec plus court et plus effilé."

middle of the belly," etc. He adds: "This species is the smallest of its group, and differs from all in the much greater amount of spotting on the under parts. The streaks, indeed, extend over the whole breast and upper part of the abdomen, instead of being mainly confined to the jugulum." It differs, he says, from *P. alaudinus* "in the strong shade of yellow on the head, the much darker tints above, and the thick crowding of larger and better defined spots beneath, with a faint tinge of reddish." He refers to it three specimens from San Francisco, Benicia, and Petaluma, California.

In 1858 Professor Baird added still another species of *Passerculus* to those previously recognized, through the redescription of the original type of this group, the *Emberiza sandwichensis* of Gmelin, based upon Latham's Sandwich Bunting * and Pennant's Unalaska Bunting.† The name Sandwich, as Professor Baird has remarked, refers not to the Sandwich Islands, but to Sandwich Sound, on the northern coast. To this species Baird judiciously refers the *Emberiza arctica* of Latham ‡ and Vigors, § and the *E. chrysops* of Pallas. ‖ Professor Baird's description of it is as follows: "Almost exactly like *P. savanna*, but half an inch larger, with much larger bill. Length, 6.12; wing, 3.00; tail, 2.55. Habitat, northwestern coast, from the Columbia River to Russian America." He also further observes: "This species is extremely similar to the *P. savanna*, and is only distinguishable by its greater size and more western locality. The tail feathers also are rather more acutely pointed. There is also a greenish-yellow shade on the top and sides of the head, brighter than is seen in *P. savanna.* The bill is considerably larger and longer, measuring .51 of an inch above instead of .44." To this is referred one specimen from "Russian America," one from Fort Steilacoom, W. T., and three from Shoalwater Bay, W. T., three of which measure as is indicated in the above-quoted description, and the other nearly three fourths of an inch less.

In respect to size, then, it appears that the so-called *P. sandwichensis* is the larger, the *P. savanna* the next in size, *P. alaudinus* the third, and *P. anthinus* the smallest. So, at least, it is claimed; but from the measurements published in Birds of North America, a female of *P. savanna* from Carlisle, Pa. (No. 780), is, with one exception (No. 4340, from Brownsville, Texas), the smallest of the specimens of this genus of which measurements are there given; two others from Pennsylvania are below the average of *P. alaudinus.* No. 10,203, from Russian America, referred to *P. sandwichensis*, is scarcely larger than an average *P. savanna.* The

* Latham's Synopsis, Vol. II, p. 202, 1783.

† Pennant's Arctic Zoology, Vol. II, Species No. 229, pp. 320, 368.

‡ Indian Ornithology, Vol. I, p. 414, 1790.

§ Zoölogy of the Blossom, p. 20, 1839.

‖ Zoographia Rosso-Asiatica, Vol. II, p. 45, pl. xlviii, fig. 1, 1811.

accompanying series of measurements shows that specimens occur in Massachusetts as large and as small as any specimens of the genus of which measurements are given by Professor Baird.

In respect to the geographical distribution of these different supposed species, it will be observed that of the three West Coast species, the larger, *P. sandwichensis*, is northern, and the others, *P. alaudinus* and *P. anthinus*, southern, which perfectly explains the difference in size that occurs between them.* In respect to *P. alaudinus* and *P. anthinus*, one is only the paler colored and the other the brighter colored form of the common savanna sparrow as represented in the Pacific States; the three supposed species together forming a series similar to what is seen when a large number of specimens of this bird from the Atlantic States are compared. In other words, the characters whereon these species are based are evidently only individual differences. The *P. alaudinus* is the form with narrow streaks and generally paler tints, or that having a minimum intensity of color; the *P. anthinus* is that with the brighter tints, or with the maximum intensity of color, the greater breadth of the streaks, and the rufous suffusion below correlating with the generally brighter tints. Aside from this normal range of variation referred to at length in Part III as obtaining in all species, there is that of season to be taken into account, as the fading of the superciliary stripe and the grayer aspect of the plumage above towards the end of the breeding season, through the natural wearing and bleaching of the plumage,† and also the rufous suffusion and greater amount of color characteristic of the renewed plumage in fall. It will be noticed that authors report the occurrence of all the western species either actually at or near the same points,‡ while *P. savanna* was not until recently supposed to occur on the Pacific slope of the continent.§ But one of the others have been announced from the plains as far east as Nebraska,‖ and from Brownsville, Texas.¶

In respect to the habits of these supposed species, there is nothing attributed to the western one that is not equally applicable to the eastern bird. Dr. Coues, it is true, says that in Southern California *P. anthinus* seemed confined to the moist salt grass and sedgy weeds of the sea-shore

* Since the above was written, Mr. Dall has given, not only *P. savanna* and *P. sandwichensis*, but also *P. alaudinus* and *P. anthinus* in his list of the birds of Alaska. (See Trans. Chicago Acad. Sciences, Vol. I, pp. 283, 284.)

† See Part III, p. 193.

‡ See Professor Baird, "Birds of North America," Dr. Coues, "Notes on the Birds of Arizona Territory," and Cooper's Ornithology of California.

§ It has recently been reported by Mr. Dall as common in Alaska.

‖ *P. alaudinus*, Sclater's Catalogue of American Birds, p. 112.

¶ *P. alaudinus*, Baird, in Birds of North America, p. 446.

itself. "When with difficulty it was flushed, its flight was," he remarks, "very rapid and irregular; and it would alight again almost immediately, and run with great celerity among the roots of the thick grasses. It was then exceedingly difficult to procure." * All of which is quite true of *P. savanna* when frequenting the salt marshes, which form its most favorite resort in Massachusetts. "*P. alaudinus*," he says, "was common two or three miles away from the coast, but on the sea-shore itself I never found one mixing with *P. anthinus*; it is a bush-and-weed rather than a grass species." *P. savanna* also frequents similar localities. Mr. Dall, under *P. anthinus*, has also accurately indicated the habits of the eastern *Passerculus*. Under *P. savanna*, however, he mentions a fact in respect to the breeding habits of this species I have never before seen mentioned as characterizing any of the *Passerculi*, namely, *its nesting in bushes*. I have met with many nests of the eastern savanna sparrow, and have always found them placed on the ground, usually in a tuft of grass.

To recur again to the series in the Museum of Comparative Zoölogy, I may add that while some of the Ipswich specimens, taken late in June, have a decidedly yellow superciliary stripe, none have it so bright as it is usually in spring specimens; in a considerable proportion it is very pale, and in Nos. 4700, 10668, etc., it is grayish-white, with no perceptible trace of yellow. No. 5099, and some others, have the spots on the breast and sides very narrow, occupying but a small share of the surface; on the other hand, in No. 5088, as also in several others of the series, the spots are so broad as to occupy more space than the enclosing white portion. In other specimens, taken at a different season of the year, the "rufous tinge" surrounding the spots referred to in the above-quoted description of *P. anthinus* is very marked. There is likewise great difference in the color of the upper surface in different specimens. In some the black central spots of the interscapularies are so broad as to give to the dorsal aspect a very dark tint; in others, taken the same day at the same locality, they are so restricted that the general aspect of this surface is gray. The bills of the different specimens vary as much in length and robustness as they are represented to do in the two extremes in this respect in the western bird. Some of the long-billed ones have the bill slender; others have it thick and stout. Occasionally one has the upper mandible projecting considerably beyond the lower, but only in cases where it is abnormally developed. A specimen from Fort Bridger, Utah (No. 11115 of the Smithsonian Catalogue), in the Museum, labelled *Passerculus alaudinus* at the Smithsonian Institution, is of this character, the upper mandible being very much abnormally developed and decurved, and projecting much beyond the lower.

* Ibis, July, 1866, 268.

In short, while not denying that there may be a slight average difference between eastern and western specimens, as I know there is between those of the Central Plains and those of the Atlantic States, I cannot allow that it is at all sufficient to substantiate a specific difference. On the contrary, I am confident that the above-named supposed species of the Pacific States are based chiefly on individual variation perfectly parallel with that seen in a large series of specimens from the Atlantic States. No one, in fact, seems to have felt very confident that any of them were distinct from the eastern *P. savanna*. Dr. Coues has even repeatedly expressed his belief that *Passerculus alaudinus* is not permanently distinct from that species. "In a large series of the latter," he says, "shot about Washington, I have found fully as great differences as I have ever detected in comparing the eastern with the western forms." *

Dr. Cooper also refers as follows to the close resemblance of the *P. alaudinus* to the *P. sandwichensis*. He says, "I think it very doubtful whether these specimens (which measure larger than the dimensions given by Baird, though otherwise agreeing) are anything more than a southern form of *P. sandwichensis*, though collected near San Diego. . . . . Baird considers it almost identical with *P. savanna* of the east, and says that *P. sandwichensis* differs from that species in its larger size. Spring specimens have the superciliary stripe more decidedly yellow, so that there only remains a more slender bill to distinguish this from *P. savanna*, and the larger size (characteristic of northern specimens generally), with darker hues, from *P. sandwichensis*." † Respecting *P. anthinus* Dr. Cooper remarks, "This species appears better marked, as compared with *P. savanna*, than the preceding [*P. alaudinus* and *P. sandwichensis*], although I am not entirely satisfied that it is different." ‡

The following measurements of twenty-six specimens (fourteen males and twelve females), all taken at Ipswich during June and July, 1868, and measured before skinning, indicates the range of individual variation presented by this species. The extremes are as follows: Length, 5.20 and 6.00, both males; alar extent, 7.61 and 9.75, both females; wing, 2.44 and 2.95; tail, 1.64 and 2.25; tarsus, .75 and .88. The average dimensions are: Length, 5.20; alar extent, 8.79; wing, 2.70; tail, 1.96; tarsus, .84. The following are the extremes of the series of measurements of the western *Passerculi*, given in Birds of North America: Length, 5.00 (*P. alaudinus* Tamaulipas, Mex.) and 6.12 (*P. sandwichensis*, Fort Steilacoom, W. T.); alar extent, 8.50 and 9.37 (same specimens); wing, 2.50 and 2.95 (same specimens); tail, 2.00 and 2.57 (same specimens). It thus appears that

* Ibis, July, 1866, p. 289.

† Ornithology of California, Vol. I, p. 182.

‡ Ibid., p. 183.

specimens taken in the breeding season in Massachusetts, overlap in two out of the four measurements given, all the so-called western species, while specimens taken in Massachusetts at other seasons, vary still more than the specimens cited in the following table.

Measurements of Massachusetts Specimens of PASSERCULUS SAVANNA, *taken in the Breeding Season.*

M. C. Z No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
5083	811	♂	Ipswich	June 12, '68	Allen & Maynard	5.76	8.32	2 72	2.07	—
—	820	♂	"	June 13, '68	"	5.76	9.25	2 55	2.00	.85
5086	846	♂	"	June 14, '68	"	5.65	9.15	2.75	1.85	.85
5087	848	♂	"	June 14, '68	"	5.50	9.13	2.75	2.07	84
5089	852	♂	"	June 15, '68	"	5.40	9.10	2 65	2.00	.85
5090	853	♂	"	June 15, '68	"	5.70	9.25	2.63	2.10	.87
5094	854	♂	"	June 15, '68	"	5.70	9.25	2.64	1.95	.88
—	855	♂	"	June 15, '68	"	5 50	9.15	2.75	1 85	84
5901	856	♂	"	June 15, '68	"	5.40	9.25	2 60	1 93	.80
5092	857	♂	"	June 15, '68	"	5.20	9.37	2 95	2.05	—
5092	858	♂	"	June 15, '68	"	5.40	9 25	2.63	2 06	.83
5096	862	♂	"	June 17, '68	"	5.75	8 00	2 90	2.00	—
5098	873	♂	"	June 17, '68	"	5.83	7 75	2.80	2.10	—
—	881	♂	"	June 17, '68	"	6.00	8.27	2.74	2.25	—
5082	810	♀	"	June 12, '68	"	5.42	8.81	2.71	1.81	—
5084	819	♀	"	June 13, '68	"	5.75	8.85	2.57	1.83	.83
5084	847	♀	"	June 14, '68	"	5.54	8.55	2.70	1.90	.80
5088	851	♀	"	June 15, '68	"	5.75	9.75	2.70	2.05	.75
5094	859	♀	"	June 17, '68	"	5.45	8.90	2.65	2.05	.85
5095	860	♀	"	June 17, '68	"	5.25	8.50	2.44	1.85	—
5096	862	♀	"	June 17, '68	"	5.70	8.90	2.70	1.90	—
5097	878	♀	"	June 17, '68	"	5.75	7.61	2.60	1.80	—
5099	877	♀	"	June 17, '68	"	5.75	8.05	2.75	2.00	—
—	890	♀	"	June 17, '68	"	5.35	9.75	2.77	1.95	—
5100	1006	♀	"	July 15, '68	C. J. Maynard	5.65	7.95	2.72	2.00	.87
—	1158	♀	"	Aug 19, '68	"	5.36	8.50	2.70	1.64	.85

41.† **Poocætes gramineus** *Baird.* GRASS FINCH.

Abundant, especially in and about the old fields. The most numerous sparrow in East Florida in winter.

42.† **Junco hyemalis** *Sclater.* SNOW BIRD.

"Common in January." — *Boardman.* Not seen by either Mr. Maynard or myself. Probably of somewhat irregular occurrence so far south.

43.† **Spizella socialis** *Bonaparte.* CHIPPING SPARROW.

Common. A large proportion of those seen were young birds.

44.* **Spizella pusilla** *Bonaparte.* FIELD SPARROW.

Common. More numerous than the preceding species (*S. socialis*). They appeared to be breeding at Jacksonville the first week in April.

The songs of the males were so different from those of the northern bird that the species was almost unrecognizable by me from its notes.

45.† **Zonotrichia albicollis** *Swainson.* White-throated Sparrow. Generally more or less common.

46.† **Melospiza melodia** *Baird.* Song Sparrow.

Not numerous. At least comparatively few were seen.

47.† **Melospiza palustris** *Baird.* Swamp Sparrow.

Common, frequenting the hummocks and swamps.

48.† **Passerella iliaca** *Swainson.* Fox-colored Sparrow.

A single specimen was seen by Mr. G. A. Boardman at Enterprise. None were seen by Mr. Maynard or myself.

49.† **Ammodromus maritimus** *Swainson.* Seaside Finch.

"Abundant at Fernandina." — *Boardman.*

50.† **Ammodromus caudacutus** *Swainson.* Sharp-tailed Finch.

"Abundant, with the preceding." — *Boardman.* Although I have marked as winter visitors both these species of *Ammodromus*, they may be resident.

51.† **Coturniculus Henslowi** *Bonaparte.* Henslow's Sparrow.

Stated by Audubon to be abundant in winter on the grassy pine barrens of Florida.*

52.* **Peucæa æstivalis** *Baird.* Pine-wood Sparrow.

Fringilla æstivalis Lichtenstein, Verzeich. Doubleder Zool. Mus. der königl. Univ. zu Berlin, 25, 1823.
Fringilla Bachmani Audubon, Orn. Biog., II, 366, pl. clxv, 1834.
Fringilla æstiva Nuttall, Man. Orn., I, 2d ed., 568, 1846.
Peucæa Bachmani Audubon, Syn. Am. Birds, 112, 1839.
Peucæa æstivalis Cabanis, Mus. Hein., 132, 1850.
Zonotrichia Cassinii Woodhouse, Proc. Phil. Acad. Nat. Sci., 1852, 60.
Peucæa Cassinii Baird, Birds N. Am., 485, 1858.

Common, but confined to the pine woods.

The twenty-two specimens, collected by Mr. Maynard's party and myself, now in the Museum, present considerable differences. Several are so different in color from most of the others as to almost have the appearance of being a different species, the general color of the upper

* Birds of America, Vol. III, p. 76.

parts being rufous instead of gray. These are all females, the others being males. But the males differ greatly in color, few of our sparrows being more variable in this respect than the present species.

The following measurements of twenty-two Florida specimens indicate quite a constancy in size, much greater than in color. The extremes of this series are as follows: Length, 5.75 and 6.20; alar extent, 7.60 and 8.30; wing, 2.17 and 2.55; tail, 2.25 and 2.68. Average: Length, 5.88; alar extent, 8.99; wing, 2.40; tail, 2.49.

Measurements of Florida Specimens of PEUCÆA ÆSTIVALIS.

M. C. Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
5377	5377	♂	Hawkinsville	Mar. 13, '69	J. A. Allen	6.00	8.20	2.35	2.50	.76
5396	5396	—	"	Mar. 15, '69	"	5.85	8.05	2.28	2.30	.75
5425	5425	♀	Jacksonville	Apr. 2, '69	"	5.90	8.00	2.40	2.40	.76
5426	5426	♂	"	Apr. 2, '69	"	5.90	8.30	2.55	2.50	.70
5427	5427	♂	"	Apr. 2, '69	"	5.60	7.85	2.50	2.25	.76
5428	5428	♂	"	Apr. 2, '69	"	5.80	8.20	2.40	2.50	74
5429	5429	♂	"	Apr. 2, '69	"	5.90	7.85	2.45	2.47	.76
5430	5430	♂	"	Apr. 2, '69	"	5.60	7.85	2.40	2.50	68
10616	18	♂	"	Apr. 3, '69	C. Thurston	5.80	8.00	2.45	2.50	.70
10617	21	♂	"	Apr. 3, '69	"	5.90	7.75	2.17	2.50	.67
——	24	♂	"	Apr. 5, '69	"	5.75	8.00	2.45	2.35	.66
10618	27	♂	"	Apr. 6, '69	"	5.75	8.00	2 50	2.55	.65
10619	28	♂	"	Apr. 6, '69	"	5.90	8.00	2.45	2.65	.62
10620	36	♀	"	Apr. 7, '69	"	5.90	8.00	2.25	2 55	.68
10624	72	♂	"	Apr. 24, '69	"	6 00	8.00	2.40	2.55	.70
10623	68	♂	"	Apr. 16, '69	"	6.00	8.00	2.40	2.56	.75
10622	67	♂	"	Apr. 16, '69	"	6.00	8.00	2.45	2.50	.74
10625	73	♂	"	Apr. 24, '69	"	6.20	8.15	2.40	2.50	.70
——	651	♂	"	Apr. 15, '69	"	6.00	8.00	2.40	2.53	.72
10621	45	♂	"	Apr. 18, '69	"	6.10	8.10	2.35	2.60	.73
——	37	♂	"	Apr. 7, '69	"	5.90	8.00	2.45	2.68	.75
10626	2934	♂	"	Apr. 13, '69	"	5.85	7.60	2.25	2.34	.70

53.* **Cardinalis virginianus** *Bonaparte.* CARDINAL BIRD.

Exceedingly numerous. Their clear, musical, loud call-note was heard everywhere, this being the most noisy bird of the forest.

None of the specimens I have seen from Florida are as large as those from the Middle States. The colors of the former are also somewhat brighter, especially in the females, in which the brownish-yellow of the lower parts is not only much deeper, but a large proportion have the breast and middle of the abdomen strongly tinged with bright red, giving a very different appearance from northern females.

The following measurements of fifty-eight specimens shows the amount of variation in size in specimens from the same locality. The females, it will be seen, average a little smaller than the males, but the sexual difference in this respect is not very great. The range of variation, which is much less in this species than in many, is as follows: In the males: Length, 7.75 to 9.10; alar extent, 11.00 to 11.78; wing, 3.50 to

3.85; tail, 3.40 to 4.20; tarsus, .62 to .80. In the females: Length, 7.50 to 8.75; alar extent, 10.70 to 11.75; wing, 3.25 to 3.85; tail, 3.40 to 4.10; tarsus, .62 to .75 Average size of the males: Length, 8.46; alar extent, 11.43; wing, 3.63; tail, 3.87. Average of the females: Length, 8.27; alar extent, 11.27; wing, 3.53; tail, 3.77.

Measurements of Florida Specimens of CARDINALIS VIRGINIANUS.

M. C. Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5164	5164	♀	Hibernia	Jan. 30, '69	J. A Allen	8.60	11.45	3.55	4.10
5165	5165	♂	"	Jan. 30, '69	"	8.45	11.70	3.65	3.83
5166	5166	♂	"	Jan. 30, '69	"	8.45	11.50	3.60	4.10
5167	5167	♂	"	Jan. 30, '69	"	8.75	11.50	3.55	3.95
5189	5189	♀	"	Feb. 3, '69	"	8.60	11.25	3.50	3.95
5192	5192	♂	"	Feb. 3, '69	"	8.75	11.75	3.50	4.10
5193	5193	♀	"	Feb. 3, '69	"	8.45	11.35	3.60	3.83
5230	5230	—	Volusia	Feb. 12, '69	"	8.15	11.00	3.30	3.78
5311	5311	♂	Enterprise	Mar. 1, '69	"	8.75	11.60	3.60	3.90
5312	5312	♀	"	Mar. 1, '69	"	8.50	11.35	3.40	3.78
5347	5347	♂	"	Mar. 4, '69	"	9.10	11.50	3.58	4.15
—	—	♀	Hawkinsville	Mar. 13, '69	"	7.75	10.70	3.25	—
—	—	♂	Jacksonville	Mar. 31, '69	"	7.75	11.15	3.55	—
5424	5424	♂	"	Apr. 2, '69	"	8.50	11.50	3.65	3.90
—	—	♀	"	Apr. 2, '69	"	8.55	11.10	3.55	—
—	1955	♂	"	Jan. 2, '69	C. J. Maynard	9.00	11.50	3.65	4.30
—	1987	♂	"	Jan. 5, '69	"	9.00	11.50	3.85	4.05
10706	1988	♂	"	Jan. 5, '69	"	8.50	11.51	3.75	4.20
10707	1989	♂	"	Jan. 5, '69	"	8.50	11.45	3.75	3.80
—	2003	♂	"	Jan. 10, '69	"	8.05	11.60	3.75	4.15
—	2041	♂	"	Jan. 7, '69	"	8.00	11.00	3.75	4.00
—	2460	♂	Dummitt's	Feb 24, '69	"	8.00	11.25	3.50	3.40
—	2418	♂	"	Feb. 22, '69	"	8.75	11.10	3.80	3.90
—	2536	♂	"	Feb. 7, '69	"	8.60	11.00	3.65	4.10
—	2537	♂	"	Feb. 9, '69	"	8.70	11.50	3.65	4.00
—	2447	♂	"	Feb. 24, '69	"	8.00	11.56	3.60	3.60
10709	2337	♂	"	Feb. 16, '69	"	8.50	11.50	3.60	3.80
—	2328	♂	"	Feb. 25, '69	"	8.25	11.50	3.50	3.80
10710	2338	♂	"	Feb. 16, '69	"	8.50	11.50	3.60	3.80
10713	2398	♂	"	Feb. 16, '69	"	8.50	11.50	3.65	3.65
—	2324	♂	"	Feb. 25, '69	"	8.60	11.50	3.60	3.50
—	2369	♂	"	Feb. 25, '69	"	8.75	11.78	3.65	3.90
—	2368	♂	"	Feb. 25, '69	"	8.40	11.50	3.60	4.10
—	2365	♂	"	Feb. 17, '69	"	8.00	11.50	3.60	3.90
—	2364	♂	"	Feb. 17, '69	"	8.50	11.50	3.60	3.60
—	2363	♂	"	Feb. 17, '69	"	8.50	11.50	3.60	4.00
—	2538	♂	"	Mar. 10, '69	"	8.15	11.18	3.60	3.40
—	2535	♂	"	Mar. 4, '69	"	8.40	11.00	3.57	3.95
—	2459	♂	"	Feb. 25, '69	"	8.50	11.50	3.75	3.95
—	2008	♀	Jacksonville	Jan. 9, '69	"	8.25	11.25	3.85	3.85
—	2042	♀	"	Jan. 6, '69	"	8.75	11.24	3.50	3.70
—	2384	♀	"	Jan. 11, '69	"	8.00	11.00	3.40	3.40
—	2579	♀	Dummitt's	Mar. 10, '69	"	7.75	10.75	3.40	3.95
—	2367	♀	"	Feb. 24, '69	"	7.50	11.00	3.30	3.50
—	2594	♀	"	Feb. 11, '69	"	8.50	11.10	3.50	3.91
—	2595	♀	"	Feb 11, '69	"	8.50	11.05	3.50	3.85
—	2384	♀	"	Feb. 24, '69	"	8.75	11.75	3.67	4.00
—	2415	♀	"	Feb. 20, '69	"	8.00	11.10	3.50	3.80
—	2394	♀	"	Feb 16, '69	"	8.00	11.75	3.30	3.55
10716	2324	♀	"	Feb 15, '69	"	8.50	11.50	3.70	4.10
—	2458	♀	"	Feb 25, '69	"	8.10	11.15	3.75	3.65
—	2366	♀	"	Feb. 17, '69	"	8.50	11.50	3.60	3.70
—	2474	♀	"	Feb. 16, '69	"	8.00	11.25	3.45	3.55
—	2475	♀	"	Feb. 26, '69	"	8.00	11.00	3.40	3.75
10117	2489	♀	"	Mar. 1, '69	"	8.05	11.15	3.64	3.40
10715	2488	♀	"	Mar 1, '69	"	8.50	11.20	3.60	4.00
10714	2427	♀	"	Mar. 4, '69	"	8.20	11.25	3.55	3.60
—	2043	♀	"	Feb. 11, '69	"	8.50	11.50	3.75	3.90

54.* **Pipilo erythrophthalmus** *Vieillot.* CHEWINK.

Exceedingly numerous.

Mr. C. J. Maynard detected an interesting local race or variety of this bird at Dummitt's. Besides having the irides *yellowish-white* instead of *red*, there is less white at the base of the primaries, less skirting the secondaries, and much less on the tail. The whole bird is also smaller. The white on the tail generally extends only to the three outer pairs of feathers; in the common northern form it extends over the four outer pairs, and on the first is much more extended than in the Florida one. The tail of the common form, with the outer pair of feathers removed, would resemble, in respect to the distribution and extent of the white, that of the Florida bird. The song of this bird, as I heard it at Jacksonville in April, is quite different from that of the northern bird, it being ordinarily only about half as long, and uttered with much less spirit. As is well known, the song of the towhe, or chewink, at the north consists of two parts, nearly equal in length but otherwise quite different. In the Florida bird the last half is almost entirely omitted. According to Mr. Maynard, this variety is almost the only one occurring on Indian River, and of which he brought home some forty or more specimens. I found also one among half a dozen I shot at Jacksonville in January. In April, among a few towhes exposed in cages for sale in the market, were several of this kind. There is probably a large proportion of northern birds among the *Pipilones* of Northern Florida in winter, while probably in summer the majority are of the southern type above described, as are those of Middle and Southern Florida, doubtless, at all seasons.

Had this form been discovered ten, or even five years since, it would probably have been regarded by most ornithologists as entitled to specific rank, and not as a local race of *P. erythrophthalmus*, as it evidently is. Indeed, there are many species still on our lists that are far less entitled to rank as species than this, but which, though at first only provisionally adopted, have become traditionally established as valid species.

The two tables of measurements of specimens of this species given below, with Table J (p. 212), show the difference in size that obtains between Massachusetts and Florida specimens. The first table embraces twenty-nine specimens (nineteen males and ten females) of the white-eyed Florida type; the second table embraces sixteen specimens (ten males and six females) of the common northern type from Eastern Massachusetts; the measurements of twenty other Massachusetts males having been also already given in Table J, on p. 212. The following are the extremes of the two series. Northern type, males: Length, 7.50 and 8.80; alar extent, 10.00 and 12.25; wing, 3.17 and 3.90; tail, 3.30 and 3.93;

Measurements of Specimens of PIPILO ERYTHROPHTHALMUS *from Indian River, Florida.*

M. C. Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
10722	2477	♂	Dummitt's	Feb. 26, '69	C. J. Maynard	8.10	10.25	3.25	3.60	1.00
——	2476	♂	"	Feb. 26, '69	"	8.00	10.50	3.20	3.65	.95
——	2531	♂	"	Mar. 5, '69	"	8.00	10.00	3.00	3.60	1.00
——	2530	♂	"	Mar. 5, '69	"	7.20	10.10	3.00	3.65	.90
——	2529	♂	"	Mar. 6, '69	"	8.30	10.20	3.25	3.70	1.00
——	2559	♂	"	Mar 7, '69	"	7.90	9.85	3.42	3.50	1.02
10729	2669	♂	"	Mar. 12, '69	"	8.20	11.00	3.45	3.57	1.01
——	2592	♂	"	Mar. 11, '69	"	8.50	11.00	3.50	3.60	.87
——	2417	♂	"	Feb. 22, '69	"	8.00	10.00	3.05	3.70	.95
——	2416	♂	"	Feb. 22, '69	"	8.00	10.25	3.25	3.35	—
——	2394	♂	"	Feb. 25, '69	"	8.00	10.10	3.10	3.50	.95
——	2426	♂	"	Feb. 20, '69	"	7.78	10.00	3.00	3.25	.90
——	2514	♂	"	Mar. 2, '69	"	7.70	9.50	2.80	3.40	.80
——	2512	♂	"	Mar. 2, '69	"	7.25	10.25	3.10	3.70	.80
10724	2511	♂	"	Feb. 20, '69	"	7.75	10.50	3.20	3.50	1.09
10721	2395	♂	"	Feb. 18, '69	"	7.40	10.00	2.92	3.90	—
10729	2668	♂	"	Feb 22, '69	"	7.40	10.75	3.00	3.45	.95
——	2044	♂	"	Feb. 17, '69	"	8.50	11.30	3.00	3.50	.95
10728	2516	♂	"	Mar. 2, '69	"	8.00	10.25	3.05	3.45	.90
——	2481	♀	"	Feb. 24, '69	"	7.50	9.48	3.00	3.60	.90
——	2483	♀	"	Feb. 20, '69	"	7.50	9.50	3.00	3.54	.90
——	2590	♀	"	Mar. 11, '69	"	7.65	10.05	3.00	3.75	.92
——	2593	♀	"	Mar. 11, '69	"	8.20	10.10	3.05	3.58	1.00
——	2591	♀	"	Mar. 11, '69	"	7.90	9.95	3.03	3.60	.92
——	2578	♀	"	Mar. 10, '69	"	7.40	9.75	3.00	3.80	.95
10727	2515	♀	"	Mar. 2, '69	"	7.50	9.75	3.10	3.05	.95
10725	2513	♀	"	Mar. 2, '69	"	7.35	10.50	3.35	3.10	.85
——	2445	♀	"	Feb. 18, '69	"	8.05	10.53	3.50	3.45	.95
10726	2514	♀	"	Mar. 2, '69	"	7.50	9.50	3.90	3.05	95

Measurements of Specimens of PIPILO ERYTHROPHTHALMUS *from Eastern Massachusetts.*

M. C. Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
——	384	♂	Newton	May 6, '68	C. J. Maynard	8.30	12.35	3.30	3.60	—
——	414	♂	Weston	May 9, '68	"	8.25	11.00	3.35	3.64	—
——	415	♂	"	May 9, '68	"	8.20	11.30	3.45	3.49	—
——	430	♂	Newton	May 11, '68	"	8.25	11.00	3.65	3.76	—
——	439	♂	Waltham	May 13, '68	"	8.45	11.30	3.51	3.85	—
——	539	♂	"	May 18, '68	"	8.35	11.23	3.46	3.55	—
——	1008	♂	Weston	July 10, '68	"	8.50	11.00	3.41	3.46	—
4616	1329	♂	Newton	Sept. 21, '68	"	8.80	11.65	3.42	3.70	1.10
——	1330	♂	"	Sept. 21, '68	"	8.51	11.41	3.51	4.00	1.00
4615	1295	♂	"	Sept. 17, '68	"	8.50	11.50	3.55	3.75	1.00
4725	496	♀	"	May 15, '68	"	7.60	10.45	3.31	3.35	—
4726	527	♀	Waltham	May 16, '68	"	8.25	11.76	3.35	3.60	—
——	——	♀	"	May 16, '68	"	8.26	10.55	3.55	3.65	—
4724	555	♀	Weston.	May 20, '68	"	8.00	10.56	3.25	3.36	—
4617	1028	♀	Newton	July 22, '68	"	8.50	11.00	3.41	3.52	1.10
4613	1328	♀	"	Sept. 21, '68	"	8.45	11.00	3.35	3.65	1.05

tarsus, .98 and 1.13. Southern type, males: Length, 7.20 and 8.50; alar extent, 9.50 and 11.30; wing, 2.80 and 3.50; tail, 3.25 and 3.90; tarsus,

.80 and 1.09. The females in both cases average a little smaller than the males. The average dimensions of thirty northern males are as follows: Length, 8.19; alar extent, 11.32; wing, 3.43; tail, 3.66; tarsus, 1.06. Of nineteen southern males: Length, 7.88; alar extent, 9.88; wing, 3.13; tail, 3.56; tarsus, .94. The measurements given in the two preceding tables were all taken by Mr. Maynard from fresh specimens.

Other species of *Fringillidæ* that from their general distribution one naturally expects to meet with in East Florida in winter, but which, so far as I can learn, have not yet been met with there, are the Yellow-winged Sparrow (*Coturniculus passerinus*), Black-throated Bunting (*Euspiza americana*), Indigo Bird (*Cyanospiza cyanea*), and the Nonpariel (*C. ciris*). Specimens of the latter, collected at Cape Florida in winter, have been received at the Museum, and it was taken in April at Jacksonville and St. Augustine by Mr. Thurston and Mr. L. L. Thaxter.

ICTERIDÆ.

55.† **Molothrus pecoris** *Swainson.* Cow Blackbird.

Not numerous. Sometimes seen in small parties by themselves, but more frequently associating with the red-wings and grackles.

56.* **Agelæus phœniceus** *Vieillot.* Red-winged Blackbird.

Abundant. Apparently chiefly Florida born birds seen, especially in February and March. The sexes were usually in separate flocks.

The differences in respect to size and color between Florida and New England specimens usually seen in individuals of the same species from these localities are very marked in the present species, especially in respect to color. In no group, in fact, is it generally more so than in the *Icteridæ*.

In the Florida red-wings the general form is slenderer and more delicate, the bill relatively longer and more pointed, and the general color more intense and lustrous. The difference is particularly marked in the shoulder-patch, in which the red of its anterior portion is darker, approaching bright orange, and the posterior part, which in the northern bird is usually pale cream-color, whitish, or even nearly pure white, is orange-yellow, — very nearly as in the *A. gubernator* of the Pacific States. The difference in color, size, and especially in the form of the bill, is much greater than the differences existing between many currently received species of North American birds, and it is surprising that the two forms have not been specifically separated. I can only account for it on the supposition that specimens from Florida and the Gulf States have not fallen into the hands of the assiduous species hunters. As remarked in Part III (p. 234), Florida and New England specimens are as different from each other as are the so-called *Agelæus phœniceus* of the Northeastern States, the *A. tricolor* and the *A. gubernator* from each other.

Specimens of *A. phœniceus* from Louisiana I find correspond very nearly in every respect with the specimens from Florida. I have also before me one specimen from Maine with the shoulder-patch as highly colored, and with nearly as long a bill as is found in the specimens from Florida.

Plate VI shows the average form of the bill in Florida and Massachusetts specimens, and the annexed table of measurements the difference in general size. They also illustrate individual variation.

The following measurements of seventy specimens of this species from Massachusetts (forty males and thirty females), eighteen specimens from South Carolina and Florida (eleven males and seven females), and thirteen specimens from California (four males and nine females), exhibit, besides the average size and the individual variation at the same locality (especially in the case of those from Massachusetts), several interesting facts in respect to geographical variation. While the northern specimens (see the summary of these measurements given below) are somewhat larger than the southern ones, the latter have the longer head (including the bill), and also the longer bill. The height and width of the bill at the base remaining essentially the same in both, the southern ones have the bill relatively more attenuated. The difference in this respect is more striking than the measurements given seem to indicate. The California specimens closely resemble those from Florida, not only in respect to size, but in regard to the size and form of the bill, and also in respect to color; these, as well as the Florida ones, belonging to the southern type. As previously remarked, they bear a much closer resemblance to the Florida form in every respect than to that found in New England.*

The individual variation in this species seems to be very great everywhere, the variation in specimens of the same sex from the same locality being fully fifteen per cent of the average size at that locality.

* The affinities of *Agelæus gubernator* and *A. tricolor* with *A. phœniceus* are acknowledged to be exceedingly close. Professor Baird cites, in his Birds of North America, one specimen of the *A. phœniceus* from San José, California, and five from Fort Steilacoom, W. T. He also cites specimens of *A. gubernator* from Petaluma and San Francisco, Cal.; but Dr. Cooper regards this species as "limited to the interior of the State" (California), while those found along the coast, he says, clearly resemble the eastern bird. (Ornithology of California, Vol. I, p. 264.). From the close resemblance, already alluded to, of both the *A. gubernator* and *A. tricolor* to *A. phœniceus*, and their occurrence mainly in the hot valleys of California, and the region more to the southward, I can scarcely doubt that these forms, especially *A. gubernator*, are the southern smaller, brighter colored, more attenuated billed western homologues of the similar eastern form from Florida and the Gulf States.

Measurements of Northern Specimens of AGELÆUS PHŒNICEUS.

M. C. Z. No.	Collector's Number.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Head.	Bill.		
											Culmen.	Height	Width.
1274	—	♂	Vassalboro', Me.	——	Mr Becker	9.40	14.90	4.65	3.82	1.82	.87	.45	.37
9577	—	♂	Waterville, "	June 20, '64	C. E. Hamlin	9.45	14.75	4.82	3.88	1.77	.87	46	.40
391	—	♂	Malden, Mass.	1859	D. Higgins	9.35	14.75	4.67	3.75	1.76	.86	.47	.40
96	—	♂	" "	"	"	9.15	14.35	4.55	3.50	1.75	.80	.50	.37
392	—	♂	" "	"	"	9.20	14 75	4.70	3.66	1.82	.89	.47	.38
92	—	♂	" "	"	"	9.25	14.50	4.75	3.82	1.80	.92	.50	.40
93	—	♂	" "	"	"	9.20	14.40	4 50	3.45	1.85	.88	.45	40
94	—	♂	" "	"	"	9.00	14.25	4.60	3.55	1.76	.90	.50	.38
95	—	♂	" "	"	"	9.00	15.10	4.65	3.65	1.83	95	.50	.40
393	—	♂	" "	"	"	9.00	14.55	4.65	3 35	1.82	84	45	.37
394	—	♂	" "	"	"	8.40	14.10	4.50	3.40	1.60	.75	46	.40
5727	—	♂	Concord, "	"	H. Mann	8 58	13.95	4 50	3.46	1.78	.92	.48	40
5723	—	♂	" "	"	"	8 45	14.45	4.55	3 35	1.75	.90	.43	45
5724	—	♂	" "	"	"	8.40	14 25	4.43	3.12	1.80	.84	.45	38
5729	—	♂	" "	"	"	9.00	14.51	4.54	3.33	1.82	.85	.47	.39
5726	—	♂	" "	"	"	9.20	14.95	4.75	3.75	1.80	87	.44	38
5720	—	♂	" "	"	"	9 05	15.00	4.86	3.86	1.84	.88	.44	.37
5721	—	♂	" "	"	"	9.70	14.88	4.68	3 80	1 77	.92	.46	.40
5722	—	♂	" "	"	"	9 00	14.50	4.65	3.65	1.74	83	.43	38
5725	—	♂	" "	"	"	9.85	14.25	4.73	3.76	1.85	.93	.43	.35
5728	—	♂	" "	"	"	9.25	14.50	4.60	3.81	1.78	.88	.44	.33
5732	—	♂	" "	"	"	9 58	14.62	4.74	3 85	1.83	.91	48	.38
10096	—	♂	Ipswich, "	June 14, '68	J. A. Allen	9.15	14.50	4.70	3.78	1.79	92	44	.40
1674	—	♂	Springfield, "	June 26, '62	"	9.00	14.00	4.59	3.42	1.62	87	45	.40
1675	—	♂	" "	June 26, '62	"	9.25	15 00	4 82	3.73	1.84	.93	46	43
1782	—	♂	" "	July 12, '62	"	9 50	14.50	4.62	3 65	1.94	.97	.45	37
1781	—	♂	" "	July 12, '62	"	9 00	14.60	4.50	3.38	1.80	.86	.43	40
626	—	♂	Auburndale, "	Mar. 23, '57	S. Tenney	9 62	15.35	4.87	3.77	1.85	.91	.43	.40
1022	—	♂	Wenham, "	May —, '61	J. Bartlett	9.25	15.00	4.67	3.55	1.84	.89	.48	.43
——	114	♂	Newton, "	Mar. 13, '68	C. J. Maynard	8.75	14.83	4.70	3.53	—	—	—	—
——	180	♂	" "	Mar 28, '68	"	9 38	15.00	4.75	3.60	—	—	—	—
——	214	♂	" "	Apr. 11, '68	"	8.90	14 85	4.60	3.52	—	—	—	—
——	251	♂	Weston, "	Apr. 18, '68	"	9.52	15.00	4.82	3.80	—	—	—	—
——	302	♂	Newton, "	Apr. 23, '68	"	9.00	15.00	4.66	3.65	—	—	—	—
——	323	♂	" "	Apr. 25, '68	"	9 00	15.00	4.85	3 40	—	—	—	—
——	352	♂	Weston, "	May 1, '68	"	9 16	15 10	4 80	3.70	—	—	—	—
——	371	♂	Newton, "	May 5, '68	"	9.00	15.00	5.00	3.90	—	—	—	—
——	351	♂	" "	May 1, '68	"	9.50	15 25	4 92	3.85	—	—	—	—
——	417	♂	Weston, "	May 9, '68	"	9.50	15 15	4.90	3.77	—	—	—	—
——	3047	♂	Newton, "	Mar. 23, '70	"	9.50	15.00	4.60	3.56	—	—	—	—
9843	—	♀	Milltown, Me.	——	G. A. Boardman	8.00	12.50	3.95	3.05	1.57	.73	.38	32
9844	—	♀	" "	——	"	8 00	12 50	4 08	3.10	1.54	.79	.40	.30
399	—	♀	Malden, Mass.	1859	D. Higgins	7 50	11.75	3.60	2.70	1 48	.72	.42	33
396	—	♀	" "	"	"	7.75	12.30	3 90	3.06	1 60	.82	43	.35
97	—	♀	" "	"	"	7.35	11.75	3 63	2.80	1 55	.70	.40	.37
402	—	♀	" "	"	"	8 55	13.55	4.26	3.15	1.66	.75	.44	.41
398	—	♀	" "	"	"	8.05	13.50	4.16	3.10	1.67	.77	.43	36
98	—	♀	" "	"	"	7.75	12.10	3.74	2.97	1 58	72	.37	33
403	—	♀	" "	"	"	7.42	11.55	3.87	2.73	1 62	.73	.37	35
397	—	♀	" "	"	"	7.50	11 25	3.70	2.98	1.58	76	34	33
395	—	♀	" "	"	"	7.40	12.50	4.11	2.68	1.50	70	.38	38
99	—	♀	" "	"	"	7.45	11.50	3.75	2.90	1.55	75	.42	.43
5730	—	♀	Concord, "	——	H. Mann	7.75	12.50	3 80	3.02	1.54	.70	.40	.33
1611	—	♀	Springfield, "	July 15, '62	J. A. Allen	7.50	12.00	3.73	2.90	1.68	.79	.40	.34
1639	—	♀	" "	June 26, '62	"	7.65	11.75	3.67	2.82	1.54	.70	38	.37
1672	—	♀	" "	June 26, '62	"	7.85	11.82	3.75	2.89	1.60	.75	.40	38
1673	—	♀	" "	June 26, '62	"	7.75	12 00	3.77	2.85	1 57	.78	.38	37
1679	—	♀	" "	June 26, '62	"	8.00	12 25	3.79	3.00	1 55	.74	.39	36
1680	—	♀	" "	June 26, '62	"	8.00	12.10	3 85	2.93	1.53	.78	38	—
——	350	♀	Weston, "	Apr. 30, '68	C. J. Maynard	7 73	12.61	3.95	2 95	—	—	—	—
——	850	♀	Ipswich, "	June 15, '68	"	7.45	13.60	4.00	3 05	—	—	—	—
——	891	♀	Essex, "	June 17, '68	"	8.00	12.35	4.00	3.00	—	—	—	—
——	893	♀	" "	June 17, '68	"	7.75	12.54	3.90	2.90	—	—	—	—
——	1093	♀	Waltham, "	Aug. —, '68	"	7.45	12.37	3 80	2.75	—	—	—	—
——	1075	♀	" "	Aug. —, '68	"	7.67	12.30	3.85	2.85	—	—	-	—
——	1096	♀	" "	Aug. —, '68	"	7.50	12 40	3.95	2.72	—	—	—	—
——	1097	♀	Newton, "	Aug. —, '68	"	7.75	12.30	3.71	2.80	—	—	—	—
——	1098	♀	Waltham, "	Aug. —, '68	"	7.50	12.00	3.85	2.65	—	—	—	—
——	1099	♀	Weston, "	Aug. —, '68	"	7.50	12.10	3 67	2.80	—	—	—	—
——	2830	♀	Newton, "	June 8, '69	"	7.50	12.00	4.00	2.90	—	—	—	—

Measurements of Southern Specimens of AGELÆUS PHŒNICEUS.

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Al. Ext.	Wing.	Tail.	Head.	Bill. Cul.	Bill. Hgt.	Bill. Wid.
4126	—	♂	Charleston, S. C.	——	L. Agassiz	9.55	14.75	4 75	3.65	1.90	1.00	.45	37
4127	—	♂	" "	——	"	8.80	14 30	4 50	3.55	1.74	.87	.47	.40
4128	—	♂	" "	——	"	9.45	14.50	4.60	3 72	1.80	.90	.50	.40
4129	—	♂	" "	——	"	9.05	13.50	4.37	3.45	1.78	.85	.43	.42
4125	—	♂	" "	——	"	9.05	14.12	4.42	3.35	1.94	.95	.46	.35
——	—	♂	Hawkinsville, Fla.	Mar. 15,'69	J. A. Allen	8.25	13.60	4.34	—	—	—	—	—
——	1928	♂	Jacksonville, "	Dec. 31,'69	C. J. Maynard	9.10	14 90	4 75	3.58	—	—	—	—
10565	1929	♂	" "	Dec. 31,'69	"	9.20	14 80	4.80	3.90	—	—	—	—
10561	2013	♂	" "	Dec. 31,'69	"	8.80	14 15	4.55	3 58	—	—	—	—
10574	2552	♂	Dummitt's, "	Mar. 8,'69	"	9 50	14.20	4.75	3.90	—	—	—	—
10573	2450	♂	" "	Feb. 24,'69	"	8.50	14.00	4.75	3.45	—	—	—	—
5153	—	♀	Hibernia, "	Jan. 30,'69	J. A. Allen	7.65	12.60	3.85	3.05	—	—	—	—
5154	—	♀	" "	Jan. 30,'69	"	7.85	12.50	3.90	3 07	—	—	—	—
5155	—	♀	" "	Jan. 30,'69	"	7.80	12.85	—	3 20	—	—	—	—
4141	—	♀	" "	Jan. 30,'69	"	8.00	12.25	3 80	3 05	—	—	—	—
5209	—	♀	Welaka, "	Feb. 8,'69	"	7.65	12.50	3 75	2 80	—	—	—	—
5208	—	♀	" "	Feb. 8,'69	"	7.50	11 85	3 63	2 75	—	—	—	—
5210	—	♀	" "	Feb. 8,'69	"	7.65	12.55	3.95	—	—	—	—	—

Measurements of California Specimens of AGELÆUS PHŒNICEUS.

M. C. Z. No.	Sex.	Locality.	Date.	Collector.	Length.	Al. Ext.	Wing.	Tail.	Tarsus.
5885	♂	San Francisco, Cal.	Winter '59 - '60	A. Agassiz	8.50	14.98	4.83	3.50	1.63
5884	♂	" "	Winter '59 - '60	"	8.75	15 05	4 95	3.35	1.74
566	♂	" "	Winter '59 - '60	"	8.60	14 55	4.47	3.09	1.90
2188	♂	Gulf of Georgia, W.T.	Sept. —, '60	"	8.71	13.50	4.45	3.26	1.75
5889	♀	San Francisco, Cal.	Winter '59 - '60	"	7 58	12 80	4.03	2.73	1.63
5893	♀	" "	Winter '59 - '60	"	7.55	12.35	3.95	2.47	1.46
5887	♀	" "	Winter '59 - '60	"	7.81	12.80	4.25	3.86	1.54
5890	♀	" "	Winter '59 - '60	"	7 50	12.75	3 94	2.47	1.56
5886	♀	" "	Winter '59 - '60	T. G. Cary	7.82	12.77	4.04	2.62	1.56
2075	♀	" "	Winter '59 - '60	"	8.29	13.27	4 32	3.00	1.62
2074	♀	" "	Winter '59 - '60	"	8.18	13.25	3.85	2.95	1 67
2078	♀	" "	Winter '59 - '60	"	8.50	13.00	4.15	3.10	1 65
5888	♀	" "	Winter '59 - '60	A. Agassiz	7.25	12.25	3 90	3.71	1.50

Summary of the above Measurements of Specimens of AGELÆUS PHŒNICEUS.

Locality.	Sex.	No. of Specim's.		Length.	Al. Ext	Wing.	Tail.	Head.	Culmen.	Height.	Width.
Massachusetts	♂	40	Aver.	9.16	14.71	4 69	3.63	1.79*	.88*	.46*	.39*
	♀	28	Aver.	7.53	12.24	3.86	2 93	1.57†	.75†	.395†	.357†
South Carolina and Florida	♂	11	Aver.	9.02	14.41	4.62	3.61	1.83	.91‡	.46‡	.39‡
	♀	7	Aver.	7.73	12 44	3.83	2.99	—	—	—	—
California	♂	7	Aver.	8.64	14.52	4.67	3.30	1.75	—	—	—
	♀	9	Aver.	7.83	12.70	4.00	2.99	1 57	—	—	—
Massachusetts	♂	40	Max.	9.85	15.35	5.00	3.90	1.94*	.97*	.50*	.45*
	♂	40	Min.	8.40	13.95	4.43	3.12	1.60*	.75*	.43*	33*
	♀	28	Max.	8 55	13.55	4.26	3.15	1.68†	.82†	.44†	.43†
	♀	28	Min.	7.35	11.25	3.63	2 65	1.48†	.70†	37†	.30†
South Carolina and Florida	♂	11	Max.	9.55	14 90	4.80	3.90	1.94‡	1.00‡	.50‡	.40‡
	♂	11	Min.	8.25	13.60	4 34	3.35	1.74‡	.85‡	.43‡	.35‡
	♀	7	Max.	8.00	12.85	3 90	3.20	—	—	—	—
	♀	7	Min.	7.50	11.85	3.63	2.75	—	—	—	—
California	♂	7	Max.	8.75	15.05	4.95	3.50	1 90	—	—	—
	♂	7	Min.	8.50	13 50	4.45	3.09	1.63	—	—	—
	♀	9	Max.	8.50	13.27	4 32	3.86	1.67	—	—	—
	♀	9	Min.	7.25	12 25	3.85	2 47	1 46	—	—	—

* 29 specimens. † 19 specimens. ‡ 5 specimens.

57.* **Sturnella ludoviciana** *Swainson.* MEADOW LARK.

Alauda magna LINNÉ, Syst. Nat., I, 167, 1758. — WILSON, Am. Orn., III, 20, pl. xix, 1811.

Sturnus ludovicianus LINNÉ, Syst. Nat., I, 290, 1766. — BONAP., Journ. Phil. Acad. Nat. Sci., IV, 180, 1824. — NUTTALL, Man. Orn., I, 147, 1832. — AUDUBON, Orn. Biog., II, 216, 1834.

Sturnus collaris WAGLER, Syst. Avium, I, 1827.

Sturnella ludoviciana SWAINSON, Faun. Bor. Am., II, 282, 1831. — BONAP., Geog. and Comp. List, 1838. — AUDUBON, Synop. Am. Birds, 148, 1839. — CABANIS, Mus. Hein., 192, 1851. — SCLATER, Cat. Am. Birds, 139, 1862. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1866, 23.

Sturnella magna SWAINSON, Phil. Mag., I, 436, 1827. — BAIRD, Birds N. Am., 535, 1858. — ALLEN, Mem. Bost. Soc. Nat. Hist., I, 496, 1868.

Sturnella collaris VIEILLOT, Analyse, 1816.

Sturnella hippocrepis WAGLER, Isis, 1832, 281. — LAWRENCE, Ann. N. York Lyceum N. Hist., VII, 266, 1860. — SCLATER, Ibis, 1861, 79. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1866, 24.

Sturnella neglecta AUDUBON, Birds of Am., VII, 339, pl. ccccIxxxvii, 1843. — BAIRD, Birds of N. Am., 537, 1858. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1866, 23.

Sturnella mexicana SCLATER, Ibis, 1861, 79. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1866, 24.

Sturnella meridionalis SCLATER, Ibis, 1861, 79. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1866, 24.

Abundant. Found chiefly in the moister parts of the pineries.

Somewhat smaller than in the Northern States, but in most cases with longer and larger bills, brighter colors, and a quite different song. The latter somewhat resembles that of the western meadow lark, but is still as distinct from it in its general character as it is from that of the New England bird. The present species has a wide geographical range, throughout the greater part of which it is resident. The Alleghanian fauna forms its northern limit, from which it mostly retires during winter. To the southward it extends to Cuba and the other larger West India Islands, throughout most of Central America, and to the elevated parts of Northern South America. It ranges westward over the elevated arid plains of the middle of the continent to the Pacific. As might be expected, it is not quite uniform in its characters at all points. The main differences, however, consist merely in the lighter color of those from the plains, and the smaller size of those from the south. The former constitute the *Sturnella neglecta* of Audubon and most other writers since his time. In Cuba it is the *S. hippocrepis* of Wagler and others, and the Mexican and Guatemalan form is the *S. mexicana* of Sclater, and the South American form the *S* *meridionalis* of the same author. Yet the distinctions between them are trivial, all of these so-called species having been generally looked upon as doubtfully distinct from the *S. ludoviciana* of the United States, especially the three last named. The *S. collaris* of Vieillot has very generally been referred by subsequent writers to the *S. ludoviciana*. The main distinctive feature of the *S. neglecta* has been its song, — a very doubtful basis on which to found a species. The Florida specimens are intermediate in size and other characters between the Cuban and New England representatives of this species. As already remarked, the song of the Florida birds is as widely different from that of the New England bird as the song of the latter is from that of the western ones. Concerning the affinities of *S. neglecta* I have already remarked.* Concerning those of the other supposed species, I may well borrow the appropriate remarks of the late Mr. Cassin, who observes in respect to them, in his "Study of the *Icteridæ*,"† as follows: —

"This bird [*Sturnella ludoviciana*] is nearly related to the next four species of this genus [*S. neglecta, S. hippocrepis, S. mexicana, S. meridionalis*], equally in structure and in colors, and it would be difficult to describe by positive characters either species of this group, so as to insure recognition absolutely, or without comparative characters being given. . . . . No other genus or sub-genus of this family presents so many species of such uniformity of structure and similarity of color, and there are, assuredly, few such in the kingdom of birds." Under *S. neglecta* he further remarks in respect to the transition that is so apparent between it and *S ludoviciana:* "In the central regions of North America it is possible that a hybrid race between the two species may be produced, to be referred with about equal propriety to either." *S. hippocrepis*, he says, is very nearly related to *S. mexicana*, "and can scarcely be distinguished from it by any characters which seem to be reliable." He thinks it to be somewhat more distinct, however, from *S. neglecta*. Mr. Lawrence had previously remarked that the *S. hippocrepis* is somewhat smaller than *S. ludoviciana* of the United States, and that he "thinks it is specifically distinct"; although he adds, "it would be difficult to point out any reliable differences in coloration, especially of the upper plumage, as individuals even of the same species are very variable."‡ He says, further, that specimens of it from Jalapa, Mexico, differ "only in the pectoral band appearing broader in the Mexican bird, and the tertials much shorter than the primaries, but this last may not be a reliable character." In the

* See Memoirs of the Boston Soc. Nat. Hist., Vol. I, p. 494, 1868.

† Proceedings of the Phil. Acad. Nat. Sciences, 1866, p. 23.

‡ Annals of New York Lyceum of Nat. Hist., Vol. VII, 266, 1860.

following year, however, Mr. Sclater separated the Mexican bird from those of Cuba and the United States, under the name *S. mexicana*, and also the South American under the name *S. meridionalis*. Mr. Cassin says of the latter: "Very nearly related to the preceding (*S. hippocrepis*), if distinct, and I give it, at present, as a species provisionally only. . . . . The colors of the upper parts seem to be less clearly defined, and of a slightly different style and pattern from the preceding, and it may bear about the same relation to that species (*S. hippocrepis*) that *S. neglecta* does to *S. ludoviciana*. Such relation I hold to be rather probable from the specimens now at hand."

Having given the views of the describers of these several "species," I may add that I have seen examples of each, and do not question that they should all be referred to one. As is evident from the above-quoted remarks, these different species gradually pass into each other, — the *S. magna* into the *S. neglecta*, the *S. neglecta* into the *S. mexicana*, and the *S. mexicana* into the *S. hippocrepis*, which is their exact geographical relation.

In regard to the Florida specimens, as compared with New England ones, the most striking differences consist in their smaller size and much brighter colors, especially of the ventral surface.

The following tables of measurements indicate the individual and sexual differences in size, and also the difference in size between specimens from the Northern States and from Florida.

Measurements of Northern Specimens of STURNELLA LUDOVICIANA.

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Al. Ext.	Wing	Tail.
4862	416	♂	Newton, Mass.	May 8, '68	C. J. Maynard	10.75	16.59	5.13	3.50
—	1100	♂	Waltham, "	Aug. 6, '68	"	10 20	16.30	4 98	2.90
4863	1134	♂	" "	Aug. 19, '68	"	10.25	15.85	4.80	2.92
—	2696	♂	Newton, "	May 15, '69	"	10 75	16 75	5.00	3 35
—	2698	♂	" "	May 15, '69	"	11.00	17.00	5.15	3.35
—	1700	♂	Waltham, "	Aug. 6, '68	"	10.20	16.30	4.98	2 90
—	4045	♂	Newton, "	Aug. 2, '69	"	11.00	17 00	5.00	3 40
—	4061	♂	" "	Aug. 2, '69	"	11.00	16.00	4.80	3.35
—	2738	♀	" "	May 15, '69	"	9.75	15.00	4.55	2 65
362	—	♀	Malden, "	—	D. Higgins	9.25	13.50	4.17	2.50
363	—	♀	" "	—	"	9.58	14.00	4.35	2.90
364	—	♂	" "	—	"	10.50	15.33	4 82	3 11
365	—	♂	" "	—	"	10.35	15.65	4.83	3.13
366	—	♂	" "	—	"	10.00	15 05	4.75	3 14
367	—	♂	" "	—	"	10.75	15 50	4.82	3 30
568	—	♀	" "	—	"	8.90	14.00	4.35	2.60
569	—	♂	" "	—	"	9.50	15.68	5.00	3 05
9764	—	♀	Evanston, Ill.	—	O. Marcy	9.25	13.92	4.15	2 82
9765	—	♀	" "	—	"	9.75	14.65	4.50	3 10
9766	—	♂	" "	—	"	10.00	15.50	4.74	3.15
2646	—	♀	Lawn Ridge, "	—	K. Butler	9 60	14.75	4.55	2 84
4042	—	♂	Concord, Mass.	—	F. C. Brown	10 25	16.00	4.77	2.83
4102	—	♀	" "	—	"	10.33	15.65	4.67	3.08

Measurements of Florida Specimens of STURNELLA LUDOVICIANA.

M. C. Z. No.	Coll. No	Sex.	Locality.	Date.	Collector.	Length.	Al. Ext.	Wing.	Tail.
—	2067	♂	Jacksonville	Jan. 20, '69	C. J. Maynard	9.55	15.60	4 50	2.85
—	2817	♂	Dummitt's	May 15, '69	"	10 20	15.10	4.50	3 20
—	2816	♂	"	May 15, '69	"	10 00	15.15	4 60	2.95
5335	—	♂	Enterprise	Mar. 4, '69	J. A. Allen	9.75	14 75	4.50	—
5336	—	♂	"	Mar. 4, '69	"	9.85	15.20	4.40	2.89
5337	—	♂	"	Mar. 4, '69	"	9 70	14.80	4 45	2.82
5368	—	♂	Hawkinsville	Mar. 12, '69	"	9 75	15.00	4 50	3.05
5369	—	♂	"	Mar. 12, '69	"	9.50	14.75	4.25	4.83
5371	—	♂	"	Mar. 12, '69	"	10.00	15 75	4.50	3.07
—	—	♀	Volusia	Mar. 17, '69	"	8.75	13 75	4.05	—
5370	—	♀	Hawkinsville	Mar. 12, '69	"	8.90	14 15	4.10	2.65
5372	—	♀	"	Mar. 12, '69	"	9.50	14 65	4.20	2.90
5125	—	♀	Jacksonville	Jan. 19, '69	"	8.75	14.25	4.20	2.70
—	2072	♀	"	Jan. 20, '69	C. J. Maynard	8.75	14.00	4.40	2.50
—	2070	♀	"	Jan. 20, '69	"	8.50	13 55	3.90	2.55
—	2070	♀	"	Jan. 20, '69	"	8.75	13 00	4.00	2.55
—	2068	♀	"	Jan. 20, '69	"	9.25	14 75	4 50	2.80
—	2069	♀	"	Jan. 20, '69	"	8.76	14 25	4 20	2 40
—	2071	♀	"	Jan. 20, '69	"	9.00	14.00	4 30	2 80
—	2051	♀	"	Jan. 20, '69	"	9.50	14.75	4.65	2.50
—	2791	♀	"	Apr. 15, '69	"	9.05	14 00	4 10	2.88

The following is a tabulated summary of the two preceding tables: —

No. of Speci-mens.	Sex.	Locality.		Length.	Alar Extent.	Wing.	Tail.
15	♂	Northern States	Average	10.43	16.30	4.91	3.16
8	♀	"	Average	9.55	14 43	4 29	2.82
15	♂	"	Maximum	11.00	17.00	5.15	3 50
15	♂	"	Minimum	10.00	15.05	4 74	2.83
8	♀	"	Maximum	9.75	15.65	4.55	3.10
8	♀	"	Minimum	8.90	13.50	4.15	2.50
9	♂	Florida	Average	9.81	15 70	4.47	2.85
12	♀	"	Average	8.93	14.09	4.22	2.57
9	♂	"	Maximum	10.20	15.75	4.60	3.20
9	♂	"	Minimum	9 50	14.75	4.25	2.82
12	♀	"	Maximum	9.50	14.75	4 65	2.90
12	♀	"	Minimum	8.50	13.00	3.90	2.40

58.† **Scolecophagus ferrugineus** *Swainson.* RUSTY GRACKLE.

Abundant. Occasionally met with in large flocks.

59.* **Quiscalus purpureus** *Cassin.* PURPLE GRACKLE.

Gracula quiscula LINNÉ, Syst. Nat., I, 165, 1766. — WILSON, Am. Orn., III, 44, pl. xxi, fig. 4, 1811.

Gracula barita LINNÉ, Syst. Nat., 165, 1766. — ORD, Journ. Phil. Acad. Nat. Sci., I, 253, 1818.

Gracula purpurea BARTRAM, Travels, 289, 1791. (No description.)

? *Oriolus ludovicianus* GMELIN, Syst. Nat., 387, 1788.

Quiscalus baritus VIEILLOT, Nouv. Dict., XXVIII, 487, 1819. — BAIRD, Birds North Amer., 556, pl. xxvii, 1858. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1866, 405.

Quiscalus versicolor VIEILLOT, Nouv. Dict., XXVIII 488, 1819. — BONAPARTE, SWAINSON, NUTTALL, AUDUBON, BAIRD.

Quiscalus purpureus Cassin, Proc. Phil. Acad. Nat. Sci., 1866, 403. — Ridgway, Ibid., 1869, 133.

Quiscalus purpuratus Swain., Lardner's Cab. Cyclop., 299, 1838 (female).

? *Quiscalus lugubris* Swain., Lardner's Cab. Cyclop., 299, 1838. — ? Cassin, Proc. Phil. Acad Nat. Sci., 1866, 408.

Quiscalus inflexirostris Swain., Lardner's Cab. Cyclop., 300, 1838. — Cassin, Proc. Phil. Acad. Nat. Sci., 1866, 407.

Quiscalus crassirostris Swain., Lardner's Cab. Cyclop., 355, 1838. — Gosse, Birds of Jamaica, 217, 1847.

Quiscalus aglæus Baird, Amer. Journ. Sci. and Arts, XLI, 87, 1866. — Cassin, Proc. Phil. Acad. Nat. Sci., 1866, 404. — Ridgway, Ibid., 1869, 135.

Quiscalus æneus Ridgway, Ibid., 134.

Quiscalus mexicanus Cassin, Ibid., 1866, 408.

Quiscalus Gundlachii Cassin, Ibid., 406.

Quiscalus brachypterus Cassin, Ibid., 406.

Quiscalus niger Cassin, Ibid., 407.

? *Quiscalus rectirostris* Cassin, Ibid., 409.

Chalcophanes quiscalus Wagler, Syst. Avium, 1827. — Cabanis, Mus. Hein., 197, 1851.

Chalcophanes baritus Wagler, Syst. Avium, 1827. — Cabanis, Mus. Hein., 197, 1851

Very abundant everywhere. Flocks containing many hundreds were frequently met with.

As already remarked in Part III, few species present such marked climatic variations as the present, or better illustrate the three principal laws of geographical variation already enumerated; namely, a decrease in general size from the north southward, and at the same time an increase in the length and slenderness of the bill, and an increase in the intensity and brilliancy of the color of the plumage. Far to the north, as in Labrador, the colder parts of Canada, and Northern New England, the bill is shortest and thickest, the size of the bird at its maximum, and the colors of the plumage least brilliant, with the metallic reflections of a light tint, tending to green rather than to blue. In Southern New Jersey the change from the northern type is already considerable; even between summer specimens from Calais (Maine) and Eastern Massachusetts there is an appreciable difference. In the lowlands of South Carolina and Georgia the divergence from the northern type is still greater, and it goes on rapidly increasing in Florida, especially in South Florida, the maximum of divergence from the northern type being attained in the West Indies. In East Florida, while the general size of the bird is less than in New England, the bill is considerably longer, much slenderer and much more decurved, as is shown by the accompanying figures (Plate VII). The change in color is equally marked. Not only do the reflections become much darker at the south, but form prismatic bars across the interscapularies and the feathers of the rump, especially in the South Atlantic States. In South Florida and the West Indies these prismatic bars, in some specimens at least, seem to lose their distinctness, evidently through the continued darkening or increased intensity of the general color. The difference in size between Florida and Massachusetts specimens is considerable, especially between those from South Florida and Massachusetts. Those from the West Indies are still smaller; and in comparing specimens of these with others from Northern New England, the difference is so striking that it seems impossible at first to believe that both can belong to the same species, yet a gradual transition between the two, through the individuals inhabiting the intermediate region, fully proves it. Even between Florida and New England specimens the difference is so great that, were there no transition from one to the other, the two extremes might well be regarded as not only valid species, but as well-marked ones. Being familiar with the so-called *Quiscalus aglæus* before visiting Florida, through specimens in the Museum of Comparative Zoölogy from Cape Florida, I had no doubt that it was a species distinct from the *Q. purpureus*. But a subsequent study of these birds in Florida, and an examination of specimens from various points between Florida and Northern Maine, and also from the West Indies, has forced me to the conclusions indicated in the above table of synonymes.

The purple grackles of the Mississippi Valley have recently been separated as specifically distinct from those of the Atlantic States, under the name *Q. æneus*, *Q. purpureus* being retained for the latter. The range of *Q. purpureus* is given as "Atlantic and Gulf? States, north to Nova Scotia, west to the Alleghanies." The New England type, however, is entirely referable to the *Q. æneus*, as defined by its describer. The same writer also follows some of his predecessors in separating those of South Florida from the *Q. purpureus*, under the name of *Q. aglæus*. But Cape Florida specimens differ but little — being, in fact, scarcely distinguishable except in size — from those from the St. John's River.

Mr. Cassin, in one of his latest papers,* took the ground that each of the larger West India Islands has a distinct species of this group, peculiar to itself. That these forms, many of them evidently difficult of recognition, should be distinct species is quite contrary to general principles. These islands are generally separated by a distance of rarely more than a hundred miles; yet a near ally of these "species," the *Q. purpureus* (or *Q. æneus* as recently restricted), is admitted to range from the Gulf of Mexico

* "A Second Study of the Icteridæ," Proc. Phil. Acad. Nat. Sci., 1866, pp. 403 – 417.

to the arctic regions, so that those that breed farthest north make annually a journey of fully a thousand miles to reach their breeding-grounds. As I have already observed, individuals of species possessing a very northern habitat usually present a great uniformity of character, while those of species ranging farther to the southward are more variable ; also that within the warm-temperate and tropical latitudes, islands but slightly separated from each other or the mainland, and peninsulas which, like Florida, are almost insular in their geographical relations, present each peculiar modifications of species ranging throughout not only all of them, but portions of the adjoining continents, which render the individuals from these different localities more or less readily distinguishable. This results partly, doubtless, from the isolation of these different districts, partly from the more sedentary habits of birds in warm countries, as compared with those of cold latitudes, and partly from the greater tendency to variation in species inhabiting tropical and sub-tropical countries.

In the subjoined tables measurements are given of thirteen males and eight females from the Northern States, and of twenty-three males and seven females from Florida, of which the following is a tabulated summary : —

No. of Specimens.	Sex.	Locality.		Length.	Alar Extent.	Wing.	Tail.
13	♂	Northern States	Average	12.63	17.73	5.66	5.30
8	♀	"	Average	11.45	15.76	4.94	4.49
13	♂	"	Maximum	13.50	18.43	6.05	6.00
13	♂	"	Minimum	12.00	17.00	5.20	4.58
8	♀	"	Maximum	12.05	16.30	5.20	4.85
8	♀	"	Minimum	10.90	15.38	4.60	4.10
23	♂	Florida	Average	12.19	16.64	5.42	5.22
7	♀	"	Average	11.12	14.86	4.75	4.55
23	♂	"	Maximum	13.00	17.80	5.75	5.50
23	♂	"	Minimum	11.00	15.25	5.00	4.55
7	♀	"	Maximum	11.75	16.75	5.00	4.77
7	♀	"	Minimum	10.25	13.75	4.50	4.45

Measurements of Northern Specimens of QUISCALUS PURPUREUS.

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
1234	——	♂	Red River, B. A.	——	S. H. Scudder	12.50	17.50	5.65	5.68
——	187	♂	Watertown, Mass.	Apr. 3, '68	C. J. Maynard	12.50	17.80	5.77	5.20
——	186	♂	" "	Apr. 3, '68	"	12.45	18 25	5.85	5.30
——	185	♂	" "	Apr. 3, '68	"	12.80	17.53	5.57	5.43
——	——	♂	" "	Mar. 28, '68	"	12.80	18.10	5.86	5.50
——	3097	♂	Ipswich, "	Aug. 28, '69	"	13.10	18.00	5.85	5 60
9768	——	♂	Evanston, Ill.	——	O. Marcy	12.40	17.75	5.62	5.07
9770	——	♂	" "	——	"	12.25	17.05	5.42	4.87
2643	——	♂	Lawn Ridge, "	——	K. Butler	12.50	17.25	5.60	5.20
1401	——	♂	" "	——	"	13.50	18.43	6.05	6.00
1871	——	♂	Springfield, Mass.	July 29, '62	J. A. Allen	12.48	17.25	5.50	5.00
1874	——	♂	" "	July 29, '62	"	12.12	17.00	5.20	4.58
2574	——	♂	" "	July 29, '62	"	12.77	17.50	5.68	5.50
1602	——	♀	" "	July 12, '62	"	11.47	15.75	5.00	4.37
1873	——	♀	" "	July 29, '62	"	10.90	15 45	4.75	4.10
9769	——	♀	Evanston, Ill.	——	O. Marcy	11 30	15.38	4.60	4.25
9767	——	♀	" "	——	"	11.48	15 67	4.95	4.40
9598	——	♀	Waterville, Me.	——	C. E. Hamlin	11 50	16.00	5.00	4.65
2284	——	♀	" "	May 3, '62	"	11.40	16.00	4.98	4.46
2271	——	♀	" "	June 9, '62	"	12.05	16.30	5.20	4.85
2501	——	♀	Lynn, Mass.	——	S. Jillson	11.50	15.50	5 05	4.85

Measurements of Florida Specimens of QUISCALUS PURPUREUS.

M. C. Z. No.	Coll. No.	Sex	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5201	—	♂	Welaka	Feb. 6, '69	J. A. Allen	12.75	17.80	5.65	5.20
5202	—	♂	"	Feb. 6, '69	"	12.40	16.87	5.45	5.00
5264	—	♂	Hawkinsville	Feb. 18, '69	"	12.80	17.15	5.50	5.37
5251	—	♂	"	Feb. 18, '69	"	11 75	17.00	5.50	4.87
5266	—	♂	"	Feb. 18, '69	"	13.00	17 60	5.55	5.40
5267	—	♂	"	Feb. 18, '69	"	11.50	16 70	5.50	—
—	—	♂	Enterprise	Feb. 21, '69	"	12.85	16.87	—	—
5345	—	♂	"	Mar. 5, '69	"	12.30	17.38	5.50	5.25
5346	—	♂	"	Mar. 5, '69	"	12.37	16.60	5.20	5.25
10604	2583	♂	Dummitt's	Mar. 9, '69	C. J. Maynard	12.40	17.50	5.55	—
—	2344	♂	"	Feb. 26, '69	"	12 25	17.50	5.75	5 50
10602	2469	♂	"	Feb. 25, '69	"	12.50	17 30	5.50	5.55
—	2470	♂	"	Feb. 25, '69	"	12.50	17 00	5.50	5 00
10603	2471	♂	"	Feb. 25, '69	"	11.75	16.75	5.75	5 55
6848	—	♂	Cape Florida	Mar. 31, '58	G. Wurdemann	11.50	15 50	5.50	5.12
6851	—	♂	"	Apr. 10, '58	"	12.00	16.25	5.25	5.00
6852	—	♂	"	Apr. 22, '58	"	11.75	16.25	5.75	5.00
—	10335*	♂	"	Mar. 31, '58	"	11 50	16.00	5.50	—
—	10336*	♂	"	Apr. 15, '58	"	11.50	15 25	5 00	—
—	10337*	♂	"	Apr. 15, '58	"	12 00	15.50	5.00	—
—	10340*	♂	"	Apr. 22, 58	"	12.00	16.50	5.12	—
—	10341*	♂	"	Apr. 9, '58	"	11.00	15.25	5 25	—
—	10342*	♂	"	May 18, '58	"	11.75	16.25	5.00	—
—	2342	♀	"	Feb. 26, '69	"	11.50	15.50	5.00	4.77
—	2344	♀	"	Feb. 26, '69	"	11.00	15.50	5.00	4.40
10601	2468	♀	"	Feb. 26, '69	"	11.50	16.00	4.50	4.60
5263	—	♀	Hawkinsville	Feb. 18, '69	J. A. Allen	11.45	15 25	4.85	4 55
6853	—	♀	Cape Florida	Apr. 22, '58	G. Wurdemann	11.00	14 50	4.50	4.45
—	10338*	♀	"	Apr. 22, '58	"	11.12	14.50	4.75	—
—	10339*	♀	"	Mar. 31, '58	"	10.25	13.75	4 75	—

The specimens from Cape Florida are considerably smaller than those from the St. John's River; but the same difference occurs in other species between specimens from these two localities. The Cape Florida specimens of *Quiscalus purpureus* differ from others from North Florida also in having a relatively longer, slenderer, and more decurved bill, but not appreciably in color.

60.* **Quiscalus major** *Vieillot.* BOAT-TAILED GRACKLE.

Abundant. Particularly numerous along the St. John's River. According to Dr. Bryant they breed about the first of April. He says that about Lake Monroe some of the birds, as late as the 6th of April, had not commenced laying, "though the majority had hatched, and the young of others were almost fledged." † He notes also their sandpiper-like habit of running along the edge of the water. At Lake Dexter I observed great numbers of them walking on the floating aquatic plants.

The females of this species present very singular variations in color. Of four specimens collected at Lake Dexter, in March, one is pale ashy-

* Smith. Inst. No. Copied from Baird's Birds of North America, p. 557.

† Proc. Bost. Soc. Nat. Hist., Vol. VII, p. 9, January, 1859.

brown below, on the throat and breast nearly white, and dull dusky-brown above; while another is deep reddish-brown below and proportionally darker above, and the others are intermediate to these.

Between the two extremes there is more difference than usually obtains between valid congeneric species. The series of twenty-four males, on the other hand, are quite uniform in color, there being only a slight difference in its intensity and in the prevailing tint of the iridescence.*

The average dimensions of the thirty-three specimens of which measurements are given below are as follows:

Length (males): 16.51; alar extent, 22.48; wing, 7.19; tail, 7.00.

Length (females): 12.95; alar extent, 17.94; wing, 5.67; tail, 5.11.

The individual variation is as follows.

Males, length, 15.50 to 16.80; alar extent, 21.10 to 23.50; wing, 6.25 to 8.35; tail, 6.25 to 7.60.

Females, length, 12.10 to 13.40; alar extent, 17.25 to 18.25; wing, 5.25 to 5.95; tail, 4.75 to 5.60.

Measurements of Florida Specimens of QUISCALUS MAJOR.

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5272	—	♂	Blue Springs	Feb. 21, '69	J. A. Allen	16.00	22.15	7.25	6.80
5252	—	♂	Enterprise	Mar. 1, '69	"	16.25	22.50	7.15	7 15
5283	—	♂	"	Feb. 22, '69	"	16 25	21.75	7.15	7.10
5332	—	♂	"	Mar. 4, '69	"	15.50	22.00	6.85	6.70
5333	—	♂	"	Mar. 4, '69	"	15 75	22.30	7.20	6.85
5334	—	♂	"	Mar. 4, '69	"	15 60	21.85	7.00	—
5407	—	♂	Hawkinsville	Mar. 15, '69	"	16 00	23 00	7.00	7.00
5243	—	♂	"	Feb. 18, '69	"	15.75	22.25	7.30	—
5408	—	♂	"	Mar. 15, '69	"	16 50	22.50	7.30	7.15
5244	—	♂	"	Feb. 18, '69	"	17.30	23.50	7.80	—
5409	—	♂	"	Mar. 15, '69	"	16.00	22.75	7.15	7.00
5410	—	♂	"	Mar. 15, '69	"	16 00	22.75	7.20	6.90
5411	—	♂	"	Mar. 15, '69	"	16 35	22.50	7.50	—
—	—	♂	"	Mar. 15, '69	"	16 50	23 25	7.25	7.40
—	2408	♂	Dummitt's	Feb. 19, '69	C. J. Maynard	16.50	23.00	7.40	7.10
10607	2405	♂	"	Feb. 19, '69	"	16.75	23.50	7.50	7.25
—	2406	♂	"	Feb. 19, '69	"	17 50	23.00	8.35	7.60
—	2345	♂	"	Mar. 17, '69	"	16.00	21 10	6.75	6.60
10610	2585	♂	"	Mar. 9, '69	"	16.90	23.00	7.70	7.50
—	2409	♂	"	Mar. 9, '69	"	16.25	22 00	7 00	7.20
—	2586	♂	"	Mar. 9, '69	"	16.75	22.00	7.00	7.00
—	2399	♂	"	Mar. 9, '69	"	15.75	22.00	6.90	7.00
—	2431	♂	"	Mar. 9, '69	"	16.00	22.25	7.25	6.75
—	2404	♂	"	Mar. 9, '69	"	16.17	20 75	6.50	6.50
—	2345	♂	"	Feb. 16, '69	"	16.50	22 30	6.25	6 25
10609	2563	♀	"	Mar. 9, '69	"	13.00	17.50	5.85	5.60
—	2343	♀	"	Mar. 9, '69	"	13.00	18.25	5.80	5.00
—	2464	♀	"	Mar. 9, '69	"	13.00	18.25	5.95	5.25
5290	—	♀	Enterprise	Feb. 25, '69	J. A. Allen	13.40	18.25	5.85	4.75
5334	—	♀	"	Mar. 4, '69	"	12.75	17.50	5.50	5.00
5412	—	♀	Lake Dexter	Mar. 23, '69	"	13.00	18.05	5 60	5.20
5413	—	♀	"	Mar. 23, '69	"	12 10	17.25	5.25	5.00
5414	—	♀	"	Mar. 23, '69	"	12 50	17.60	5.45	—

* For a very full biography of this species, see an article by Dr. Elliott Coues in the Ibis. Vol. VI, pp. 367–378, 1870.

The present species is hence not only remarkable for variation in size between specimens of the same sex, but especially so for its sexual variation in size, the sexual difference in this respect being greater than in any other species of insessorial bird with which I am acquainted, and it is rarely, if ever, exceeded in any group.

CORVIDÆ.

61.* **Corvus americanus** *Audubon.* Common Crow.

Corvus corone Wilson, Am. Orn., IV, 79, pl. xxv, fig. 3, 1811. — Nuttall, Man. Orn., I, 209, 1832.

Corvus americanus Audubon, Orn. Biog., II, 317, 1834. — Baird, Birds N. Am., 566, 1858.

Corvus americanus var. *floridanus* Baird, Ibid., 568, 1858.

Corvus minimus Gundlach, Cabanis's Journal für Ornithologie, IV, 97, 1856.

Everywhere abundant.

In the average, while the general size of Florida specimens is smaller than New England ones, the bill is somewhat larger. As is well known, the crow is exceedingly variable in the size and shape of its bill even in specimens collected from the same flock. There is, however, an appreciable average difference in the size of the bill, as in general size, between northern and southern examples. This was some time since observed by Professor Baird in comparing a single specimen from the southern point of the Florida peninsula with others from the Northern States, and so strongly was he impressed by it that he thought if his Florida specimen did not represent a distinct species, it did at least a distinct variety, and as such he characterized it, calling it *Corvus americanus* var. *floridanus.* He at the same time referred to the little crow of Cuba, described by Dr. Gundlach as *Corvus minutus*, to which he said it was more nearly allied than either are to *C. americanus.* I have no examples of the latter, but from descriptions of it see no reason why it should be regarded as other than the extreme southern form of *C. americanus.*

62.* **Corvus ossifragus** *Wilson.* Fish Crow.

Abundant. Perhaps rather more numerous than the common crow.

63.* **Cyanurus cristatus** *Swainson.* Blue Jay.

Very abundant and unsuspicious. It frequents the towns, where it seems half domestic.

The same difference occurs in this species between Florida and northern specimens in size and shape of bill as has been already pointed out in respect to *Corvus americanus*, but it is far less marked than in *Agelæus phœniceus*, *Quiscalus purpureus*, and *Sturnella ludoviciana*. The brilliancy of its colors seems not much greater than in New England specimens.

The difference in size between northern and southern specimens is as follows: Average of eighteen Massachusetts specimens (eleven males and seven females): Length, 11.71; alar extent, 16.87; wing, 5.13; tail, 4.89. Average of eleven Florida specimens (proportion of males and females nearly the same as in the previous case): Length, 10.98; alar extent, 15.11; wing, 4.75; tail, 5.00. The maxima and minima of the eleven males from Massachusetts are as follows: Length, 12.25 and 11.35; alar extent, 17.50 and 16.30; wing, 5.50 and 5.00; tail, 5.65 and 4.25.

Measurements of Specimens of CYANURA CRISTATA.

M. C. Z. No.	Coll. No.	Sex.	Locality.		Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
——	34	♂	Newton,	Mass.	Oct. 25, '67	C. J. Maynard	11 62	16.30	5.32	5 06
——	90	♂	"	"	Feb. 5, '68	"	11.35	17.00	5.00	4.78
——	94	♂	"	"	Feb. 8, '68	"	12 00	17.00	5.00	5.00
——	93	♂	"	"	Feb. 8, '68	"	11.55	17.20	5.25	4.80
——	—	♂	"	"	Feb. 21, '68	"	12.00	16.80	5.00	5.00
——	687	♂	"	"	May 28, '68	"	12 16	17 00	5.45	5.40
——	1667	♂	"	"	——	"	12.25	17.25	5.65	5 65
12393	—	♂	Springfield,	"	Feb. 25, '70	Irving Allen	12.00	17.20	5.15	5.15
12392	—	♂	"	"	Feb. 25, '70	"	11.50	17 00	5.30	5.10
12388	—	♂	"	"	Feb. 25, '70	"	12.00	17.00	5.00	4 25
12385	—	♂	"	"	Feb. 25. '70	"	12.00	17.50	5.50	5.40
12389	—	♀	"	"	Feb. 25, '70	"	12.00	17 00	4.40	4.45
12392	—	♀	"	"	Feb. 25, '70	"	11.00	16 50	4.33	4 80
12391	—	♀	"	"	Feb. 25, '70	"	11.00	17.00	5 25	4.75
12386	—	♀	"	"	Feb. 25, '70	"	11.50	17 00	5.50	5.15
——	33	♀	Newton,	"	Oct. 25, '67	C. J. Maynard	11.40	16.32	5.30	5.30
4875	688	♀	"	"	May 28, '68	"	11.62	16.53	4.75	4.77
——	1685	♀	"	"	Nov. 4, '68	"	11.75	16.00	5.20	4.35
10733	1951	♂	Jacksonville,	Fla.	Jan. 2, '69	"	11.15	16.00	5.00	5.00
10734	1973	♀	"	"	Jan. 3, '69	"	11.00	15.50	4.80	4 80
10734	1974	♀	"	"	Jan. 3, '69	"	11 00	14.75	4.00	4.80
5522	—	?	Blue Springs,	"	Feb. 21, '69	J. A. Allen	10.75	15.75	4 20	—
5128	—	?	Jacksonville,	"	Jan. 21, '69	"	10 75	15.50	4.70	5.12
5190	—	♂	Welaka,	"	Feb 3, '69	"	10.70	15.60	5.10	5.10
——	—	♂	Enterprise,	"	Mar. 1, '69	"	11.00	15 75	5.00	—
——	—	?	"	"	Mar. 4, '69	"	10.70	15.15	4.50	—
5348	—	♀	"	"	Mar 4, '69	"	11.00	16.00	5.00	5.05
5162	—	?	Hibernia,	"	Jan. 30, '69	"	11.25	15 75	5.00	5.15
5163	—	?	"	"	Jan. 30, '69	"	11.50	15 50	5.00	—

64.* **Cyanocitta floridana** *Bonaparte.* FLORIDA JAY.

Corvus floridanus BARTRAM, Travels, 291, 1791. — AUDUBON, Orn. Biog., I, 444, pl. lxxxvii, 1831.

Garrulus floridanus BONAP., Am. Orn., II, 11, pl. ix, 1828.

Garrulus cærulescens ORD, Journ. Phil. Acad. Nat. Sci., I, 347, 1818.

Garrulus californicus VIGORS, Zoöl. Beechey's Voyage, 21, pl. v, 1839.

Cyanocitta floridana BONAP., Consp. Gen. Avium, 377, 1850.

Cyanocitta superciliosa STRICKLAND, Ann. & Mag. Nat. Hist., XV, 260, 1845.

Cyanocitta californica STRICKLAND, Ibid., 342.

Cyanocitta Woodhousei BAIRD, Birds N. Am., 585, 1858.

Numerous in the scrub, but does not appear to frequent the pine woods the hummocks or swamps. I saw none along the St. John's, except at Blue Springs, but they occur in numbers a few miles back from the river.

On comparing a number of specimens of the so-called *Cyanocitta californica* with numerous others from Florida, I find, as previous writers have observed, that the differences between them are very slight, and not so great as obtain between Florida and New England specimens of *Pipilo erythrophthalmus*, *Agelæus phœniceus*, and other species where there is no reason to question their specific identity. The so-called *C. Woodhousei* is described as, and is, intermediate in character between *C. floridana* and *C. californica*. The habitat of *C. Woodhousei* is also intermediate between those of the other two, but adjoins that of *C. californica*, to which it is most nearly allied. How great the interval is between the habitats of *C. floridana* and *C. Woodhousei* I have not been able to accurately determine. Bonaparte * reported the former as being found in Louisiana and northward to Kentucky, and the latter occurs in Western Texas.

In the following measurements of twelve specimens of this species (six males and six females) the extremes are as follows: Length, 11.00 and 12.50 (both specimens being females); alar extent, 13.50 (female) and 15.00 (male); wing, 4.00 and 4.75 (both specimens females); tail, 4.25 and 5.35 (both specimens females). The average dimensions of these specimens are as follows: Length, 11.74; alar extent, 14.44; wing, 4.42; tail, 4.80. The females average slightly smaller than the males.

Measurements of Florida Specimens of CYANOCITTA FLORIDANA.

M. C Z No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length	Alar Extent.	Wing.	Tail.
10739	2480	♂	Dummitt's	Feb. 22, '69	C. J. Maynard	11.50	14.50	4.30	4.35
—	2377	♂	"	Feb. 22, '69	"	12.00	15.00	4.45	4.75
—	2421	♂	"	Feb. 15, '69	"	12.00	15.00	4.75	5.00
10736	2326	♂	"	Feb. 15, '69	"	12.00	14.50	4.50	4.60
—	2329	♂	"	Feb. 15, '69	"	11.50	14.25	4.50	4.25
—	2379	♀	"	Feb. 22, '69	"	11.50	14.25	4.50	5.35
10737	2328	♀	"	Feb. 15, '69	"	12.50	14.50	4.75	4.90
—	2378	♀	"	Feb. 15, '69	"	11.50	14.10	4.30	5.15
—	2375	♀	"	Feb. 15, '69	"	11.60	14.40	4.60	4.25
5271	—	♀	"	Feb. 21, '69	J. A. Allen	11.00	13.50	4.00	5.35
5272	—	♂	"	Feb. 21, '69	"	12.00	14.50	4.30	4.75
5523	—	—	"	Feb. 21, '69	"	11.75	14.80	4.20	—

TYRANIDÆ.

65.† **Sayornis fuscus** *Baird.* PEWEE.

Abundant all winter, and a few remain till into April.

The king-bird (*Tyrannus carolinensis*), the great-crested flycatcher (*Myiarchus crinitus*), and the wood pewee (*Contopus virens*) became

* Am. Orn., Vol. II, p. 60, 1828.

common the last week in March, as also, according to Mr. Boardman, the least flycatcher (*Empidonax minimus*).

Several specimens of the gray king-bird (*Tyrannus dominicensis*) were obtained by Mr. L. L. Thaxter at St. Augustine, about the first of May.

ALCEDINIDÆ.

66.* Ceryle alcyon *Boie.* Kingfisher.

Abundant. As shy and distrustful here as in the more thickly settled parts of the country. Begins to breed very early. Mr. Maynard saw them forming their holes in the coquina rock, in the banks of the canal connecting Indian River with Mosquito Lagoon, the first week in February.

CAPRIMULGIDÆ.

67.* Antrostomus carolinensis *Gould.* Chuckwill's Widow.

Abundant. Not observed till about the first of March, when its notes are usually first heard. Said by Audubon to be resident; which statement is confirmed by the testimony of old residents of the State.

68.* Antrostomus vociferus *Bonaparte.* Whippoorwill.

Apparently not numerous in winter. I heard it once in February, and Mr. Maynard took it at Dummitt's in the same month. The inhabitants along the St. John's agree with Audubon that this species is also a winter resident.

The night hawk (*Chordeiles popetue* * Baird) was collected at Jacksonville by Mr. Thurston as early as April 20th.

* *Caprimulgus virginianus* Brisson, Orn., II, 477 (in part).
Caprimulgus popetue Vieillot, Ois. Am. Sept., I, 56, pl. liv, 1807.
Caprimulgus americanus Wilson, Am. Orn., V, 65, pl. cxl, 1812.
Caprimulgus (*Chordeiles*) *virginianus* Swain., Faun. Bor. Am., II, 62, 1831.
Chordeiles virginianus Bon., Geog. & Comp. List, 8, 1838. — Gosse, Birds of Jamaica, 33, 1847.
Chordeiles sapiti Bonap., Consp. Gen. Avium, I, 63, 1849. — Cassin, Ill. N. Am. Birds, 238, 1855.
Chordeiles brasilianus Lawr., Ann. N. Y. Lyceum Nat. Hist., V, 114, 1851.
Chordeiles Henryi Cassin, Ill. N. Am. Birds, 239. — Baird, Birds N. Am., 153.
Chordeiles Gundlachii Lawr.. Ann. N. Y. Lyc. Nat. Hist., VI, 167, 1856.
Chordeiles texensis Lawr., Ibid., 165. — Baird, Birds N. Am., 154.
Chordeiles minor Cabanis, Journ. für Orn., 5, 1856.
Chordeiles popetue Baird, Birds N. Am., 151.

This widely distributed species presents only the usual variations in size and color

CYPSELIDÆ.

The chimney swift (*Chætura pelasgia*) arrives about the last week in March. It was common at Jacksonville, April 1st.

TROCHILIDÆ.

The ruby-throated humming-bird (*Trochilus colubris*) became common about March 1st. Some probably spend the winter in South Florida.

PICIDÆ.

69.* **Campephilus principalis** *Gray.* IVORY-BILLED WOODPECKER.

Picus principalis LINNÉ, Syst. Nat., I, 173, 1767.

Campephilus principalis GRAY, Genera of Birds, 1840.

Campephilus Bairdii CASSIN, Proc. Phil. Acad. Nat. Sci., 1863, 322. (West Indian form.)

Rather rare; at least far less numerous than most of the other species of woodpecker.

With only Florida specimens of this species before me, I am unable to give comparisons between them and specimens from other localities. According to the late Mr. Cassin, those found in Cuba differ from those of the Southern States, in being smaller, as would be expected, with very slight deviations in color-markings. He has, however, given to the Cuba race the name of *Campephilus Bairdii*, remarking that it appears to be "one of those singular insular species which have become well known to naturalists."

Measurements of Florida Specimens of CAMPEPHILUS PRINCIPALIS.

M. C. Z. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5221	♂	Volusia.	Feb. 12, '69	J. A. Allen	20.00	32.25	10.40	6.90
5222	♂	"	Feb. 12, '69	"	19.50	32 50	10.25	6 90
5229	♀	"	Feb. 12, '69	"	19.30	31.50	10.60	6.85
5354	♂	Enterprise	Mar. 5, '69	"	19.25	30.50	9.70	6.40
5399	♀	Hawkinsville	Mar. 15, '69	"	19.50	31.50	10.25	6.75

seen in other species of our birds. Yet these variations have in the present case been mistaken as indicating numerous species. The southern representatives of it are appreciably smaller than the northern, and have the white markings on the wings more restricted, — variations that have already been pointed out in this paper as occurring in numerous others similarly distributed. Those from the central arid region of the continent are also lighter in general color than those from the eastern or western portions; also a common color variation in other species. The latter type forms the so-called *Chordeiles Henryi*; the southern ones have been variously characterized as *C. sapiti*, *C. texensis*, *C. Gundlachii*, etc., as indicated in the above-cited synonymes.

70.* **Hylotomus pileatus** *Baird.* Pileated Woodpecker.

Abundant. Much smaller than at the north, but not otherwise appreciably different.

The average dimensions of fourteen Florida specimens (seven males and seven females) are as follows: —

Males, length, 17.48; alar extent, 28.07; wing, 9.21; tail, 6.82.

Females, length, 16.44; alar extent, 26.80; wing, 8.98; tail, 6.54.

The individual variation is as follows: —

Males, length, 17.25 to 17.75; alar extent, 27.50 to 28.50; wing, 9.00 to 9.50; tail, 6.20 to 6.75.

Females, length, 15.50 to 16.80; alar extent, 26.00 to 27.75; wing, 8.50 to 9.50; tail, 5.85 to 6.80.

Measurements of Florida Specimens of Hylotomus pileatus.

M.C.Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5118	—	♂	Hibernia	Jan. 30, '69	J. A. Allen	17.75	28.25	9.25	6.65
5203	—	♂	Welaka	Feb. 7, '69	"	17.25	28.00	9.00	6.50
5215	—	♂	"	Feb. 10, '69	"	17.50	28.50	9.25	6.75
—	—	♂	Hawkinsville	Mar. 10, '69	"	17.25	27.50	9.50	—
—	1937	♂	Jacksonville	Dec. 31, '69	C. J. Maynard	17.75	28.50	9.50	6.40
—	2076	♂	"	Jan. —, '69	"	17.25	27.75	9.00	6.20
—	2543	♂	Dummitt's	Feb. 15, '69	"	17.60	28.00	9.00	6.45
—	2334	♀	"	Mar. 11, '69	"	15.50	26.40	8.70	5.85
—	2602	♀	"	Mar. 5, '69	"	16.60	27.75	9.00	6.75
5204	—	♀	Welaka	Feb. 7, '69	J. A. Allen	16.75	26.25	8.50	6.75
5214	—	♀	"	Feb. 10, '69	"	16.35	26.75	9.15	6.60
5216	—	♀	"	Feb. 10, '69	"	16.30	27.25	9.00	6.80
5274	—	♀	Blue Springs	Feb. 21, '69	"	16 75	27 20	9 50	6.50
—	—	♀	Hawkinsville	Mar. 10, '69	"	16.80	26.00	9.00	—

71.* **Picus villosus** *Linné.* Hairy Woodpecker.

Picus villosus Linné, Syst. Nat., I, 175, 1767. — Forster, Philosoph. Transact., LXII, 383, 1772. — Wilson, Am. Orn., I, 150, pl. ix, fig. 3, 1808. — Audubon, Orn. Biog., V, 164, pl. ccccxvii, 1837. (Northern form.)

Picus leucomelanus Wagler, Syst. Av., No. 18, 1827. (Immature male.)

Picus Auduboni Swainson, Faun. Bor. Am., II, 306, 1831. (Immature male.) — Trudeau, Journ. Phil. Acad. Nat. Sci., 404, 1837. (Immature male). — Audubon, Orn. Biog., V, 194, 1839. (Same as the last.)

Picus Martinæ Audubon, Ibid., 181, pl. ccccxvii. (Very immature.)

Picus Phillpsii Audubon, Ibid., 186, pl. ccccxvii. (Immature.)

Picus Harrisii Audubon, Ibid., 191, same plate. (Northwestern form.) — Baird, Birds N. Am., 87.

Picus septentrionalis Nuttall, Man. Orn., I (2d Ed.), 685, 1840.

Picus rubricapillus Nuttall, Ibid., 684. (Immature male.)

Picus Cuvieri Malherbe, Mon. Picidæ, I, 85, pl. xxii, fig. 3. (Young female.)

Picus Jardinei Malherbe, Ibid., I, 85, pl. xxv, fig. 4, 5. — Cassin, Proc. Phil. Acad. Nat. Sci., 1863, 201.

Not numerous in Florida in comparison with the other species of *Picidæ*.

The difference in size between northern and southern specimens of all the species of the *Picidæ* is greater than obtains in most other families of birds. So great is it in *Picus villosus* and *Picus pubescens* that it was in these species that such variations were first noticed. This difference is well pointed out by Professor Baird in his work on the North American Birds, and fully demonstrated in his table of measurements. On this ground he distinguished three varieties of *P. villosus*, — *P. villosus major*, occupying the northern and western portions of the continent; *P. villosus medius*, occupying the Middle States; and *P. villosus minor*, occupying the Southern States. Audubon regarded the two former as distinct species. In addition to these variations in size, my Florida specimens indicate a well-marked variation in color between the northern and extreme southern races, the Florida specimens differing from New England ones in having the white markings of relatively less extent, which gives to the plumage a considerably darker aspect. Through this variation there is an approach in the Florida examples of *P. villosus* to the so-called *P. Harrisii* of the Pacific coast and Rocky Mountain regions of the continent, and in the Florida examples of *P. pubescens* to the so-called *P. Gairdneri*, also of the middle and western regions of the continent. These, as is well known, differ respectively from *P. villosus* and *P. pubescens* almost solely in a general darker aspect, resulting simply from the relatively greater predominance of the black color of the plumage over the white markings in the western type; there being no change whatever in the general style of coloration, though some of the smaller white spots seen in the eastern are entirely obsolete in the western type. Under *Picus Gairdneri* Professor Baird thus describes these variations. "There is," he says, "the same series in specimens of *Picus Gairdneri* that were indicated under *P. Harrisii*. Thus the most northern from Washington Territory and Oregon have the under parts more brown, with faint black streaks, the white spots above smaller and less numerous. In specimens from California and farther east the white is purer, the spots more conspicuous." "The almost perfect parallelism," he further observes, "with appreciable differences between the markings of the northwestern and southeastern varieties of *Picus Harrisii* and *Gairdneri*, and their relationship to *P. villosus* and *pubescens*, is a remarkable fact in American ornithology, and may possibly indicate the necessity either of dividing the dark ones into a Pacific and Rocky Mountain series, or of considering all as variations of two species, a larger [*P. villosus*] and a smaller [*P. pubescens*], changing their character with longitudinal distribution." And he aptly adds, "Many other supposed species are involved in the same consideration." * Professor Baird in his account of these species, expressly refers to California specimens that have less white on the wings than the one form and more white than the other.† This with the color differences existing between Florida specimens and New England ones, similar in character to these, though less in degree, seems to confirm the necessity alluded to by Professor Baird of regarding the small spotted woodpeckers in question as forming only two species, — the *Picus villosus* and *Picus pubescens*, — with parallel and remarkable geographical variations. So great is the difference, however, between typical representatives of the two leading forms of each, that their discoverers, with too few specimens of each to enable them to detect the gradual passage of the one into the other, — a fact which now seems well substantiated, — were quite excusable in regarding them as distinct species. Several other supposed species, as indicated by the synonymes given above, and previously by other authors, have been based on phases of immaturity. The young of either sex often have the crown spotted with red or yellow, while the mature male alone has red on the head, and in which it is usually confined to a narrow occipital transverse band. In respect to the number, shape, position, and size of the white spots on the wings, however, there is always considerable variation in specimens from the same locality, these variations being dependent upon neither sex nor age.

Florida specimens of not only *Picus pubescens* and *P. villosus*, but of *Centurus carolinus*, *Sitta carolinensis*, and *Sitta pusilla*, often have the plumage of the lower surface of the body so much soiled and darkened by running over the blackened trees in recently burnt districts as to materially alter their appearance, so that they might almost be taken for distinct species, as previously noted by Audubon. ‡

72.* **Picus pubescens** *Linné*. Downy Woodpecker.

Picus pubescens Linné, Syst. Nat., I, 175, 1766. — Wilson, Audubon, Bonaparte, Nuttall, Baird, Cassin, etc.

Picus (*Dendrocopus*) *pubescens* Swainson, Faun. Bor. Am., II, 307, 1831.

Picus (*Dendrocopus*) *medianus* Swainson, Ibid., 308. (Described from New Jersey specimens).

* Birds of North America, p. 91.

† In accounting for these intermediate forms, Mr. Cassin adopts the very convenient but, as it seems to me, uncalled-for and incorrect theory of hybridity, so often resorted to in similar cases. Under *Picus villosus*, he says that *P. villosus* and *P. Harrisii* probably associate in a region intermediate between the proper ranges of the two species, "and produce hybrids, which present difficulties to naturalists." Under *Picus pubescens* he makes similar remarks in respect to *P. pubescens* and *P. Gairdneri*. *Proc. Phil. Acad. Nat. Sci.*, 1863, pp. 200, 201.

‡ Orn. Biog., Vol. II, p. 82.

Picus (*Dendrocopus*) *meridionalis* SWAINSON, Ibid. (Southern race.)

Picus Gairdneri AUDUBON, Orn. Biog., V, 317, 1839. (Northwestern form.) — BAIRD, Birds N. Am., 91, 1858.

Picus meridionalis NUTTALL, Man. Orn., I, (2d Ed.) 690, 1840. (Not of Swainson).

Picus Lecontei JONES, Ann. N. York Lyc. Nat. Hist., IV, 489, pl. xviii, 1848. (Three-toed specimen.)

Picus Turati MALHERBE, Mon. Pic., I, 125, pl. xxix, fig. 5, 6. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1863, 202.

Common. Much more numerous than *Picus villosus.*

The difference in size and color between northern and southern specimens has been sufficiently detailed under the previous species.

73.* **Picus borealis** *Vieillot.* RED-COCKADED WOODPECKER.

Picus borealis VIEILLOT, Ois. Am. Sept., II, 66, pl. cxxii, 1807. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1863, 203.

Picus querulus WILSON, Am. Orn., II, 103, pl. xv, fig. 1, 1810. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1863, 203.

Common in the pineries.

Mr. Cassin regards the Carolina and Georgia representatives of this species as specifically distinct from the Pennsylvania ones. He says that they are as distinct and as easily recognized as are *Picus villosus* and *P. Harrisii,* which he of course regards as valid species. He assigns Vieillot's

Measurements of Florida Specimens of PICUS BOREALIS.

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
10641	1919	♀	Jacksonville	Dec. 31, '68	C. J. Maynard	8.40	14.20	4.75	3.52
10642	1920	♂	"	Dec. 31, '68	"	8.30	14.20	4.76	3 62
10643	1921	♀	"	Dec. 31, '68	"	8.30	14.80	4.80	3 56
——	1922	♂	"	Dec. 31, '68	"	8.50	14.50	4.75	3 69
10644	1923	♂	"	Dec. 31, '68	"	8.20	14 45	4.75	3.39
——	1924	♂	"	Dec. 31, '68	"	8.50	15.00	4 80	3.32
10645	1925	♂	"	Dec. 31, '66	"	8 50	14.75	4.85	3.60
——	1971	♀	"	Jan. 3, '69	"	8.50	15.00	4.85	3.50
10646	1972	♂	"	Jan. 3, '69	"	8.50	14 30	4.75	3.75
10631	29	♂	"	Apr. 11, '69	"	8.00	14.75	4.90	3.45
10632	30	♀	"	Apr. 6, '69	"	8.50	15.00	4.90	3 35
10633	31	♀	"	Apr. 6, '69	"	8.30	14.90	4.85	3 35
10634	41	♂	"	Apr. 7, '69	"	8.15	14.50	4.70	3 25
10637	47	♂	"	Apr. 8, '69	"	8.60	15.15	4.87	3.40
10638	48	♂	"	Apr. 8, '69	"	8.50	15.00	4.95	3.46
10639	58	♀	"	Apr. 13, '69	"	8.50	14 10	4.75	3.59
——	49	♀	"	Apr. 8, '69	"	8.50	14.15	4.85	3.49
10640	59	♀	"	Apr. 12, '69	"	8.50	15.00	4.80	3.50
10636	44	—	"	Apr. 7, '69	"	8.30	15.00	4.80	3.60
10635	43	♀	"	Apr. 7, '69	"	8.35	14.60	4.60	3.60
——	32	♂	"	Apr. 3, '69	"	8.30	14.90	4.85	3.50
——	42	♂	"	Apr. 7, '69	"	8.20	14.70	4 75	3.29
5116	—	♂	"	Jan. 19, '69	J. A. Allen	8.50	15 20	4.40	3 30
5137	—	♂	"	Jan. 25, '69	"	8.38	14 75	4.57	3.42
5375	—	♂	Hawkinsville	Mar. 12, '69	"	8.55	14.55	4.50	3.40
5393	—	♂	"	Mar. 15, '69	"	8.50	14.50	4.45	3.20
5394	—	♂	"	Mar. 15, '69	"	8.25	14.50	4.40	3.15
5414	—	♀	Volusia	Mar. 25, '69	"	7.90	14.60	4.45	3.25

name *borealis* to the Pennsylvania type, and Wilson's name *querulus* to the more southern form. In recognizing two species of red-cockaded woodpecker in the Atlantic States, Mr. Cassin differs from all previous writers. Having only Florida specimens, a series of twenty-two, before me, I cannot state from personal observation as to how they differ from northern ones. They appear, however, to be merely a little smaller and darker.

The average size of the twenty-eight Florida specimens of which measurements are given in the foregoing table is as follows: Length, 8.34; alar extent, 14.46; wing, 4.71; tail, 3.41.

74.† **Sphyrapicus varius** *Baird.* YELLOW-BELLIED WOODPECKER.

Common.

75.* **Centurus carolinus** *Bonaparte.* RED-BELLIED WOODPECKER.

Picus carolinus LINNÉ, Syst. Nat., I, 174, 1767.
Picus griseus VIEILLOT, Ois. Am. Sept., II, 52, pl. cxvi, 1807.
Centurus carolinus BONAP., Geog. & Comp. List, 40, 1838.

Abundant. The most numerous species of its family in Florida. Specimens in the Museum from Cape Florida, taken the 8th of May by Mr. G. Wurdemann, indicate it as resident throughout Florida, though considered by Audubon and others as only a winter visitant to this and the other Gulf States.

The Florida specimens are all very much brighter colored than others before me from Maryland, Indiana, Illinois, and Michigan, the Michigan specimens being the palest. Professor Baird has remarked, in regard to a specimen from Amelia Island, Florida,* that it was not only very much smaller than northern ones, but had the white transverse bands on the back much narrower, the black ones being three times the breadth of the white ones, instead of twice, as in the northern specimens. These differences my large series from the St. John's River indicate as constant. A similar increase in the breadth of the black bands over the white ones in southern specimens as compared with northern ones, in species banded transversely, is seen in numerous other species. It is well marked in *Colaptes auratus* (where the bands are dark and light brown), in *Sphyrapicus varius*, and, as I shall show more fully subsequently, in *Ortyx virginianus*. The extent and intensity of the red on the abdomen and head, and especially its brilliancy on the head, is much greater in the Florida specimens of *C. carolinus*. In this respect there is also a well-marked difference between Cape Florida specimens and those from the St. John's River, the Cape Florida ones being much the brighter. These seem to accord in every particular with

* Birds of North Amer., p. 109.

the so-called *Centurus subelegans* of Lower California and Mexico. It is interesting to note that variations in color occur between the northern and southern representatives of *Centurus flaviventris* similar to those exhibited by northern and southern examples of *C. carolinus*. The southern forms of *C. flaviventris* were long since characterized by Wagler, Swainson, and Bonaparte as specifically distinct from the northern, under the names of *C. elegans*, *C. santacruzi*, etc., etc., which many authors still rank as species.

76.* **Melanerpes erythrocephalus**, *Swainson*. RED-HEADED WOODPECKER.

Rare in winter; said to be common in summer. I saw two only, about March 15th. Mr. Boardman also gives it as rare, while Mr. Maynard did not meet with it at all. Audubon speaks of its being very abundant in winter in Louisiana, and Dr. Coues gives it as resident in South Carolina; but it is certainly not common in winter in East Florida.

77.* **Colaptes auratus** *Swainson*. GOLDEN-WINGED WOODPECKER.

Abundant.

Considerably smaller than at the north, with the colors much more intense, and the transverse black bars on the back relatively broader. The individual variations in this species, even at the same locality, are very considerable, especially in respect to the bill. Figures 5 and 6, Plate VIII, illustrate the variation in the form and size of the bill of two specimens from Massachusetts, both of which are females.

The following summary of the subjoined tables indicates the difference in size between Massachusetts and Florida specimens, and the individual differentiation in the same respect at each locality. The sexes seem not to differ essentially in size.

No. of Specimens.	Sex.	Locality.		Length.	Alar Extent.	Wing.	Tail.
18	—	Massachusetts.	Average	12.45	19.94	6 24	4.35
11	—	Florida	Average	11.66	18.82	5.84	4.40
18	—	Massachusetts.	Maximum	13.00	20.75	6.60	4.70
18	—	"	Minimum	12.00	19.00	6.00	4.00
11	—	Florida.	Maximum	12.75	19.75	6.25	4.85
11	—	"	Minimum	10.60	17.60	5.60	4.10

While the Florida specimens are considerably smaller than the northern in three of the measurements, the tail is actually longer in the Florida birds, and hence relatively much longer. In most of the species of which comparative tables of measurements are given in the present paper, there is a decided tendency to an elongation of the tail at the southward, the tail decreasing less in length than the wing or the general size.

Measurements of Massachusetts Specimens of Colaptes auratus.

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
——	29	♂	Watertown	Oct. 14, '67	C. J. Maynard	12.50	20.15	6.00	4.15
——	232	♂	"	Mar. 17, '68	"	12.60	20.00	6.31	4.56
——	252	♀	Waltham	Apr. 18, '68	"	13.00	20.75	6.60	4.60
——	281	♂	Newton	Apr. 21, '68	"	12.30	19.60	6.00	4.24
4880	280	♂	"	Apr. 21, '68	"	12.25	19.90	6.25	4.62
——	325	♀	"	Apr. 25, '68	"	12.55	20.05	6.27	4.35
——	——	♂	"	Aug. 5, '68	"	12.67	19 80	6 10	4.00
4881	356	♂	"	May 1, '68	"	12.00	19.00	6.10	4.10
——	958	♂	"	June 2, '68	"	12 00	19.45	6.10	4.25
5460	1011	♂	Waltham	Aug. 6, '68	"	12.50	19.90	6.20	4.05
——	2902	♂	Newton	June 12, '69	"	12.50	20.50	6.40	4 30
——	4028	♀	Waltham	Aug. 22, '69	"	12.50	20.00	6.25	4.70
——	4029	♂	Newton	Aug. 22, '69	"	13.00	20.60	6.25	4 70
——	4034	♀	"	Aug. 26, '69	"	12.50	20.27	6.25	4 35
——	2913	♂	"	June 30, '69	"	12.10	20.00	6 45	4.55
——	2916	♂	"	June 22, '69	"	12.00	19.50	6.15	4.25
——	2915	♂	"	June 22, '69	"	12.50	19.50	6.25	4 20
——	2939	♂	"	May 1, '69	"	12 50	20.00	6.30	4.45

Measurements of Florida Specimens of Colaptes auratus.

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
——	2075	♀	Jacksonville	Jan. 20, '69	C. J. Maynard	10.75	18.50	5.75	4.55
——	2074	♀	"	Jan. 20, '69	"	11.00	17.60	5 50	4.50
10612	2346	♀	Dummitt's	Feb. 16, '69	"	11.75	19.50	6.25	4.10
10614	2601	♀	"	Mar. 11, '69	"	12.00	19 00	5.90	4 60
10611	2584	♀	"	Mar. 9, '69	"	10.60	17.75	5.70	4.30
10613	2542	♀	"	Mar. 5, '69	"	12.75	19.10	6.00	4.85
10610	2385	♂	"	Mar. 5, '69	"	12 00	19.20	6.00	4.25
5196	——	♂	Welaka	Feb. 5, '69	J. A. Allen	12 20	19.10	5.85	4.30
5321	——	♀	Enterprise	Mar. 1, '69	"	11.50	18.75	5.60	4.15
——	——	♀	Volusia	Mar. 25, '69	"	12.25	19.75	6.00	—
——	——	♂	"	Mar. 25, '69	"	11.50	18.75	5.65	—

Of the eight species of woodpecker mentioned above as occurring in Florida in winter, all but one or two (*Melanerpes erythrocephalus* and *Campephilus principalis*) are numerously represented. Most of them are exceedingly abundant, the woodpeckers hence forming a conspicuous element in the bird-fauna of East Florida. All of them are resident, according to Dr. Coues, in South Carolina. Audubon, however, states that two of them (*Sphyrapicus varius*, *Centurus carolinus*) do not breed south of Maryland, but Dr. Coues gives them as resident the whole year in South Carolina.

PSITTACIDÆ.

78. **Conurus carolinensis** *Bonaparte.* Carolina Parokeet.

Common. Hundreds are captured every winter on the Lower St. John's by professional bird-catchers and sent to the northern cities. Thousands of others are destroyed wantonly by sportsmen. Concerning this needless slaughter Mr. Boardman thus writes: "The little parokeet must soon be exterminated. Some of our Enterprise party would sometimes shoot forty or fifty at a few discharges, for sport, as they hover about when any are shot until the whole flock is destroyed." From its habit of feeding upon the tender maize in autumn, it is sometimes somewhat injurious to the farmer, and for this cause many are also killed. It is also more or less hunted as a game-bird. It is well known that the parokeet formerly inhabited large portions of the United States where it is now never seen, and the cause of its disappearance has been deemed a mystery. Such facts as these, however, seem to render clear what its ultimate fate must be in the United States, — extermination.

I could learn nothing from the inhabitants in regard to the time, manner, or place of breeding of this species, even old residents professing total ignorance in regard to these points.

The following table of measurements of specimens of this species serves to indicate its average size and proportions in Florida. In mature specimens the sexual difference in color and size is very slight. Neither sex acquires its adult colors before the second or third year.

The average size of the nineteen specimens (six males and thirteen females) cited below is as follows: Length, 13.10; alar extent, 21.76; wing, 7.59.

The extremes are as follows: —

Length, 12.50 and 13.60 (both specimens females); alar extent, 21.10 (female) and 22.50 (male); wing 7.00 and 7.85. These specimens seem to indicate a tolerable constancy in general size and proportions.

Measurements of Florida Specimens of CONURUS CAROLINENSIS.

M. C. Z. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5205	♂	Welaka	Feb. 8, '69	J. A. Allen	13.25	22.00	7 70	6.05
5206	♂	"	Feb. 8, '69	"	13 55	22.30	7.85	6.75
5207	♀	"	Feb. 8, '69	"	12.90	21.50	7.45	6.10
5225	♀	Volusia	Feb. 12, '69	"	13.00	21.75	7.00	5.80
5226	♀	"	Feb. 12, '69	"	13 00	21.60	7 35	5.80
5227	♀	"	Feb. 12, '69	"	13.00	21.75	7 30	6.00
5228	♀	"	Feb. 12, '69	"	13 00	21.50	7 50	6.00
5294	♂	Enterprise	Feb. 25, '69	"	13.25	21.50	7 40	—
5295	♀	"	Feb. 25, '69	"	13 00	22.45	7.60	6.00
5296	♀	"	Feb. 25, '69	"	13.60	22 00	7.34	6.60
5297	♂	"	Feb. 25, '69	"	13.45	22.00	7.50	—
—	♂	Hawkinsville	Mar. 13, '69	"	13 25	22.50	7.75	—
—	♂	"	Mar. 13, '69	"	13.15	21 25	7.50	—
—	♀	"	Mar. 13, '69	"	12.50	21 35	7.30	—
—	♀	Orange Bluffs	Mar. 24, '69	"	12.85	21 75	7.40	—
—	♀	"	Mar. 24, '69	"	13.60	22.30	7.75	—
—	♀	"	Mar. 24, '69	"	13.05	21.10	7.50	—
—	♀	"	Mar. 24, '69	"	13.25	21.30	7 50	—
—	♀	"	Mar 24, '69	"	13.25	21.50	7.55	—

VULTURIDÆ.

79.* **Cathartes aura** *Illiger.* TURKEY VULTURE.

Vultur brasiliensis BRISSON, Orn., I, 468, 1760.

Vultur aura LINNÉ, Syst. Nat., I. 122, 1767. — VIEILLOT, Ois. Am. Sept., I, 25, pl. 2 bis, 1807. — WILSON, Am. Orn., IX, pl. lxiv, fig. 1, 1814.

Cathartes aura ILLIGER, Prodromus, 283, 1811. — BONAPARTE, Ann. N. Y. Lyc. Nat. Hist., II, 23, 1828. — AUDUBON, Orn. Biog., II, 296, pl. clii, 1835. — BONAPARTE, Geog. and Comp. List, I, 1838. — D'ORBIGNY, Voy. dans l'Amer. Merid., IV, iii, 38, 1844. — CASSIN, Proc. Phil. Acad. Nat. Sci., 1849, 159. — BONAPARTE, Consp. Gen. Av., I, 9, 1850.

Vultur jota MOLINA, Saggio sul stor. nat. del Chile, 1782.

Cathartes ruficollis SPIX, Av. Spec. Novæ, 2, 1824.

Vultur jota MOLINA, Sagg. sul stor. nat. del Chile, 235, 1782. — GMELIN, Syst. Nat., I, 347, 1788.

Cathartes jota BONAPARTE, Consp. Gen. Av., I, 9, 1850. — CASSIN, U. S. Nav. Astr. Exp., II. 172, 1855.

Cathartes septentrionalis PR. MAXIMILIAN, Reise in das Nord-Amer., I, 162, 1839.

? *Cathartes Burrovianus* CASSIN, Proc. Phil. Acad. Nat. Sciences, 1843, 212. — ? CASSIN, Baird's Birds of N. Am., 6, 1858.

Abundant. Collect in large companies about the dead alligators so numerous in the St. John's River.

Both this species and the following (*Carthartes atratus*) paid us frequent visits at our camps at Enterprise and Hawkinsville, and whenever we left them they did not fail to gather up and devour the carcasses of the birds and mammals thrown away by us after skinning. We found them, in fact, rather troublesome neighbors, since on more than one occasion they proceeded, in our absence, to investigate the character of the specimens we had left in the sun to dry, and in a manner so unsatisfactory to ourselves that one of the party was frequently obliged to stay in camp to protect them while the others were away collecting.

Both this and the following species were represented as breeding late in the season, and as frequenting the palmetto swamps as well as some of the islands above Enterprise for this purpose.

The synonymy here given of the present and following species indicates clearly the confusion which several continental European authors have introduced through their descriptions of these species, to which attention has been previously called by Mr. Cassin.* While a *Vultur* (or *Cathartes*) *aura* has been described by most authors who have written of the two species in question, the name *aura* has been applied sometimes to the one and

* Proc. Phil. Acad. Nat Sci., 1849, 159.

sometimes to the other, but when given to the true *aura* of Linné, Vieillot, and Wilson, the *atratus* of Bartram and Wilson has been cited as a synonyme, and the true *atratus* described under a new name. The name *jota* has likewise been repeatedly applied to both species by different authors, and in some cases even by the same author, as has been also the name *brasiliensis*. The description given by Linné in the twelfth edition of his Systema Naturæ, under *V. aura*, clearly refers to the *V. aura* of Wilson, of which the *V. jota* of Molina and Gmelin are synonymes; although some of Linné's synonymes may refer to the *C. atratus* of modern writers. Bonaparte, however, in both his Synopsis of the Birds of the United States and in his Geographical and Comparative List, strangely applied the name *jota* to the *atratus* of Wilson, in which he was for a time followed by other writers. By those who have regarded the South American representatives of *C. aura* as distinct from its North American ones, the name *jota* has latterly been applied to the supposed distinct South American representative of the supposed true or northern *C. aura*.

The distinctions between the so-called *C. jota* and *C. aura* seem, judging from the published accounts, to be by no means clear. Mr. Cassin, in his report on the birds of Lieutenant Gilliss's Expedition, says the *C. jota* "is apparently, or so far as can be ascertained from prepared specimens, a more slender bird, *and longer in all its measurements*. The last character is particularly applicable to its wings." * In his Illustrations of the birds of California and Texas, published the following year, he reverses this statement, and says: "The South American species [*C. jota*] *is the smaller*," and "is the more slender in all its members"; and adds: "All the specimens that we have seen have been of a more uniform clear black color." Having myself examined numerous specimens, both in Brazil and in Florida, I find the difference in the average exceedingly slight, and nearly as stated by Mr. Cassin in his later work; that is, the Brazilian are slightly smaller, and have the plumage appreciably darker.

Bonaparte, in his Conspectus, gives the *jota* of Molina as being simply smaller and with a shorter tail than *aura* of Linné. The differences are indeed very slight; they are, moreover, strictly in accordance with the well-known general laws of variation between specimens of the same species from northern and southern localities, and by no means indicate a diversity of species. Because formerly not known to occur in some of the West India Islands, it was at one time supposed by some that the habitats of the two supposed species did not meet, or that there was a region in Central and Northern South America where neither existed. As I have elsewhere stated,† this is a mistake, both this species and the *C. atratus* ranging from

* U. S. Naval Astronomical Expedition, Vol. II, p. 173, 1855.

† Memoirs Bost. Soc. Nat. Hist., Vol. I, p. 500, 1868.

the middle and northern portions of the United States nearly to the southern extremity of South America; the *C. aura* also extending as much beyond the southern limit of the *C. atratus* in South America as it does to the north of it in North America.

The *Cathartes Burrovianus* of Cassin, described in 1843, from a single specimen from Mexico, is referred by Bonaparte, in his Conspectus, to *C. jota*, or to what I regard as the typical form of *C. aura*, and evidently with good reason. It differs from *C. aura* only in being smaller. I am therefore disposed to regard it as based on an unusually small specimen of that species. Though Dr. Gambel supposed he had seen it with the other species in Lower California, but two specimens seem to have been known to Mr. Cassin, one of which was from an unknown locality.

Measurements of Florida Specimens of CARTHARTES AURA.

M.C.Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5143	——	♂	Jacksonville	Jan. 25, '69	J. A. Allen	27.50	72.50	22.50	11.10
5180	——	♂	Hibernia	Feb. 1, '69	"	27.50	72.00	22.00	11.75
5187	——	♂	"		"	——	——	21.00	12.00
10746	2541	♀	Dummitt's.	Mar. 11, '69	C. J. Maynard	26.50	68.00	21.00	11.00
——	2603	♀	"	Mar. 11, '69	"	——	68.00	20.00	10.50
——	2433	♀	"	Mar. 10' '69	"	27.50	72.00	21.75	11.25

80.* **Cathartes atratus** *Swainson.* BLACK VULTURE.

? *Vultur brasiliensis* aut *mexicanus* RAY, Synop. Meth. Avium, 10, 1713.

Vultur atratus BARTRAM, Travels, 289, 1791.

Cathartes atratus SWAINSON, Faun. Bor. Am., II, 6, 1831. — AUDUBON, Synopsis, 3, 1839. — BONAPARTE, Consp. Gen. Av., I, 9, 1850. — CASSIN, Illust. Birds Cal., Texas, etc., 58, 1854. — CASSIN, Gilliss's U. S. Nav. Astr. Exp., II, 173, 1855.

Vultur jota WILSON, Am. Orn., IX, 104, pl. lxxv, fig. 2, 1814. (Not of Molina; not of Gmelin.)

Cathartes jota BONAPARTE, Ann. N. Y. Lyc. Nat. Hist., II. — AUDUBON, Orn. Biog., II, 33, 1835. — BONAPARTE, Geog. and Comp. List, I, 1838.

Vultur urubu VIEILLOT, Ois. Am. Sept., I, 53, pl. ii, 1807.

Cathartes urubu LESSON, Voy. autour du Monde, 614. — D'ORBIGNY, Voy. dans l'Amer. Merid., 1844.

Cathartes aura SPIX, Av. Spec. Novæ, 2, 1824.

Cathartes brasiliensis BONAP., Consp. Gen. Av., I, 9, 1850.

Abundant. On the whole, probably about as numerous as the preceding, but the two species occur in different proportions at different localities, and at different times at the same locality. None were seen about Jacksonville during the two weeks I spent there in January, and none were met with for some distance up the river. Above Lake

George it was generally common, and sometimes outnumbered the other species, as it did often at Hawkinsville during my stay there. The younger birds appear to be generally not so highly colored as the fully mature, nor to have the naked skin of the head and neck so rugose and corrunculated as the older. The differences in these respects are very considerable between individuals of the same flock.

A comparison of Florida specimens with Brazilian ones shows that the latter are slightly smaller than the former; in color or other general features they do not appear to differ. Most writers have regarded the South American as identical with the North American, but Mr. Cassin,* apparently on the authority of Bonaparte,† says the South American bird "is the *Vultur brasiliensis* Ray," and that "it is considerably smaller, and otherwise quite distinct." But he only refers definitely to the difference in size. The year preceding the publication of these remarks, however, he gives *C. atratus* as inhabiting Chili.‡ In speaking of the Chili specimen, he says: "A single specimen in mature plumage and excellent condition is exactly identical in size and other characters with the common species [*C. atratus*] of the southern parts of North America." He adds: "It is the only specimen presenting this similarity that we have ever seen from South America, and is larger and in other respects different from the allied *Cathartes brasiliensis*, which is an inhabitant also of that division of this continent." *C. atratus*, he says, is "not abundant in Chili, though represented to be occasionally met with in the interior"; these larger individuals referred to being doubtless the birds that inhabit the more elevated districts. Whatever Mr. Cassin's *Cathartes brasiliensis* may prove to be, it remains unquestionable that the *C. atratus* is a general inhabitant of South America, and that Bonaparte's *brasiliensis* is merely the southern type of this species. The exact parallelism of its range on the two continents as compared with that of *C. aura* has already been alluded to.

The Painted or Sacred Vulture ("*Vultur sacra*"), § an apocryphal species described by Bartram ‖ as inhabiting Florida, demands in this connection a passing notice. Though not identified by any succeeding author (by some, however, it has been referred to the king vulture, *Sarcorham-*

* Illust. Birds of Cal. and Texas, p. 58, 1856.

† Conspectus Generum Avium, Tom I. p 9, 1850

‡ U. S. Naval Astronomical Expedition, Vol. II, p. 173, 1855.

§ Travels in Florida, etc., p. 150, 1790.

‖ *Vultur sacra* Bartram, Travels, pp. 150, 289, 1791. — Vieillot. — Nuttall, Man. Orn. I, 42.

Sarcorhamphus sacer Cassin, Illust. Birds of Cal. and Texas, 59, 1856.

See also Bonaparte, Conspectus Gen. Av., I, 9.

phus papa), Bartram's account of it leads one to infer that he found it quite abundant. His description of it is given with satisfactory detail. He says it is " near the size of the turkey-buzzard, but his wings are much shorter, and consequently he falls greatly below that admirable bird in sail. I shall call this bird the painted vulture. The bill is long and straight almost to the point, where it is hooked, or bent suddenly down, and sharp; the head and neck bare of feathers nearly down to the stomach, where the feathers begin to cover the skin, and soon become long and of a soft texture, forming a ruff or tippet, in which the bird, by contracting his neck, can hide that as well as his head; the bare skin on the neck appears loose and wrinkled, which is of a deep bright yellow color, intermixed with coral red; the hinder part of the neck is nearly covered with short, stiff hair; and the skin of this part of the neck is of a dun-purple color, gradually becoming red as it approaches the yellow of the sides and fore part. The crown of the head is red; there are lobed lappets of a reddish orange color, which lay on the base of the upper mandible. But what is singular, a large portion of the stomach hangs down on the breast of the bird, in the likeness of a sack or half wallet, and seems to be a duplicature of the craw, which is naked and of a reddish flesh color; this is partly concealed by the feathers of the breast, unless when it is loaded with food (which is commonly, I believe, roasted reptiles), and then it appears prominent. The plumage of the bird is generally white or cream color, except the quill feathers of the wings, and two or three rows of the coverts, which are of a beautiful dark brown; the tail, which is large and white, is tipped with this dark brown or black; the legs and feet of a clear white; the eye is encircled with a gold-colored iris; the pupil black.

" The Creeks or Muscogulgees," he continues, " construct their royal standard of the tail feathers of this bird, which is called by a name signifying the eagle's tail; this they carry with them when they go to battle, but then it is painted with a zone of red within the brown tips, and in peaceable negotiations it is displayed new, clean, and white; this standard is held most sacred by them on all occasions, and is constructed and ornamented with great ingenuity. These birds seldom appear but when the deserts are set on fire (which happens almost every day throughout the year in some part or other, by the Indians, for the purpose of rousing up game, as also by the lightning), when they are seen at a distance soaring on the wing, gathering from every quarter, and gradually approaching the burnt plains, when they alight upon the ground yet smoking with hot embers; they gather up the roasted serpents, frogs, and lizards, filling their sacks with them. At this time a person may shoot them with pleasure, they not being willing to quit the feast, and indeed seem to brave all danger."

Mr. Cassin * refers the species described as above by Bartram to the genus *Sarcorhamphus* (*S. sacer* Cassin = *Vultur sacra* Bartram), believing it to be a valid species, and remarks that its identification "may be considered as one of the most important services to be performed in North American ornithology." It is related, Mr. Cassin continues, "to the king vulture (*S. papa*), but that species has a black tail, and in case of mistake or misprint in Bartram's description, it may be presumed, at any rate, to relate to an occurrence of that species within the United States.† There is no more interesting nor more singular problem in North American ornithology." Two years later, in Baird's Birds of North America, Mr. Cassin again refers to the subject, and says that "recent information renders it probable that this [*Vultur sacra* Bartram], or a species different from the vultures just described [*Cathartes aura*, *C. atratus*, *C. Burrovianus*], is found about Lake Okechobee in Southern Florida, where it is called king buzzard. The verification of this statement by actual specimens would be one of the most important discoveries yet to be made in North American ornithology."

Although the description of Bartram's "*Vultur sacra*" accords more nearly with the *Sarcoramphus papa* than with any other known species, I cannot avoid the conclusion that it is in the main a *purely mythical species*, notwithstanding the high reputation for veracity generally accorded to Mr. Bartram. I mainly so regard it for the reason that Florida has of late been too often traversed by naturalists, *and especially all the parts visited by Bartram*, for a bird of so striking an appearance, and so numerous as Bartram represented his *V. sacra* to be, to remain undiscovered if such a species exists there. While it nearly accords with the *S. papa* in size and general color, it is most radically different from this species, in the color of the tail, and in having a "large portion of the stomach hanging down on the breast, in the likeness of a sack or half-wallet." In the latter feature it is structurally widely different from any known American bird. It is mentioned as though it was an abundant species on, at least, the upper portion of the St. John's River, inasmuch as he speaks of large flights of them. As to the feathers of its tail being used by the Creek Indians for a royal standard, and to which feathers they give a "name signifying an eagle's tail," it seems to me more probable that they were really feathers of the white-headed eagle (*Haliaëtus leucocephalus*), since it is well known that the tail feathers of that bird are very generally used for this and similar purposes by the Indian tribes of this continent, whereas the tail feathers of so foul a bird as the vulture must in all

* Illustr. of Birds of Cuba and Texas, p. 59.

† The *S. papa*, a Central and South American species, appears to have not yet been seen north of Mexico.

probability be too ill scented to suit even the unfastidious taste of an Indian. As to Mr. Cassin's supposition that the word *white* in the description of the tail should perhaps read *black*, the context wholly forbids its probability. If thus changed the passage referred to would read, "the tail which is rather large and *black*, is tipped with this *dark brown or black!*" which makes simply an absurdity. Besides this, the tail is again mentioned in the following paragraph as being painted by the Indians, when used in their war standards, etc., "with a zone of red within the brown tips," and afterwards as being "displayed new, clean, and *white*." As to the information referred to by Mr. Cassin as having been received by him respecting a "king buzzard" existing in Southern Florida, it may be remarked that this is the name by which the caracara eagle (*Polyborus tharus* Cassin) is commonly known in Florida, and which is undoubtedly the bird of which, under the name of "king buzzard," Mr. Cassin had heard.

On the whole, it seems evident that Bartram's account of the *Vultur sacra* is a confused mixture either of pure fiction and truth, with the former largely in preponderance, or of the characters of several different species. The description would seem to have been mainly drawn from an example of *Sarcoramphus papa* that he may have somewhere met with, but with which he combined certain features of this or other species which he had only observed at a distance, and that he thus misjudged their exact character (as in respect to the strange external food-pouch) or else added them solely on popular, fabulous rumors. The flights of these birds, which he observed assembling over recently burned districts, I think must refer to the *Polyborus tharus*, which is well known to have this habit, while the tail feathers he speaks of as used by the Indians in their councils were more probably either those of the *Haliaëtus leucocephalus* or *Polyborus tharus* than of any species of vulture, since a white-tailed American vulture, I believe, is a bird thus far unknown. If the "*V. sacra*," then, is to be regarded as anything else than a myth, it should in all probability be identified with the *S. papa*, as already stated, and as was done by Bonaparte in his Conspectus.

FALCONIDÆ.

81 † **Falco peregrinus** *Linné*. DUCK HAWK.

Falco peregrinus GMELIN, Syst. Nat. I, 272, 1788. — WILSON, Am. Orn., IX, 120, 1814. — BONAPARTE, Journ. Phil. Acad. Nat. Sci., 1st Ser., I, 342, 1824. — AUDUBON, Orn. Biog., I, 85, 1832; V, 365, pl. xvi. — NUTTALL, Man. Orn., I, 53, 1832.

Falco anatum BONAPARTE, Geog. and Comp. List, I, 1838. — CASSIN, Illust. Birds Cal. and Texas, 86, 1853. — CASSIN, Baird's Birds of N. Am., 7, 1858. — ALLEN, Proc. Essex Inst., IV, 153, 1865.

Falco nigriceps Cassin, Illust. Birds of Cal., 87, 1853. — Cassin, Baird's Birds of N. Am., 1858.

"One instance, St. Augustine, February, 1868." *Boardman.* Mr. Maynard found it rather common near Dummitt's, where he observed its peculiar manner of capturing the ducks. Also well known to occur in winter in Cuba and other of the West India Islands.

In 1838, Bonaparte, in his "Geographical and Comparative List," gave to the American peregrine or duck hawk the name *Falco anatum*. Previous to this time all writers had considered it, and it seems to me justly, as identical with the European peregrine, or *F. peregrinus*, — an opinion still held by many eminent ornithologists. Until about this date the peregrine falcon was believed to have a nearly cosmopolitan distribution, but since then the Australian and other supposed species have been separated from it on grounds that it now seems should be reconsidered. Among these supposed species is the *Falco nigriceps* of Cassin, first described in 1858, from specimens received from California and Chili. These first specimens were smaller, with the rufous color of the under parts in the young of a stronger tint than in the so-called *F. anatum*, they more resembling the African, Australian, and especially the Indian type of *F. peregrinus*. Specimens since obtained from farther north, however, fully equal those from Eastern North America, and the slight differences found to really exist between them seem to be by no means of specific value.

Formerly a difference in breeding habits was supposed to obtain between the American and European peregrines, the American peregrine being for a long time believed to breed in trees, whilst the European was well known to nest on cliffs. Recently, however, the American bird has been repeatedly found nesting in similar situations, but never yet in trees.*

82.† Falco columbarius *Linné*. Pigeon Hawk.

Falco columbarius Wilson and subsequent American writers generally.

Falco æsalon Swainson, Faun. Bor. Am., II, 35, pl. xxv, 1831. — Nuttall, Man. Orn., I, 60, 1832.

Falco temerarius Audubon, Orn. Biog., I, 381, pl. lxxv, 1832.

"Frequent." *Boardman.*

* For an account of the breeding habits and nesting-places of the American bird in the Atlantic States, see the author's papers in Proc. Essex Inst., Vol. IV, pp. 153 - 161, and American Naturalist, Vol. III, p. 514. The past summer (1870) its eggs have been received by Mr. C. W. Bennett from Vermont. Prof. S. S. Haldeman was not only the first naturalist who made known the fact of its breeding on cliffs, but of its breeding in the United States. See Proc. Phil. Acad. Nat. Sci., Vol. I, p. 54, July, 1841.

Many of the earlier ornithological writers regarded, as is well known, a considerable proportion of the rapacious birds of North America as identical with species inhabiting the Old World. More accurate comparisons of specimens from the two continents, however, eventually revealed appreciable differences between them, and one after another of those of the American continent were regarded as specifically distinct from their Old World relatives; and now there is not one of the diurnal species that has not been separated by one author or another. The owls of the two continents, with two exceptions, have also been similarly separated. While in many of these cases there are appreciable differences that seem more or less constant, in the majority of instances there appears to be no just cause for the separation. Especially is this the case in respect to *Falco peregrinus* (as already observed), *Falco candicans*, *Archibuteo lagopus*, *Aquila chrysaëtos*, *Pandion haliaëtus*, *Otus vulgaris*, *Brachyotus palustris*, *Nyctale Tengmalmi*, and *Strix flammea*, in all of which species the American birds have been specifically separated from the European. *Buteo borealis*, *Astur atricapillus*, and *Falco columbarius* present stages of plumage that are scarcely distinguishable from certain stages of respectively *Falco æsalon*, *Buteo vulgaris*, and *Astur palumbarius*, and it is hence not strange that each of these European species have been described by many good authorities as occurring in the northern parts of North America. Certain styles of plumage presented by *Falco columbarius*, especially at northwestern localities, so strongly resemble common phases of *F. æsalon*, that one is readily puzzled to know whether to recognize the latter as also inhabiting North America, or whether, since these types imperceptibly grade into the so-called typical *F. columbarius*, all should not be regarded as forming a single species, since they differ essentially only in coloration, and never very widely. The specimens of *F. æsalon* before me (all immature) mainly differ from average specimens of *F. columbarius* of corresponding age in being less ferrugineous, the style of coloring being the same in both.

83.* **Falco sparverius** *Linné*. Sparrow Hawk.

Falco sparverius Linné, Syst. Nat., 128, 1766; and of subsequent writers generally.
Falco dominicensis Gmelin, Syst. Nat., I, 285, 1788.
Falco gracilis Swainson, Lardner's Cab. Cyc., 281, 1838.
Falco cinnamominus Swainson, Ibid., 281.
Falco isabellinus Swainson, Ibid., 281.
Falco sparveroides Vigors, Zoöl. Journ., III, 436, 1827.

Abundant. Breeds in March. As has been previously pointed out, though not observed by all writers, the sexes differ greatly in color, the adult females being banded transversely above, much as the young birds are.

Florida specimens are considerably smaller than New England ones, the former being intermediate in size between the latter and the West Indian and South American representatives of this species, which have been regarded as distinct species, and to which various names have been applied by different writers. Audubon observes that he found this species in the Southern States, and more especially in Florida, so much smaller than the northern birds that he was at first inclined to consider them specifically distinct, but finally felt sure they were the same. The colors, as usual in other species, are generally brighter in the more southern examples. Wide variations in the color of the plumage in this species have been long recognized, but, as Mr. Cassin has remarked, "they do not appear to be constant, nor peculiar to any locality." *

84 * **Accipiter fuscus** *Bonaparte.* SHARP-SHINNED HAWK.

Falco fuscus GMELIN, Syst. Nat., I, 280, 1788.
Accipiter fuscus BONAPARTE, Geog. and Comp. List, 5, 1838.
Astur fuscus AUDUBON, Syn., 18, 1839.
Falco dubius GMELIN, Syst. Nat., I, 281, 1788.
Falco velox WILSON, Am. Orn., V, 116, 1812.
Falco pennsylvanicus WILSON, Ibid., VI, 13, 1812.
Accipiter striatus VIEILLOT, Ois. Am. Sept., I, 42, 1807.
Accipiter fringilloides VIGORS, Zoöl. Journ., III, 434, 1827.
Accipiter pennsylvanicus RICH. & SWAIN., Faun. Bor. Am., II, 44, 1831.
Nisus Malfini LESSON, Traité d'Ornithol., I, 58, 1831.

Common. I was unable, however, to obtain specimens.

In this species, as in the hawks generally, but more especially in the group to which the present species belongs, there are wide variations in color and size, not only with age and sex, but independently of either. One of the most interesting features in the specimens before me, in respect to these variations, is the much brighter color of the several western and southwestern examples in the collection of the Museum, as compared with New England ones. In one from Cheltenham, Missouri, the color of the lower parts is nearly uniformly red; the transverse dark lines, which in adult eastern specimens usually occupy half the exposed surface of the feathers, and often more, being in this specimen almost obsolete. The tibial feathers are especially bright, while the tints are livelier throughout the plumage. Other specimens from Fort Steilacoom, received from the Smithsonian Institution, present nearly the same appearance. Although the western representatives of the present species yet await some enter-

* Illust. Birds of California and Texas, etc., p. 93.

prising divisionist to give them a distinctive name, they are interesting as indicating a rufous western race, corresponding with the *Accipiter mexicanus* form of the *A. Cooperi*, the *Falco nigripes* form of the *F. peregrinus*, the *Archibuteo ferrugineus* form of the *A. lagopus*, and the western rufous forms of *Buteo borealis* and *Circus hudsonius*.*

Although the *Accipiter fuscus* has always been regarded as closely related to the *Accipiter nisus* of the Old World, they have, with one or two exceptions,† been regarded by all authors as specifically distinct. The only distinctive difference between them, however, has been properly regarded as a slight difference in color, which difference is merely one of tint, the style of coloration being precisely the same in both. In the Museum of Comparative Zoölogy are several specimens of *A. nisus* from Germany and Switzerland, which represent both the adult and the young. The brown transverse markings on the lower plumage of the mature *A. nisus* are rather darker and broader than in most New England specimens of *A. fuscus;* but they still more closely resemble average New England specimens than the latter do any specimens of *A. fuscus* I have seen from the western parts of the United States. The western form of *A. fuscus*, as already stated, is brighter colored or more rufous than the eastern, while the eastern differs similarly from the European, the latter being much duller colored than the eastern form of *A. fuscus.* So closely, however, does one of the immature examples of *A. nisus* resemble several of the immature New England specimens of *A. fuscus*, that, if their origin was unknown, few ornithologists would probably consider them as otherwise than specifically identical; especially if placed in a large series composed of both eastern and western specimens of the *A. fuscus.* As I have previously remarked, the transverse markings on the lower plumage in the adult stage are broader and more regular and distinct in *A. nisus* than in *A. fuscus.* This, it may be added, is also the only difference observable between *A. palumbarius* and *A. atricapillus.* Such a coincidence of parallel differences between *Accipiter nisus* and *Accipiter fuscus*, and between *Astur palumbarius* and *A. atricapillus*, is a point of much interest to any

* For further remarks concerning the rufous western races of several of these species see the following pages.

† Prince Max zu Wied, in his "Beiträge zur Naturgeschichte von Brasilien," referred a hawk, probably of this species, of which he obtained a single immature male in Eastern Brazil, to the *Falco nisus* Linn. Respecting this species he observes: "Der Vogel dieser Beschreibung scheint von dem europäischen Sperber nicht abzuweichen. . . . . Dieser Sperber ist mir selbst in Braslien nicht vorgekommen, allein *Freireifs* hat mir ein Exemplar davon mitgetheilt, welches in der Gegend von *Camamú*, südlich von *Bahia*, geschossen wurde. So viel ich von diesem einzigen Individuo urtheilan kann, so scheint es identisch mit dem europäichen *Nisus* zu seyn; denn sowohl seine Verhaltnisse als sein Gefieder stimmen vollkommen überein." Vol. III, pp. 112, 114.

one interested in geographical color variations in animals; the more so, perhaps, from the two latter species being so intimately related as to have been at one time generally regarded as identical. Yet so far as can be judged from a limited number of specimens, *Astur palumbarius* differs more from *A. atricapillus* than *Accipiter nisus* does from *Accipiter fuscus*, which latter species have never been considered as identical.*

85.* **Accipiter Cooperi** *Cassin.* Cooper's Hawk.

Falco Cooperi Bonap., Am. Orn., II, 1, 1828.
Falco Stanleyi Audubon, Orn. Biog., I, 186, 1831 (young).
Astur Cooperi Bonap., Geog. and Comp. List, 5, 1838.
Accipiter Cooperi Cassin, Illust. Birds of Cal., etc., 96, 1854.
Accipiter mexicanus Swain., Faun. Bor. Am., II, 45, 1831. — Cassin, Baird's Birds N. Am., 17, 1858.
Accipiter Gundlachi Lawr., Ann. N. Y. Lyc. Nat. Hist., VII, 252, 1860.

Common.

Mr. Cassin has very properly indicated the variations in size and color commonly seen in this species in the following remarks: "Rather a difficult species to the ornithologists, on account of the great variations in its colors, and in size also. It is, in fact, unusual to find two alike in a dozen specimens." † Its relationship to *Accipiter fuscus* is of course well understood, it holding a similar relationship to that species that *Picus villosus* does to *Picus pubescens*, the essential difference between them being mainly a great difference in size. But the specific distinctness of *A. mexicanus* from it is not so clear. Being without authentic specimens of *A. mexicanus*, and having only New England specimens of *A. Cooperi*, ‡ I cannot speak confidently respecting the character and affinities of the former. According to authors, however, it seems to differ from *A. Cooperi* in being somewhat smaller and more highly colored. It is also more southern in its distribution. Hence these variations, being in accordance with the general laws of geographical variation in size and color, do not necessarily

* In this connection I wish to cite some interesting variations in color presented by Massachusetts and Maine specimens of *Astur atricapillus*. Ordinarily this species has each feather below centred with a longitudinal dark shaft-line, with several transverse broader but somewhat irregular dark ashy-brown bars on a lighter ground. Some specimens, however, as one from Maine, have the transverse bars so narrow and broken that the lower surface presents a nearly uniform, minutely mottled appearance. Another specimen (from Springfield, Mass.) represents the opposite extreme, it having the transverse bars broad, regular, and quite far apart, so that its resemblance to average specimens of *Astur palumbarius* is very close. The color in this specimen is much darker throughout than is usual in this species.

† Illustrations of Birds of California, etc., p. 93, 1854.

‡ Since the above was written, specimens have been received at the Museum from Jalapa, Mexico, from Sn. R. Montes-de-Oca.

imply a diversity of species; they only accord with what would naturally be expected to occur if *A. mexicanus* and *A. Cooperi* were known to constitute but a single species.*

Accipiter Cooperi, as is well known, is not only closely allied in general structure to *Buteo lineatus*, but also in style of coloration in both the immature and adult stages. It may be fair, then, to test the value of the distinctive characters assigned to *A. mexicanus* by what obtains as geographical variations in size and color in *Buteo lineatus* Of this species I have fortunately a large number of specimens, including some from localities similarly separated to those whence *A. Cooperi* and *A. mexicanus* respectively come. In the case of *Buteo lineatus* there is no reason whatever to doubt that my specimens from Florida and New England are specifically identical. Yet the Florida specimens are very much brighter colored, and very much smaller; the difference in the length of the folded wing between two males, one of which is from Maine and the other from Florida, being *two and one half inches*, with corresponding differences in general measurements. This is relatively much greater than the difference in size between specimens of the so-called *A. Cooperi* and *A. mexicanus*. Similar variations in color and size to those between *A. Cooperi* and *A. mexicanus* also occur between northeastern and southwestern specimens of *A. fuscus*, the latter, as already noted under *A. fuscus*, being smaller than the former, and very much brighter colored; the difference in color between specimens from Maine and the State of Missouri being greater than is represented to occur between *A. Cooperi* and *A. mexicanus*, and of a parallel kind. In accordance with the evident inference that may be drawn from these facts, I provisionally include *A. mexicanus* among the synonymes of *A. Cooperi*. The *A. Gundlachi* of Cuba differs from the southern *A. Cooperi* in the way southern birds usually differ from the northern ones of the same species, that is, in being smaller and brighter colored, and in having the dark transverse bars on the under plumage increased in breadth at the expense of the alternating light ones.

86.* **Buteo borealis** *Bonaparte*. RED-TAILED HAWK.

Falco borealis GMELIN, Syst. Nat., I, 266, 1788. — WILSON, Am. Orn., VI, 75, pl. lii, fig. 2, 1812. — RICH. & SWAIN., Faun. Bor. Am. II, 50, 1831. — AUDUBON, Orn. Biog., I, 265, pl. II, 1832.

Buteo borealis BONAPARTE, Geog. and Comp. List, 3, 1838. — GOSSE, Birds of Jamaica, II, 1847. — LEMBEYE, Av. de la Isla de Cuba, 18, 1850. — CASSIN, Syn. N. A. Birds (Illust. Birds Cal. and Texas, etc.), 97, 1854. — BREWER, N. Am. Oölogy, 21, 1857. — CASSIN, Baird's Birds of N. Am., 25, 1858. — BRYANT, Proc. Bost. Soc. Nat. Hist., VIII, 109, 1861. — ALLEN, Memoirs Bost. Soc. Nat. Hist., I, 499, 1868.

* Bonaparte indeed long since cited *A. mexicanus* Swainson as a synonyme of *A. Cooperi*.

Falco leverianus GMELIN, Syst. Nat., I, 266, 1788. — WILSON, Am. Orn., VI, 78, pl. lii, 1812.

Falco jamaicensis GMELIN, Syst. Nat., I, 266, 1788.

Falco aquilinus BARTRAM, Travels, 290, 1791.

Falco Harlani AUDUBON, Am. Orn., I, 441, 1831.

Accipiter ruficaudus VIEILLOT, Ois. Am. Sept., I, 47, 1807.

Buteo ferrugineicaudus VIEILLOT, Ibid., 32.

Buteo fulvus VIEILLOT, Nouv. Dict. Hist. Nat., IV, 472, 1816.

Buteo americanus VIEILLOT, Ibid., 477.

Buteo vulgaris RICH. & SWAIN., Faun. Bor. Am., II, 47, pl. xxvii, 1831. — AUDUBON, Syn., 5, 1839.

Buteo buteoides NUTTALL, Man. Orn., I, 100, 1832.

Falco buteo AUDUBON, Orn. Biog., IV, 108, 1838.

Buteo Swainsoni BONAPARTE, Geog. and Comp. List, 3, 1838. — CASSIN, Illust. Birds Cal. Texas, etc., 98, 1854. — BREWER, N. Am. Oölogy, 24, 1857. — COOPER & BAIRD, Orn. Cal., I, 476, 1870.

Buteo Harlani BONAPARTE, Geog. and Comp. List, 3, 1838. — CASSIN, Illust. Birds Cal., Texas, etc., 101, 1854. — CASSIN, Baird's Birds N. Am., 14. — ? BRYANT, Proc. Bost Soc. Nat. Hist., VIII, 115, 1861. — COOPER & BAIRD, Orn. Cal., I, 473.

Buteo montanus NUTTALL, Man. Orn. I (2d ed.), 112, 1840. — CASSIN, Baird's Birds N. Am., 26. — COUES, Proc. Phil. Acad. Nat. Sci., 1866, 43. — COOPER & BAIRD, Orn. Cal., I, 469.

Buteo Bairdii HOY., Proc. Phil. Acad. Nat. Sci., 1853, 451. — CASSIN, Baird's Birds N. Am., 21.

Buteo insignatus CASSIN, Birds Cal. and Texas, 102, pl. xxi, 1854. —CASSIN, Baird's Birds N. Am., 23. — COOPER & BAIRD, Orn. Cal., I, 474.

Buteo calurus CASSIN, Proc. Phil. Acad. Nat. Sci., 1855, 281. — CASSIN, Baird's Birds N. Am., 22. — COOPER & BAIRD, Orn. Cal., I, 471.

Not apparently uncommon, but far less numerous than the next species.

The *Buteoninæ*, or the group of hawks to which the present and the two following species belong, is well known to embrace species more variable in color than those of any other section of the *Falconidæ*, although all the members of this family are more or less remarkable for individual and other variations of plumage. The present species, however, admitting for it the wide variation in this respect herein claimed, scarcely equals the immense range of color variation well known to characterize its near ally and representative in the Old World, the *Buteo vulgaris* auct. (*Falco buteo* Linné). Six specimens of this species in the Museum from Switzerland and Germany, received under the name *Falco buteo*, vary in color as follows: One is almost entirely black; another is nearly black throughout, with obscure narrow transverse bands of ferruginous on the crissum and abdomen; another is mainly black, but varied below with bars of pale rufous and blotches of white; a fourth is also nearly black, or very dark brown, but considerably more relieved with white below than the last; a fifth is mainly white below, with longitudinal stripes of dark brown, and so nearly resembles a common immature stage of the American *Buteo borealis* that if placed together the most discriminating observer could not tell which specimen was the European or which the American one. The sixth is very light colored throughout, with only a few dusky longitudinal spots on the breast. This specimen is also not readily distinguishable from certain common phases of *B. borealis*. Another specimen of *B. vulgaris*, in the La Fresnaye collection in the Museum of the Boston Society of Natural History, is still lighter than this, being nearly uniform whitish below, and very light colored, almost white above. The latter specimen and the first-mentioned dark specimen present as great differences in color as two specimens of one species can well be conceived to exhibit.

The variations presented by the American *B. borealis* have already been fully detailed by the late Dr. Henry Bryant, in his "Remarks on the Variations of the Plumage of *Buteo borealis* auct., and *B. Harlani* Aud." * He observes that the variation in plumage of the species of *Buteo*, common in the Atlantic States, "are so slight that it is not to be wondered at that the first specimens from other parts of the country, presenting as they did such extraordinary variations in color, should have been described as distinct species. At present, however," he continues, "the number of specimens known is so large that on careful examination it seems to me necessary to adopt one of two conclusions, namely, either to increase the number of species indefinitely, or to reduce them to a much smaller number than are now supposed to exist. As the European buzzard, *Buteo vulgaris*, is well known to present the greatest variety of color, it seems to me more reasonable to adopt the last conclusion." † With the above opinions and remarks I in the main agree, but do not regard the variations presented by the *Buteo borealis* as by any means slight, even in the Atlantic States. Although instances of such excessive variation as are seen in the Central and Pacific States are apparently more rare in the Atlantic States, speci-

* Proc. Bost. Soc. Nat. Hist., Vol. VIII, p. 107, 1861.

† In respect to the variety of color in the *B. vulgaris*, Dr. Bryant makes the following quotation from Naumann's Natural History of the Birds of Germany (Vol. I, p. 347): "In the coloring of the feathers of the bird there prevails a most extraordinary difference, and one which is not often seen in other birds of prey. From the darkest uniform blackish-brown to the purest white, we find all the shades, and also both colors mixed and spotted, in such various ways that the countless transitions cannot be described; this difference is independent of age and sex." Many other European writers, it may be added, have made similar remarks in respect to its astonishing range of variation in color.

mens from Massachusetts now before me vary as follows: Some are nearly unspotted beneath, others, sparsely spotted, have the spots mainly restricted to the pectoral region; others, in which the spots are equally few, have them mainly accumulated on the abdominal region, while still others have them so numerous as to occupy the greater part of the lower surface, sometimes covering the abdomen in an almost unbroken broad band. They likewise vary in the amount of rufous tint in the plumage, in some it being very slight, while others are as strongly ferruginous as any of the California specimens (*B. montanus*) I have yet seen.

The *Buteo borealis* was first described by Latham in his "General Synopsis of Birds,"* in 1781, under the names of "cream-colored buzzard" and "American buzzard," the first name being applied to the young,† and the last to the adult stage of plumage. Pennant, in his "Arctic Zoölogy,"‡ also redescribes the immature bird as the "Leverian falcon," and to these several descriptions of Latham and Pennant, Gmelin, in his "Systema Naturæ," gave respectively the names *Falco jamaicensis*, *F. borealis*, and *F. Leverianus*. Some twenty years later the *Buteo borealis* was redescribed by Vieillot, in his "Histoire des Oiseaux de l'Amerique Septentrionale," as *Accipiter ruficaudus* and *Buteo ferrugineicaudus*, both names evidently referring to the mature or nearly mature bird; and again ten years later, in the "Nouveau Dictionnaire d'Histoire Naturelle," as *Buteo fulvus* and *B. americanus*. Audubon, in 1831, figured and described a specimen from Louisiana under the name *Falco Harlani*. This specimen, which was finally sent to the British Museum, has been regarded by Mr. G. R. Gray and others as only a very dark-colored example of *B. borealis*.§ In the same year Richardson and Swainson reported the *Buteo vulgaris*, in their "Fauna Boreali-Americana," as an inhabitant of North America, and of which they figure an immature male. As already remarked, the *B. vulgaris*, in certain stages of plumage, is not readily distinguishable from *B. borealis*, so that the mistake is a perfectly excusable one. This form, however, was for some time currently received by most writers as a species distinct from the *B. borealis*, and to which the name *B. Swainsoni* was given by Bonaparte. In 1832 Nuttall described a *Buteo buteoides*, which, though referred by Bonaparte to *B. lineatus*, and by Cassin to *B. pennsylvanicus*, seems to me to much more nearly agree with *B. borealis*. In 1840 the same writer described a *B. montanus*, which was subsequently

* Vol. I, pp. 49, 50, Nos. 30 and 31.

† Latham observes: "This beautiful specimen was sent to me from Jamaica by an intelligent friend and a good naturalist, who did not hint the least of its being a variety of the common buzzard [*Buteo vulgaris* auct.], which I should have otherwise suspected."

‡ Vol. II, p. 206. No. 101.

§ Cat. of Birds in British Museum.

referred by Bonaparte to his *B. Swainsoni*, but has since been recognized as a valid species by Cassin and other recent American authors. In 1853 Mr. P. R. Hoy described a *Buteo Bairdii*, and in 1854 Mr. Cassin added *B. insignatus*, in 1855 *B. calurus* and *B. oxypterus*, and in 1856 *B. Cooperi*. In 1861 Dr. Bryant made a revision of the group, then containing eight or nine species currently recognized by American ornithologists, and reduced the number of species to two, one of which he called *B. borealis* and the other *B. Harlani;* which latter, however, is not the *Harlani* of Cassin, and probably not the *Harlani* of Audubon.

Dr. Bryant, in the above-cited paper, describes in detail the leading variations presented by our red-tailed hawks, and the character of the numerous supposed species of this group that had then been recently described. He having at his command all the specimens of this group contained in the Museums of the Philadelphia Academy and the Smithsonian Institution, including the original types of Mr. Cassin's species, as well as the specimens in his own collection, his opportunities for investigating the subject were unusually favorable. The results of his examination of this material may be briefly stated in his own words. He says that after examining this large series of specimens, he found " that of all those belonging to *Harlani*, *insignatus*, *Swainsoni*, *Bairdii*, *oxypterus*, *borealis*, *montanus*, *calurus*, and perhaps *Cooperi*," could be " easily reduced to two very distinct groups, each of which is distinguishable by definite external characters, and in which the variations of plumage, though apparently so great, if the extremes of the series only are taken into consideration, can, it seems to me, be arranged in a series, in which the connecting of the different members may be readily traced. Of these two groups, or rather species, one, which should be called *B. borealis*, as the first described, consists of that species, *montanus*, *calurus*, *Harlani*, and probably *Cooperi*, and is characterized by a very muscular body,* stronger and longer bill, longer and more powerful tarsi, and a more rounded wing, the fourth quill generally the longest, the fifth little if any shorter than the third, and the first always longer than the eighth. The other species, to which *Harlani ?*, *insignatus*, *Swainsoni*, *Bairdii*, and *oxypterus* belong, is distinguishable by a more slender body, shorter and weaker tarsi, and a more pointed wing, the third quill generally the longest, the fifth considerably shorter than the third, and the first always longer than the eighth."

" On making the examinations which led to the conclusion above stated," he further observes, " I was struck by the small number of specimens in which all the feathers were equally developed, and when they were so, the variation in the proportions of the primaries, and of the wings and

* Stuffed skins evidently afford rather unsatisfactory data for the determination of the relative muscularity of the body.

tail, in specimens of the same variety, was much greater than I had expected to find"; a result which indicates how unreliable such features are as specific distinctions, as I have already repeatedly remarked, and also, of course, the fallacy of the belief so generally held, that they are really among the most trustworthy.* After detailing some of the instances of variation in this respect in the specimens in question, he makes the following remarks on variations in other characters: "The variation in the number and shape of the tarsal scales is considerable, as is usual in birds of this order. The development of the festoon of the lower edge of the upper mandible, *one of the principal generic characters,*† varies particularly in *B. montanus*, the series of which is the largest, *from a sharp, almost tooth-like process to an entire absence of it.*"‡

Dr. Bryant described each of the so-called species of the later authors, and generally several authentic specimens of each, showing the variations of color they present. *B. montanus* is the so-called "western red-tail," replacing, it is supposed, *B. borealis* in the western half of the continent, and differing from it in the main only in being more rufous or brighter colored. Some specimens, however, from California and Oregon are not appreciably different from others from the Atlantic States, and among them is one received at the Museum from the Smithsonian Institution labelled "*B. borealis.*" *B. calurus* differs from these in being much darker throughout, and especially below. It has, however, according to Dr. Bryant, two varieties, one of which is much darker than the other. The *B. Harlani* of Cassin, Dr. Bryant says, "resembles very closely the dark variety of *calurus*, with the exception of its tail, which resembles *montanus*." Respecting the single known specimen of *B. Cooperi*, he says there is nothing in its coloration "that would make the supposition of its being a variety of *montanus* improbable." The tail presents the greatest dissimilarity and "has very much the appearance it would have in a semi-adult of this species, if the color were partially washed out." The tarsus, though long, he says is not longer than in some specimens of *montanus*; but observes that the scutellation of the tarsus presents certain peculiarities not seen in the others, there being but *two* rows of lateral scales instead of *three or four*, and two more than the usual number of transverse scales.§ In respect to these supposed species he then observes: "After

* See the remarks on this point in Part III.

† The italicizing is my own.

‡ On differences of this kind the several supposed species of the *B. borealis* group have been arranged *in different subgenera!*

§ Since writing the above I have learned from Professor Baird that he is inclined to regard this specimen as "only an *Archibuteo ferrugineus* without feathers on the tarsus; at any rate, hardly a species." It is hence omitted in Cooper and Baird's "Ornithology of California," which has just appeared.

carefully examining the birds described above, I do not see, if *Buteo borealis*, *montanus*, and *calurus* are to be considered distinct species, that we can avoid increasing the number by separating from *montanus* two species, — one the dark Steilacoom variety, and the other that from Cape St. Lucas (which, by the way, is the most distinct variety that I have seen); from *calurus*, one species, the ferruginous variety from Fort Tejon; and adding to this group one species based on the adult *Harlani* of the Academy [*Harlani* of Cassin, not of Audubon], making in all seven species of this group. I have not included in this list the young *Harlani* of the Academy, which differs as much from the adult as from any other specimen of this group; or *Cooperi*," etc. After next describing in detail *Buteo Harloni* (*B. Harlani* of Bryant, not *B. Harlani* of Cassin, nor of Audubon), and its several varieties, which form the "species" *B. insignatus*, *Swainsoni*, and *oxypterus* of Cassin and the *B. Bairdii* of Hoy and Cassin, *with several varieties under each*, some of which he clearly shows are connecting links to others, Dr. Bryant concludes his paper with the following summary: "Taking color, therefore as a sufficient ground for specific distinction, we find that we have in the red-tailed group seven species, and in the other nine, which, with the young *Harlani* of the Academy, *Cooperi*, *fuliginosus*, *albonotatus*, *lineatus*, *elegans*, and *pennsylvanicus*, give a total of twenty-three species of this genus which are found in the United States."

But Dr. Bryant by no means admits color in this group to be a specific characteristic, and, as I have already remarked, in reducing the number of species of the red-tailed hawks to two, he takes general size and the proportions of the primary quills of the wing as the basis of distinction. He has accordingly given a table of comparative measurements and proportions of the two species, in which he has arranged, as he says and doubtless supposed, the larger specimens under *B. borealis*, and the smaller under *B. Harlani*. Size and the proportions of the quills, however, it seems to me, are equally arbitrary grounds for their separation, as an examination of his tables and descriptions evidently proves. It happens that in the first, or *B. borealis* series, nearly all the specimens are fully adult, as indicated by the tail being uniformly red, with a subterminal black band, — a stage of plumage which characterizes only adult individuals. In the second, or *B. Harlani* series, but one specimen (which does not appear in the table of measurements), is described that is not evidently somewhat immature, while the greater part of them are quite so.* Respecting the so-called *Buteo Bairdii*, of which numerous specimens have been reported, some from quite eastern localities, Dr. Bryant

* They have at least the tail numerously banded, as all immature *B. borealis* do have, and their general diagnosis is that of immature birds.

remarks that a single specimen in the Museum of the Philadelphia Academy is the only one he had seen "presenting the least appearance of adult plumage." In regard to the size of the specimens of the two series, adopting the length of the folded wing as the basis of comparison, — the best element in the tables available for comparison, in this respect, — the smallest and the largest specimens, measuring 370 and 438 millimetres respectively, occur in the *B. borealis* series. The average length of wing in twenty specimens of *B. borealis* is 409 millimetres, and in fourteen * specimens of *B. Harlani* Bryant, 405. The difference of 4 millimetres is an amount too trivial to be of account, as the addition of a single specimen to either series might reverse the difference. Hence the impression possessed by Dr. Bryant of an average difference in size between the two series was evidently an erroneous one.

There hence remains but a single difference, that in respect to the form of the wing, or the relative length of the primaries, by which to distinguish the two series, which is at best one of doubtful value. My present opinion is that all the so-called species of these two groups may be safely referred to the original *Buteo borealis*, except the *B. oxypterus*, which should be undoubtedly referred to the *B. pennsylvanicus*.

87.* **Buteo lineatus** *Jardine.* RED-SHOULDERED HAWK.

Falco lineatus GMELIN, Syst. Nat., I, 268, 1788. — WILSON, Am. Orn., VI, 86, pl. liii, fig. 3, 1812. — AUDUBON, Orn Biog., I, 296, pl. lvi, 1832.

Buteo lineatus JARDINE, Am. Orn., I, 1832. — AUDUBON, Syn., 7, 1839. — CASSIN, Baird's Birds N. Am., 28, 1858. — VERRILL, Proc. Essex Institute, III, 141, 1862.

Falco hyemalis GMELIN, Syst. Nat., I, 274, 1788. — WILSON, Am. Orn., IV, 73, 1812. — NUTTALL, Man. Orn., I, 106, 1832. — AUDUBON, Orn. Biog., V, pl. lxxi, 1832 (young).

Buteo Cooperi ALLEN, Amer. Nat., III, 518, 1869.

Circus hyemalis BONAP., Journ. Phil. Acad. Nat. Sci., 1st Ser., III, 305, 1824.

Buteo elegans CASSIN, Proc. Phil. Acad. Nat. Sci., 1855, 281. — CASSIN, Baird's Birds of N. Am 28, 1858.

Very abundant. By far the most numerous species of the family.

Generally smaller and much brighter colored than New England specimens. The dark line along the shaft of the feathers below, especially on the throat and breast, is very distinct, in this respect and in the bright colors greatly resembling the so-called *Buteo elegans* of Cassin. *B. elegans*,

* The *B oxypterus*, referred to the *B. Harlani* by Bryant, is very much smaller than any other specimen in either series, and it seems to me has decided affinities, in its small size as in other features, with the *B. pennsylvanicus*, as stated by Mr. Cassin, and it is hence excluded in my computation of the average length of the folded wing.

however, has been generally considered as the western representative of *B. lineatus*, but it differs from the latter only in being brighter colored, or in having the ferruginous of the under parts more intense. In this it resembles the western representatives of the *B. borealis*, *Archibuteo lagopus*, *Accipiter fuscus*, *Circus cyaneus*, *Falco peregrinus*, and other species of this family, the western specimens of which are ordinarily more rufous than the eastern, though in only a part of them have the eastern and western races as yet been separated as distinct species.

The considerable difference in size between specimens of this species from New England and Florida has led to the supposition that the former may be specifically distinct from the latter, or at least that they form well-marked varieties.* The following measurements, however, show that specimens occur in Florida, in winter at least, nearly as large as average-sized New England specimens. But these may have been merely winter visitors, since two of the three specimens taken in February on the St. John's River are larger than any of the others, all of which were taken later in the season. Those taken by Dr. Würdemann at Cape Florida and Indian Key are also smaller than those from the St. John's River.

Measurements of Florida Specimens of BUTEO LINEATUS.

M. C. Z. No	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing	Tail.
5223	♂	Volusia	Feb. 12, '69	J. A. Allen	22.25	41.50	13.00	7.75
5224	♂	"	Feb. 12, '69	"	20.00	39.50	12 25	7 50
5276	♂	Blue Springs	Feb. 21, '69	"	20.00	42.00	13.00	8.40
5310	♂	Enterprise	Mar. 1, '69	"	17.65	39.15	12.25	8.00
5331	♂	"	Mar 1, '69	"	17.75	40.25	12.30	7.50
5398	♂	Hawkinsville	Mar. 15, '69	"	18.00	40.50	12.85	7.75
10744	♀	Jacksonville	Dec. 31, '68	C. J. Maynard	19 20	41.50	12.60	8.50
10743	♀	"	Jan. 11, '69	"	19.20	40.05	12.60	8.50
6899	♀	Cape Florida	Apr. 5, '58	G. Würdemann	15.75	35.75	11.00	6 75
8630†	♂	Indian Key	Aug. 31, '57	"	17.50	37.00	11.20	—
6898	—	"	Aug. 1, '58	"	15.50	34.50	10.50	7.15
8629†	—	"	Nov. 10, '57	"	17.75	40.00	12.00	—
8631†	♂	"	Aug. 31, '57	"	17.50	37.00	11.10	—

88.† **Buteo pennsylvanicus** *Bonaparte.* BROAD-WINGED HAWK.

Falco pennsylvanicus WILSON, Am. Orn., VI, 22, 1812.

Buteo pennsylvanicus BONAP., Geog. and Comp. List, 3, 1838. — AUDUBON, Syn., 6, 1839. — CASSIN, Illust. Birds Cal., Texas, etc., 100, 1854. — CASSIN, Baird's Birds N. Am., 29, 1858.

Falco latissimus WILSON, Am. Orn., VII, 22, 1812. (Later published copies.)‡

* See Prof. A. E. Verrill in Proc. Essex Institute, Vol. III, p. 141, 1862.

† Smithson. Inst., No. (Copied from Cassin in Baird's Birds of North America, p. 28.)

‡ Concerning the names *F. pennsylvanicus* and *F. latissimus* given by Wilson to this species, see Mr. Cassin's remarks, Illust. Birds of Cal., Texas, etc., p. 101.

Falco Wilsoni Bonap., Journ. Phil. Acad. Nat. Sci., III, 348, 1824.
Sparvius platypterus Vieillot, Encyc. Meth., III, 1273, 1823.
Buteo oxypterus Cassin, Proc. Phil. Acad. Nat. Sci., 282, 1855. — Cassin, Baird's Birds of N. Am., 31, 1858.

"Common." — *Boardman.* Audubon, however, gives it as rare south of the Middle States, and it is not mentioned by Dr. Coues in his list of the birds of South Carolina. There is, however, a specimen in the Museun of Comparative Zoölogy labelled as having been taken in Florida.

As previously observed, it appears to me that the *Buteo oxypterus* of Cassin, described from a single specimen taken at Fort Filmore, New Mexico, corresponds more nearly with the young of this species than with any known stage or form of *B. borealis.*

89.* Circus cyaneus *Boie.* Marsh Hawk.

Falco cyaneus Linn., Syst. Nat. I, 126, 1766. — Bonap., Am. Orn., II, 30. — Audubon, Orn. Biog., IV, 396, pl. ccclvi, 1838.
Circus cyaneus Boie, Isis, 1822, 549. — Audubon, Synop., 19, 1839. — G. R. Gray, Gen. of Birds, I, p. 32. — Ibid., Cat. Brit. Birds, 17, 1863.
Falco hudsonius Linn., Syst. Nat., I, 128, 1766.
Falco uliginosus Gmelin, Syst. Nat., I, 278, 1788.
Circus uliginosus Vieillot, Ois. Am. Sept., I, 37, 1807.
Falco uliginosus Wilson, Am. Orn., VI, 67, pl. li, fig. 2, 1812.
Buteo (Circus) cyaneus ? var. ? *americanus,* Rich. and Swain., Faun. Bor. Am., II, 55, pl. xxix, 1831.
Circus hudsonius Vieillot, Ois. Am. Sept., I, 36, 1807. — Cassin, Ill. Birds Cal., Texas, etc., 108, 1854. — Brewer, N. Am. Oöl., 42, 1857. — Cassin, Baird's Birds N. Am., 38, 1858.
Circus variegatus Vieillot, Ois. Am. Sept., I, 37, 1807.
Strigiceps uliginosus Bonap., Geog. and Comp. List, 5, 1838.
Strigiceps pygargus Bonap., Ibid.

Common about the savannas.

The present species has been considered by most writers as identical with the *C. cyaneus* of the Old World. It was first separated as a distinct species by Bonaparte in 1838, in his Geographical and Comparative List. Mr. Cassin also regarding it as distinct, this opinion has been generally adopted by recent American ornithologists. They seem to be, however, quite identical.

The same variation in color between eastern and western specimens is seen in this species that has been noted in others of this family, the young western ones especially being much brighter colored than the eastern.

The great variation in plumage attending differences of age and sex in this species have given rise to numerous synonymes, of which twenty are cited by Mr. G. R. Gray in his Catalogue of British Birds.

90.* **Pandion haliaëtus** *Cuvier*. Fish Hawk. Osprey.

Falco haliaëtus Linné, Faun. Suec., 22, 1735. — Wilson, Am. Orn., V. 13, pl. xxxvii, 1812. — Bonap., Ann. N. Y. Lyc. N. Hist., II, 26, 1828. — Audubon, Orn. Biog., I, 415, pl. lxxxi, 1832. — Nuttall, Man. Am. Orn., I, 78, 1832.

Pandion haliaëtus Cuv., Règ. An., I, 316, 1817. — Audubon, Synopsis, 12, 1839. — G. R. Gray, Cat. Brit. Birds, 5, 1863. — Pelzeln, Ornithol. Brasiliens, 4, 1868. — Heuglin, Ornithol. Nordost-Afrika's, 54, 1869.

Falco arundinaceus Gmelin, Syst. Nat. I, 263, 1788.

Falco carolinensis Gmelin, Ibid.

Pandion carolinensis Bonap., Geog. and Comp. List, 3, 1838. — Cassin, Illust. Birds Cal., Texas, etc., 112, 1854. — Brewer, N. Am. Oöl., 53, 1857. — Cassin, Baird's Birds N. Am., 44, 1858.

Falco cayanensis Gmelin, Syst. Nat. I, 268, 1788.

Aquila piscatrix Vieillot, Ois. Am. Sept., I, 29, 1807.

Pandion fluviatilis Savig., Descr. de l'Egypte, Hist. Nat., I, 96, 1809.

Pandion americanus Vieillot, Gal. des Ois., I, 33, 1828.

Pandion indicus Hodgson, Journ. As. Soc. Bengal, 366, 1837.

Abundant everywhere; especially so around the lakes of the Upper St. John's. Commences nesting in January. At Lake Monroe I counted six nests from a single point of view. Their nests were also frequent all along the river. They generally selecting a dead tree in which to build, and often those situated in cleared fields, their nests were conspicuous objects, and could usually be seen from a long distance. Even these harmless birds do not fail to attract the fire of the numerous sportsmen who visit this region in winter, some of whom are ignorant enough to believe that when shooting them they are killing "bald eagles."

Gmelin, in his "Systema Naturæ," described the present species not only as *Falco haliaëtus*, but he gave to it also the names *F. carolinensis*, *F. arundinaceus*, and *F. cayanensis*, apparently indicating under them, however, what he regarded as varieties rather than as distinct species. For many years, however, the common fish-hawk was generally regarded as having an almost cosmopolitan distribution. Bonaparte spoke of it in 1826, in his Synopsis of the Birds of the United States,* as follows: "Inhabits almost every part of the globe near waters; much more common in North America than in Europe." Ten or twelve years later, however, he seems to

* Annals of the N. Y. Lyceum of Nat. History, Vol. II, p. 26.

have changed this opinion, since in his Geographical and Comparative List of the Birds of Europe and the United States (to which paper, by the way, we are indebted for the separation of eight of the American species of raptorial birds previously considered identical with the European,* embracing all thus separated up to the present time, except two †) he calls the American fish-hawk *Pandion carolinensis*, and gives its habitat as "America generally." Other authors have since separated the West Indian and South American as a third, the Asiatic as a fourth, and the Australian as still another. The numerous specimens in the Museum show that considerable variation obtains in color, size, and proportions among those recognized by authors as belonging to the *P. carolinensis*, much greater differences in color — the main ground on which they have been separated from the European — being presented among the Florida specimens alone than obtains in the average between Brazilian and New England specimens, or American and European. Generally the feathers of the breast are each centred with a broad longitudinal spot or stripe of brown, which spots sometimes cover the greater part of the breast; but they are often simply narrow lines, and are not unfrequently entirely wanting. Sometimes these spots are uniform dark-brown, at others suffused or broadly margined with ferruginous, and are occasionally altogether of the latter color. In reuniting the American fish-hawk with the osprey of the Old World, I but adopt the view always held by a large number of ornithologists, though by all American authors they have for the last fifteen years been commonly considered as distinct.

Measurements of Florida Specimens of PANDION HALIAËTUS.

M. C. Z. No.	Sex	Locality.	Date.	Collector.	Length	Alar Extent.	Wing.	Tail.
5268	♂	Blue Springs	Feb. 21, '69	J. A. Allen	21.75	64.00	19.50	8.75
5298	♂	Enterprise	Feb. 25, '69	"	24.25	68.75	20.25	10.00
5330	♂	"	Mar. 4, '69	"	22.00	63.50	19.25	9.00
5356	♂	Hawkinsville	Mar. 10, '69	"	20.75	63.00	18.75	8.60
5355	♀	"	Mar. 10, '69	"	——	——	20.25	7.80
——	♀	"	Mar. 15, '69	"	24.25	66.25	19.00	——
——	♀	"	Mar. 15, '69	"	23.50	68.50	20.25	——

91. **Haliaëtus leucocephalus** *Savigny*. WHITE-HEADED EAGLE.

Falco leucocephalus GMELIN, Syst. Nat., I, 255, 1788. — WILSON, Am. Orn., IV, 89, pl. xxxvi, 1811. — AUDUBON, Orn. Biog., I, 58, pl. xxi, 1832; II, 160; V, 354, pl. cxxvi.

* *Pandion carolinensis* from *P. haliaëtus*, *Butætes* (or *Archibuteo* as now called) *Sancti-Johannis* from *B. lagopus*; *Buteo Swainsoni* from *B. vulgaris*; *Falco anatum* from *F. peregrinus*; *Astur atricapillus* from *A. palumbarius*; *Strigiceps* (*Circus* as now called) *uliginosus* from *S. pygargus* (*cyaneus* auct.); *Otus americanus* (or "*Wilsonianus*") from *O. vulgaris*; *Nyctale Richardsoni* from *N. Tengmalmi*; *Strix pratincola* from *S. flammea*.

† *Aquila chrysaëtos*, *Brachyotus palustris*.

Haliaëtus leucocephalus SAVIGNY. — BONAPARTE, Geog. and Comp. List, 3, 1838. — AUDUBON, Synop., 10, 1839. — CASSIN, Illust. Birds Cal., Texas, etc., 111, 1854. — CASSIN, Baird's Birds N. Am., 43, 1858.

Falco ossifragus WILSON, Am. Orn., VII, 16, pl. lv, 1813.

Aquila (Haliaëtus) leucocephalus RICH. & SWAIN., Faun. Bor. Am., II, 15, 1832.

Falco Washingtoni AUDUBON, Orn. Biog., I, 58, pl. xi, 1831 (plate published 1827).

Falco Washingtoniana AUDUBON, Loudon's Mag. N. Hist., I, 115, 1828.

Haliaëtus Washingtoni AUDUBON, Synop., 10, 1839. — CASSIN, Baird's Birds N. Am., 42, 1859.

Common. Breeds in January and later. Very abundant on the Upper St. John's, and especially at Lake Monroe. Saw them repeatedly dive and catch their own fish, though usually depending upon robbing the fish-hawks for them. The same fact has been reported by other observers,* although it was formerly supposed they never caught any fish themselves.

The large specimen of an eagle taken by Audubon in Kentucky, and figured and described by him as *Falco Washingtoni*, seems not to have been preserved; it is at least not known to be extant, and appears to have never been examined by any other naturalist. Audubon states that he altogether saw not "more than eight or nine" specimens, † and deemed it very rare. He does not appear, however, to have really examined but the one figured. Numerous local observers have reported it as occasional at different localities, and Mr. Cassin has doubtfully referred specimens to it taken in New Jersey. Nuttall believed the young were more or less common near Boston every winter, and considered it as "probably also indigenous to northern Europe, but confounded with the ordinary sea eagle." ‡ But, as remarked by Mr. Cassin, "No specimen precisely corresponding to Mr. Audubon's bird has been obtained since its discovery, and it has latterly been looked upon by naturalists, especially in Europe, as an unusually large specimen of the white-headed eagle." § The important point of difference between Audubon's bird and other representatives of this genus consists in the scutellation of the tarsi, which are covered in front with broad transverse scales, instead of with a great number of small irregular ones, as in other sea eagles. This, Mr. Cassin

* WILLIAM COUPER, Massachusetts Ploughman, August 26, 1870. CHARLES H. NAUMAN, on his own authority and that of Professor S. S. Haldeman, Ibid., September 24, 1870. HENRY REEKS, Can. Nat., Vol. V, No. 1, p. 43, 1870.

† Loudon's Mag. of Nat. Hist., Vol. I, p. 116, April, 1828.

‡ Mem. Am. Acad., 1st Ser., Vol. I, p. 92, 1831.

§ Illustrations of Birds of California, Texas, etc., p. 111, 1854.

has observed, is "a character quite unusual in any rapacious bird," * though I do not see that in this respect it differs essentially from *Buteo lineatus*, *B. pennsylvanicus*, or *Circus cyaneus*, etc. Its other main point of difference from the *H. leucocephalus* is its greater size. Audubon described his bird as measuring "3 feet 7 inches in length," "10 feet 2 inches" in extent of wings, and the folded wing "32 inches." In this series of measurements there is no discrepancy between the different dimensions given — the proportions being exactly the same as in *H. leucocephalus* — that might lead to the suspicion of a typographical or other accidental error, as some writers have suggested there may be in respect to the alar extent. It is, then, either a valid species or a large individual of *H. leucocephalus*, or a large immature *H. albicilla*. Since known specimens of *H. leucocephalus* sometimes nearly approach the supposed *H. Washingtoni* in size, it seems not unreasonable, on the whole, to regard it as really a remarkably large example of *H. leucocephalus* in immature plumage. Audubon describes his bird as breeding within the United States, and hence it is hardly probable it could have been the arctic *H. albicilla*, which has never, so far as known to me, been observed so far south at any season of the year. In reference to its fishing habits, supposed by Audubon to distinctively characterize it, it is now well known that the *H. leucocephalus* will occasionally capture its own fish, instead of depending wholly upon robbing the fish-hawk for them.

Mr. Cassin further observes, † respecting the *H. Washingtoni*. that he believes it to be more nearly related to his *H. pelagica*, which he describes as "the largest of eagles," than to any other. In the same connection he judiciously remarks respecting the numerous apocryphal species of eagles on record as follows: "But there is no end to the accounts of strange eagles given by travellers and naturalists. Some of them may have reference to peculiar species which have in later times escaped attention, but the probability is they more frequently allude to accidental varieties, or that the authors describe from such reports as they had heard at second hand, or fell into error from insufficient personal observation." Many of these reports he alludes to in detail, including the reference by Captain Cook ‡ to a "black eagle" with a "white breast" seen by him at Kay's Island, on the northwest coast of America. A specimen of the *H. leucocephalus* in peculiar (probably albinic) plumage in the Museum of Comparative Zoölogy, taken in Eastern Massachusetts, seems to indicate that the eagle of Captain Cook may have been but an unusual stage of coloration of the common white-headed eagle. The Massachusetts specimen

* Baird's Birds of N. America, p. 42.

† Illust. Birds of Cal. and Texas, p. 36.

‡ Cook's Voyages, II, 352, 1784.

above referred to has the general color of the under parts white, with most of the feathers centred with spots of dusky brown of varying size, but with a nearly uniform dusky brown patch on the middle of the breast. The interscapulars are also mainly white, and the general plumage above, except the wings, more or less varied with the same color. The tail below is mottled with irregularly shaped specks and spots of dusky or black on a white ground, and above with white on a nearly black ground, and tipped with dusky. The appearance of the under side of the bird at a distance would be nearly uniform whitish.

Mr. Cassin having stated repeatedly that his *Haliaëtus pelagicus* (the *Aquila pelagica* Pallas *) is the largest and most powerful of all known eagles,† I was greatly surpised, in critically studying his description, to find it in every respect evidently far inferior in size to Audubon's bird of Washington, and scarcely equalling the *H. albicilla*, as described by himself; the folded wing, in fact, of his *H. pelagicus* is *one inch shorter* than the folded wing of his *H. albicilla*, *four inches shorter* than the wing of the *H. Washingtoni*, as measured by Audubon, and *two inches shorter* than the folded wing of several different Massachusetts specimens of *H. leucocephalus!* The length he gives of "a skin from Behring's Strait" — the only specimen, he says, at that time in America — is "about 3 feet 8 inches," which exceeds by *one inch only* the length of Audubon's *H. Washingtoni*, as given by Audubon, doubtless from the fresh bird. But the length given by Mr. Cassin for his *H. pelagicus* is evidently too great, as, taken in connection with the other measurements of the same specimen given by Cassin, if correct, it would indicate a bird of the most anomalous and improbable proportions. Mr. Cassin's erroneous conception of the gigantic size of his bird was doubtless formed from the length of his specimen, which if a flat or unfilled skin, as it probably was, must have measured several inches more than the natural length of the bird.‡ While I do not in the least question the sincerity of Mr. Cassin's belief in the large size of his bird, I have felt it proper to call the attention of future investiga-

* Zoographia Rosso-Asiatica, I, p. 343.

† "The bird which is the subject of our present article is the largest and most powerful of the eagles." — *Illust. Birds Cal. and Texas*, p. 32, first paragraph. "Even the famous condor of the Andes, the largest of vultures, scarcely exceeds him in size," etc. *Ibid.*, p. 32, third paragraph. "The largest of all known eagles, and nearly related to *H. Washingtoni* (Aud.). It differs from the latter as described by Audubon in being generally *larger*," etc. *Ibid.*, p. 38. "It is the largest of the eagles and appears to be related to the species immediately succeeding" (*H. Washingtoni*). *Ibid.*, p. 110.

‡ Pallas says of his *Aquila pelagica*, which Cassin makes identical with his *H. pelagicus:* "Caudæ 1′ 1″; longitudo alæ compositæ 1″, 11″, 2‴"; which dimensions do not indicate a bird larger than avarage examples of ***H. leucocephalus*** or ***H. albicilla***.

tors of this group to this evident discrepancy of proportions in Mr. Cassin's description. An error in Mr. Cassin's figure also demands attention, which is doubtless due to an inadvertency of the artist. This consists in the scales on the front of the tarsus being arranged as Mr. Cassin says he never saw in any rapacious bird, namely, continued to the toes in broad, *unbroken transverse plates*, nearly as in Audubon's figure of the *H. Washingtoni!*

92.* **Polyborus brasiliensis** *Audubon.* CARACARA EAGLE. "KING BUZZARD."

Milvus brasiliensis RAY, Synop. Method. Av. et Pisc., 17, No. 6, 1713.
Circus brasiliensis BRISSON, Ornithologie, I, 116, No. 31, 1760.
Falco brasiliensis GMELIN, Syst. Nat., I, 262, 1788.
Falco tharus MOLINA, Sagg. sul. Storia Nat. del Chile, 1782.
Polyborus tharus CASSIN, Illust. Birds of Cal. and Texas, 113, 1856. — CASSIN, Baird's Birds N. Am., 45, 1858.
Polyborus vulgaris VIEILLOT, Nouv. Dict., V, 257, 1816. — AUDUBON, Orn. Biog., II, 350, pl. clxi (young).
Polyborus brasiliensis AUDUBON, Synop., 4, 1839. — BONAP., Consp. Gen. Av., 13, 1850.

"Frequent at Enterprise, associating with the vultures." — *Boardman.* The swallow-tailed hawk (*Nauclerus furcatus*) became more or less common early in March. I also saw a specimen of the Mississippi kite (*Ictinia mississippiensis*) at Hawkinsville, March 15th.

STRIGIDÆ.

93. **Bubo virginianus** *Swainson.* GREAT-HORNED OWL.

Strix virginiana GMELIN, Syst. Nat., I, 287, 1788. — WILSON, NUTTALL, AUDUBON.
Strix (Bubo) virginiana SWAINSON, Faun. Bor. Am., II, 82, 1831.
Bubo virginianus BONAPARTE, Geog. and Comp. List, 6, 1838. — AUDUBON, Synop., 29, 1839. — CASSIN, Illust. Birds Cal. and Texas, 177, 1854. — CASSIN, Baird's Birds of N. Am., 1858.
Strix bubo, var. *magellanicus* GMELIN, Syst. Nat., I, 286, 1788
Strix pythaules BARTRAM, Travels, 289, 1791.
Bubo ludovicianus DAUDIN, Traité d'Orn., II, p. 210, 1800.
Bubo pinicola VIEILLOT, Ois. Am. Sept., I, 51, 1807.
Strix (Bubo) arctica SWAINSON, Faun. Bor. Am., II, 86, pl. xxx, 1831.
Bubo sub-arcticus HOY, Proc. Phil. Acad. Nat. Sci., VI, 211, 1852.

Not apparently numerous. Mr. Boardman states that he saw only a single specimen, which was killed at Enterprise. I did not observe it above Lake George, and only heard its notes a few times below. Mr. Maynard gives it as rather common about Jacksonville, and says he frequently observed it elsewhere.

Mr. Cassin has very properly remarked that different specimens of this widely distributed species vary materially in size and color, and states that after having examined a large number of specimens from many localities he believed that they were all of one species. He thought, however, that four leading varieties, which he called *atlanticus*, *pacificus*, *arcticus*, and *magellanicus*, could be distinguished. I am not disposed to regard them, however, as by any means strictly geographical, since specimens have been taken recently in Massachusetts that typically represent each of them.* While there are doubtless more or less well-marked local forms of this species, as of all other widely distributed species, many of the differences on which the different varieties have been based are probably only individual.

94.* Scops asio *Bonaparte.* MOTTLED OWL.

Strix asio LINNÉ, Syst. Nat., I, 132, 1767. — WILSON, Am. Orn., V, 83, pl. xliii, fig. 1, 1812. — AUDUBON, NUTTALL, etc.

Scops asio BONAPARTE, Geog. and Comp. List, 6, 1838. — CASSIN, Illust. Birds Cal. and Texas, 179, 1854. — CASSIN, Baird's Birds N. Am., 51, 1858. — ALLEN, Amer. Nat., II, 327, 1868.

Strix nævia GMELIN, Syst. Nat., 289, 1788. — WILSON, Am. Orn., III, 16, pl. xix, fig. 1, 1812.

Bubo striatus VIEILLOT, Ois. Am. Sept., I, 54, pl. xxi, 1807.

Ephialtes choliba LAWRENCE, Ann. N. Y. Lyc. Nat. Hist., VI, 4, 1854.

Scops McCalli CASSIN, Illust. Birds Cal. and Texas, 180, 1854. — CASSIN, Baird's Birds N. Am., 52, 1858.

Scops Kennicotti ELLIOT, Proc. Phil. Acad. Nat. Sci., 1867, 69. — IBID., Illust. Birds N. Am., pl. xi. — BAIRD, Trans. Chicago Acad. Sci., I, 311, pl. xxvii, 1869.

Specimens were procured by Mr. Maynard, by whom, and also by Mr. Boardman, it is reported as not unfrequent.

The remarkable differences in the color of the plumage this species presents has led many to suppose it embraced two well-marked species, the red stage being recognized as one and the gray or mottled as another. Gmelin described the red stage as *Strix asio* (which is the same as the *Strix asio* of Linné, and the *Scops carolinensis* of Brisson) and the gray stage as *Strix nævia*. Wilson redescribed these different stages as distinct species. Bonaparte was the first to regard them as identical, he believing

* See Part III, p. 189.

the differences in plumage to be the result of age.* The red he believed to be the young bird, and the mottled the adult, which opinion was also entertained by Audubon. During the last thirty years, however, they have been by some authors again regarded as distinct species;† by others‡ the gray were regarded as the adult and the red as the young, while some have held the opinion that the difference in color was sexual. A general survey of the facts, either on record or known to me, show that the young birds are sometimes gray and sometimes red; that red young have sometimes *red* parents and sometimes *gray*; that the female is sometimes red and sometimes gray; and also that both sexes of a mated breeding pair of old birds are sometimes alike in color and sometimes different. Hence the opinion already advanced, § that this variation is dependent upon neither age nor sex, but is simply a case of irregular and somewhat remarkable individual variation of a single species, seems a well-founded one. But these different stages, though usually so different, are not always well marked, so that one is often at a loss to know whether to refer certain specimens to the red series or to the gray. In other words, specimens occur of every intermediate grade between the typically bright red stage and the typically gray stage.

I have already given my reasons for referring the *Scops McCalli* of Cassin to the common *S. asio*, of which it is merely the somewhat smaller southern type. § It is also difficult to perceive wherein the *Scops Kennicotti* Elliot, known thus far from a single specimen, differs essentially from a common phase of *S. asio*.‖

* "Observations on the Nomenclature of Wilson's Ornithology," Journ. Phil. Acad. Nat. Sci., 1st Ser., Vol. III, p. 357, 1824. — "Synopsis of the Birds of the United States," Annals N. Y. Lyc. Nat. Hist., Vol. II, p. 36, 1828.

† Michner, Dr. Ezra, "A few Facts in Relation to the Identity of the Red and Mottled Owls," Journ. Phil. Acad. Nat. Sci., 1st Ser., Vol. VII, p. 53, 1834. — Hoy, Dr. P. R., "Notes on the Ornithology of Wisconsin," Proc. Phil. Acad. Nat. Sci., Vol. VI, p. 306, 1853; Ibid., Transact. Wisconsin Agr. Soc., Vol. II (1852), p. 344, 1853.

‡ Cabot, Dr. S., Jr., "Observations on the Plumage of the Red and Mottled Owls," Journ. Bost. Soc. Nat. Hist., Vol. II, p. 126, 1838.

§ Allen, J. A., "Notes on the Red and Mottled Owls," American Naturalist, Vol. II, p. 327, 1868.

‖ Since the above was written two adult specimens of this species have been received at the Museum from Dallas, Texas, one of which is of the mottled and the other of the red type of plumage. The specimen in mottled plumage, besides being generally darker throughout than northern specimens, has also the dark markings broader and blacker. The specimen in red plumage has the red more intense than it is in specimens of the northern red type. Both the Texas specimens are a little smaller than average New England specimens.

I have seen no specimens as yet from Florida, but from Mr. Cassin having referred a specimen from Indian River, (Fla.,) provisionally to his *Scops McCalli*, they would seem to differ but little from Texas specimens, resembling them, as would be naturally expected, more than northern ones.

95.* **Syrnium nebulosum** *Gray.* BARRED OWL.

Strix nebulosa FORSTER, Trans. London Philos. Soc., LXII, 386, 424, 1772. — WILSON, Am. Orn., IV, 61, pl. xxxiii, fig. 2, 1812. — AUDUBON, Orn. Biog., I, 242, pl. xlvi, 1832.

Syrnium nebulosum GOULD, Birds of Europe, I, pl. xlvi, 1832. — AUDUBON, Synop., 27, 1839. — CASSIN, Illustr. Birds of Cal. and Texas, 184, 1854. — BREWER, N. Am. Oöl., I, 72, 1857. — CASSIN, Baird's Birds N. Am., 56, 1858.

Ulula nebulosa BONAP., Geog. and Comp. List, 7, 1838. — BONAP., Conspect. Gen. Av., I, 53, 1851.

Strix chichictli GMELIN, Syst. Nat., I, 296, 1788.

Strix acclamator BARTRAM, Travels, 289, 1791.

Strix fernandica SHAW, Gen. Zoöl., VII, 263, 1809.

Very abundant. The only species of owl at all common. Their ludicrous notes are heard at night everywhere, and not unfrequently during the day. At night they often startle the traveller by their strange utterances from the trees over his head.

The four Florida specimens of this species before me are several shades darker than New England specimens, one only of a considerable series of the latter being as dark as the lightest-colored Florida example. The Florida specimens are also a little smaller than the northern ones.

Measurements of Florida Specimens of SYRNIUM NEBULOSUM.

M. C. Z. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.
5241	♀	Lake Dexter	Feb. 14, '69	T. Marcy	20.00	45.75	14.00	8.75
5242	♂	"	Feb. 14, '69	"	20.00	46.25	14.00	8.75
5299	—	Enterprise	Feb. 25, '69	"	19.50	45.75	13.00	9.00
——	—	Hawkinsville	Mar. 15, '69	J. A. Allen	19.75	46.00	13.25	—

96.* **Otus brachyotus** *Boie.* SHORT-EARED OWL.

Strix brachyotus GMELIN, Syst. Nat., I, 289, 1788. — FORSTER, Trans. Lond. Phil. Soc., LXII, 384, 1772. — WILSON, Am. Orn., IV, 64, pl. xxxiii, fig. 3, 1812. — BONAP., Ann. N. Y. Lyc. N. Hist., II, 37, 1828. — AUDUBON, Orn. Biog., V, 373, pl. ccccxxxii, 1835. — RICH. & SWAIN., Faun. Bor. Am., I, 75, 1831.

Otus brachyotus BOIE, Isis, 1822, 549. — AUDUBON, Syn., 28, 1839. — CASSIN, Illust. Birds Cal. and Texas, 182, 1854. — G. R. GRAY, Gen. of Birds, I, 40. — IBID., Cat. Brit. Birds, 27, 1863.

Otus palustris BREHM, Vög. Deutschl., I, 124.

Brachyotus palustris BONAP., Geog. and Comp. List, 7, 1838.

Brachyotus Cassini BREWER, Proc. Bost. Soc. Nat. Hist., V, 321, 1856. — BREWER, N. Am. Oöl., I, 68, 1857. — CASSIN, Baird's Birds N. Am., 54, 1858.

"Quite common about marshes." — *Boardman.*

Specimens of this bird from Europe, in the Museum of Comparative Zoölogy, are not appreciably different from others from various parts of the United States. Neither do the habits of the European bird appear to differ from those of the American, as some have supposed. Dr. Richardson described its principal haunts in the Fur Countries as being "dense thickets of young pine-trees or dark entangled willow clumps, where it sits on a low branch, watching assiduously for mice." But it is now well known to more commonly frequent open fields and savannas, situations similar to those the European frequents.

An interesting state of plumage of this owl is exhibited by two pairs taken on Muskeget Island, Massachusetts, about July 1, 1870, by Messrs. C. J. Maynard and William Brewster, in which the color is so light as to almost suggest their being albinos. They are many shades lighter than the specimens of this species are from the interior, and show clearly, when taken in connection with the light race of *Arvicola riparius* (*Arvicola Breweri* Baird), also occurring on this small sandy island, the effect of the combined influence of an absence of shade and the increased light caused by reflection from the light-colored sand. The influence of similar circumstances is seen on a large scale in the birds and mammals of the Colorado desert and the arid peninsula of Lower California, and in less degree on the open arid plains of the middle region of the continent.

The long-eared owl, *Otus vulgaris* Fleming,* may be expected, from its known distribution, to also occur in Florida.

97.* **Strix flammea** *Linné.* Barn Owl.

Strix flammea Linné, Syst. Nat., I, 133, 1767. — Wilson, Nuttall, Audubon (Orn. Biog.), Bonaparte (Synop.).

Strix pratincola Bonap., Geog. and Comp. List, 7, 1838. — Cassin, Brewer, and recent American authors.

Strix americana Audubon, Synop., 25, 1839.

Strix perlata Bonap., Consp. Gen. Av., I, 55, 1850.

Strix furcata Temm., Pl. Col., I, 432.

A specimen was taken by Mr. Thaxter at St. Augustine. Mr.

* *Strix otus* Linné, Faun. Suec., 24, 1761.

Strix otus americana et *mexicana* Gmelin, Syst. Nat., I, 288, 1788.

Strix otus Wilson, Bonap. (Synop.), Nuttall, Audubon (Orn. Biog.).

Otus vulgaris Fleming, British Animals, 60, 1828. — Audubon, Synop., 28, 1839. — G. R. Gray, Gen. Birds, I, 40; Cat. Brit. Birds, 26, 1863.

Otus Wilsonianus Lesson, Traité d'Orn., I, 110, 1831. — Cassin, Brewer, and recent American authors.

Otus americanus Bonap., Geog. and Comp. List, 7, 1838.

Maynard informs me it was said to be common, and that at Dummitt's a hollow tree was shown him in which a pair of these birds had bred for several years. Audubon also speaks of it as being common in Florida.

Respecting the numerous species of late recognized in the *Strix flammea* group of owls, Mr. Cassin has, with great propriety, remarked that naturalists have "established species on very slender characters."

As is well known, different specimens from near the same locality vary considerably in color and size, while specimens from different continents are frequently almost undistinguishable. From the considerable number of specimens I have seen from distant points, as Europe, the United States, South America, Southern Asia, the West Indies, Australia, and South Africa, I see no reason why the *Strix flammea* may not be regarded as having a nearly cosmopolitan distribution, which indeed seems to be the present opinion of several European ornithologists. Nearly the same variations in color appear to occur on each continent, the general color in specimens from near the same locality varying from yellowish rufous to pale fulvous, and the dusky spots from being large and conspicuous to nearly obsolete or entirely wanting.

COLUMBIDÆ.

98.* Chamæpelia passerina *Swainson*. Ground Dove.

Common, especially about cultivated grounds.

99.* Zenædura carolinensis *Bonaparte*. Mourning Dove.

Columba carolinensis Linné, Syst. Nat., I, 286, 1766.— Gmelin, Wilson, Nuttall, Audubon (Orn. Biog.).

Columba marginata Linné, Syst. Nat., I, 286, 1766.

Ectopistes marginellus Woodhouse, Proc. Phil. Acad. Nat. Sci., Vol. VI, 104, 1852.

Zenædura carolinensis Bonaparte, Consp. Gen. Avium, II, 84, 1854.

Zenædura marginellus Bonaparte, Ibid., 85.

Abundant. Among its favorite resorts are the wild orange-groves, where it feeds on the seeds of the decaying fruit. Smaller than at the north, with the metallic tints much brighter and more bronzy.

MELEAGRIDÆ.

100.* Meleagris gallopavo *Linné*. Wild Turkey.

Meleagris gallopavo Linné, Syst. Nat., 268, 1766. — Gmelin, Wilson, Bonaparte, Audubon, Nuttall, Baird, etc.

Meleagris americana Bartram, Travels, 290, 1791.

Meleagris sylvestris Vieill., Nouv. Dict., IX, 447.

Meleagris fera VIEILL., Galérie des Ois., II, 10, pl. x, 1824.

Meleagris mexicana GOULD, Proc. Lond. Zoöl. Soc., 1856, 61. — BAIRD, Birds N. Am., 618, 1858. — COOPER & BAIRD, Orn. Cal., I, 523, 1870.

Gallopavo sylvestris, Novæ Angliæ RAY, Synopsis, 51, 1713. — LECONTE, Proc. Phil. Acad. Nat. Sci., IX, 179, 1857.

Common and even quite numerous in those sections where it is not too much hunted. Mr. Boardman informs me that very fat male birds often weigh twenty-five to twenty-eight pounds, but that the average weight of the males is eighteen to twenty pounds, and of the females six to ten pounds.

THE ORIGIN OF THE DOMESTIC TURKEY.

Although it had been for a long time previously vaguely conjectured that the domestic turkey did not originate from the common wild turkey of North America, it was not until about 1856 that it was fully asserted that such was not its origin. In a paper read before the Zoölogical Society of London, in April, 1856, Mr. John Gould, the well-known English ornithologist, assigned this bird to the list of those domesticated animals whose origin had become involved in obscurity. He refers, however, to the fact of its known introduction into Europe from Mexico about 1524, and to the belief, shared by all naturalists from Linné up to that time, that the domesticated turkey was derived from the wild turkey of North America. He also states that, "on account of the great differences which are met with among our domestic turkeys, and the circumstance that the wild turkeys recently imported from North America not readily associating or pairing with them," he had for some years entertained the opinion that the wild turkey of the United States was not the original of the domestic turkey. He also at this time described a single specimen of a turkey from Mexico as belonging to a species distinct from the wild turkey of the United States, to which he gave the name of *Meleagris mexicana.* It differed, however, but slightly from the northern bird, mainly in having more white on the upper tail coverts. Although he claimed that it was of larger size, his measurements indicate it to be only barely above the average, and considerably smaller than the larger specimens from the Northern States. In considering it as distinct from the common wild turkey, he seems to have been greatly influenced by the locality whence his specimen came; as he states that he hardly thinks it probable that the common turkey, "authors to the contrary, notwithstanding," ranges very far into Mexico, since it is found, he says, along the southern boundary of Canada, which is nearly two thousand miles from Mexico. He deems it unlikely that a bird inhabiting "the cold regions of Canada should also be indigenous to the hotter country of Mexico, whence," he adds, "and not from North America, the turkey was originally introduced into Europe"; thus leaving it to be inferred that, in his opinion, the Mexican bird — his new species — was the ancestor of the domestic turkey. The facts in respect to the distribution of the wild turkey are briefly these: It exists in Canada only in the warmer portions of that country, and thence southward uninterruptedly throughout the table-lands of Mexico.

Dr. Henry Bryant, of Boston, in reviewing Mr. Gould's paper, a few months after its appearance, took exceptions to the views of that gentleman, and in referring to the two principal statements made by Mr. Gould, namely, that the wild and domestic turkeys were structurally different, and refused to breed together, Dr. Bryant thus observes: "How far climate and other influences may have affected the domestic variety in England I do not yet know, but with us neither of these two statements is correct. If it were not for the difference in the plumage it would be impossible in many cases to distinguish the two birds; and even with this aid it is sometimes very difficult to decide with certainty when the specimen is a female..... The wild turkey breeds here with the tame variety quite as readily as could be expected; wherever the wild turkeys are numerous, it is an ordinary occurrence for the tame hen to prefer the wild gobbler to the domestic ones. I have had in my own possession wild hens that bred with the tame gobblers, — a fact much stranger than that of the wild gobbler breeding with the tame hen. But the most satisfactory proof of their specific identity is that the offspring of mixed blood is known to be hardier and more prolific than the domestic variety, — a fact which cannot be reconciled with their specific diversity." *

Dr. Bryant's facts, with those of previous writers, seem amply sufficient to settle the question as to the origin of the domestic turkey; yet a few months later Major John LeConte, who probably at that time had not seen Dr. Bryant's remarks, published a paper entitled "Observations on the Wild Turkey, or *Gallopavo sylvestris* of Ray." † In this paper he took the ground that the tame turkey could not possibly have been derived from the wild turkey of the United States. And, if what he states in support of his opinion as facts were such, they would go far towards rendering his position a tenable one, but in reality they are but baseless, dogmatic assumptions, which not only ran counter to the then generally received opinion, but were squarely opposed to unquestionable evidence already on record. Major LeConte's opinions, notwithstanding

* Proc. Bost. Soc. Nat. Hist., Vol. VI, p. 158, March, 1857.

† Proc. Phil. Acad. Nat. Sci., Vol. IX, p. 179, September, 1857.

that they were based on groundless assumptions, as an investigation of the subject fully proves, have been so generally entertained by subsequent authors, who have accepted his statements without investigating the facts for themselves, that a careful revision of the subject is now required. Major LeConte observes: "Whoever has compared the wild turkey of the United States with the domestic animal of the same genus must have observed that there existed very striking differences between them." While asserting that "these differences do not consist of slight and unimportant particularities, but in radical disagreements, which ought to remain unchangeable under all circumstances, and which form good specific characteristics," his sole point of distinction consists "in the possession by the tame bird of an enormous palear or dewlap," which he affirms, contrary to fact, is not possessed by the wild bird.* He refers also to the conviction that had long existed in his mind, that the two birds — the wild and domestic — "were really distinct species." "More than fifty years ago," he says, "when I first saw a wild turkey, I was led to conclude that one never could have been produced from the other. I have mentioned this to many ornithologists, but no one would take the trouble to investigate the matter [!]," etc. It does not appear, however, that even with him this long-standing conviction had resulted from a thorough investigation of the subject, for he gives no detailed comparison of the two, and many of his statements are not simply erroneous, but diametrically opposed to facts previously well substantiated. He refers to the early introduction of the turkey into Europe, and to the fact that it was found by the first explorers of America in both the wild and domesticated state. He alludes also to Mr. Gould's above-cited paper, remarking respecting it that he was unable to determine whether Mr. Gould's supposed new Mexican species was the same as the *M. gallopavo*, or was the original of the domestic bird. He thought, however, that the Mexican was identical with the common wild bird. He then remarks: "I have before observed that the turkey was found domesticated among the nations of Central America. *Now the bird which we have native among us has never been domesticated. All attempts to conquer its peculiar habits have failed, notwithstanding what has been said and written on the subject to the contrary.* I DEFY ANY ONE TO SHOW A TURKEY, EVEN OF THE FIRST GENERATION, PRODUCED FROM A PAIR HATCHED FROM A WILD HEN.† We have every year in our market offered for sale birds of a very dark color, and in some degree resembling the wild species; but in every instance, by the presence of the palear, the imposition can be detected at

* It is usually, however, either entirely absent in the wild bird, or present only in a rudimentary state.

† The italicizing in this extract is of course my own.

first sight, and the cheat exposed. I have known the eggs found in the woods hatched by a domestic hen, the chickens brought up carefully, and rendered so tame and familiar as to eat out of the hand, and to show considerable pleasure whenever persons with whom they were acquainted approached them. *Yet they never would associate with the domestic turkeys, studiously avoiding their company,* and in little more than a year running off to the woods, and never again returning to the haunts of their infancy. *I know,*" he continues, "*that I shall be contradicted in this statement, and many quotations from authors brought forward against me. I repeat,* contrary to the assertions of many others, THAT NO ONE HAS EVER SUCCEEDED IN DOMESTICATING OUR WILD TURKEY. I speak not only from my own personal observations, but from the undivided testimony of many southern gentlemen. The turkey of our own poultry-yards, which, when young, is difficult to bring forward, it was thought might be obtained of a hardier race by a new domestication ; but every attempt has failed, nor can I find a single well-authenticated case of a mixed breed being obtained." One is certainly at a loss to know what the self-confident Major would call a well-authenticated case of a mixed breed of wild and tame turkeys, since he must have been familiar with Bonaparte's excellent account, derived mainly from notes furnished him by Mr. Audubon, of this bird given in the first volume of his continuation of Wilson's "American Ornithology." In speaking of the mixing of the wild and tame turkeys, this author remarks as follows : "This crossing often occurs in countries where wild and tame turkeys are frequent ; it is well known that they will readily approach each other ; and such is the influence of slavery upon even the turkey, that the robust inhabitant of the forest will drive his degenerate kinsfolk from their own food and from their females, being generally welcomed by the latter and by their owners, who well know the advantage of such a connection. . . . . Eggs of the wild turkey have been frequently taken from their nests and hatched under the tame hen ; the young preserve a portion of their uncivilized nature, and exhibit some knowledge of the difference between themselves and their foster-mother, roosting apart from the tame ones, and in other respects showing the force of hereditary disposition. The domesticated young, reared from the eggs of the wild turkey, are often employed as decoy birds to those in a state of nature." *

Audubon, in his account of the Canada goose, also incidentally refers to the crossing of the wild and tame turkeys, in a manner that leads us to suppose that it was to his knowledge a matter of common occurrence. He says : "The crossing of the Canada goose with the com-

* Nearly the same words are used by Audubon in his Ornithological Biography and in his Birds of America.

mon domestic species has proved as advantageous as that of the wild with the tame turkey." * He also states, "My friend, Dr. Bachman, assures me that in a state of domestication the wild turkeys, *though kept separate from tame individuals,* lose the brilliancy of their plumage in the third generation, becoming plain brown, and having here and there white feathers intermixed " †

The assertions of Major LeConte are so fully controverted by previously recorded testimony that they might have been justly ignored, had they not received, as already observed, the sanction of eminent authorities, and thus have come to be more or less currently adopted. Among the first to give them support was Professor Baird, of the Smithsonian Institution. This gentleman, in his work on the "Birds of North America," published less than two years subsequently to Major LeConte's paper, cites LeConte's opinions and statements, and partially indorses them, though he had not, he says, specimens at hand of the domestic bird for comparison with the wild one. To the data for their distinction adduced by Major LeConte, he adds a statement from Bonaparte in respect to the difference in color between the domestic and wild bird; Bonaparte observing that the wild bird never has the whitish tip to the tail which distinguishes the domestic ones. Professor Baird also adds that the flesh of the two differs in color, that of the wild bird being "much darker." He adds that, upon the whole, it is exceedingly probable that they are specifically distinct. "If the dewlap," he says, "be characteristic of a species at present only known in captivity, then, as Major LeConte remarks, it should bear the name of *M. gallopavo*, as based by Linnæus essentially upon the description by Brisson of *Gallopavo sylvestris*, in which this dewlap is particularly mentioned. In this event our wild bird will be entitled to a new name," etc. Professor Baird concludes his remarks on this subject with the following ingenious theory, which has been to some extent accepted as a probably correct one. "In conclusion," he says, "I venture to suggest the following hypothesis, which, however, is not original with myself: That there are really three species of turkey, besides the *M. ocellata*, a fourth species from Central America, entirely different from the rest. That one of them, *M. americana*, is probably peculiar to the eastern half of North America; another, *M. mexicana*, belongs to Mexico, and extends along the table-lands to the Rocky Mountains, the Gila, and the Llano Estacado; and a third is the *M. gallopavo*, or domesticated bird. That it is not at all improbable that the last was originally indigenous to some one or more of the West Indian Islands, whence it was transplanted as tamed to Mexico, and from Mexico taken to Europe about A. D. 1520.

* Birds of America, Vol. VI, p. 190.

† Ibid., Vol. V, p. 55.

Finally, that the wild turkeys were probably completely exterminated by the natives, as has been the case with equally large birds in other islands, as the dodo and solitaire.* This hypothesis," he continues, "will explain the fact of our meeting nowhere at the present day any wild turkeys resembling the domestic one.† . . . . The entire subject is one of much interest, and deserves to be investigated thoroughly. It is quite possible that a careful examination of the external form and habits of the New Mexican bird may do much to throw full light on the whole question."

It is not surprising that a theory presenting to the imagination so many attractive features, and indorsed by authority so eminent, should have been currently received, as has this, by those who have not had the opportunity, nor perhaps the desire, to examine the subject for themselves. But, if I mistake not, it has also been accepted as at least a *probably* correct hypothesis by many ornithologists.‡ I have, however, already adduced evidence from Bonaparte, Bachman, Audubon, and Bryant sufficient to show, not only the erroneous character of Major LeConte's fundamental proposition, to wit, that the wild turkey of the United States has never been and never can be domesticated, but that such an hypothesis as the one above quoted is wholly uncalled for. As the whole question of the origin of the domestic turkey and its relationship to the wild turkey of the United States turns, however, upon the fact of the domesticability or non-domesticability of the common wild turkey, it may perhaps be proper to bring forward some recent testimony respecting this disputed point.

I have myself always been more or less familiar with the domestic bird, and with the fact that breeds exist which closely resemble the wild bird, and which their owners claimed were one fourth, one half, or one eighth

* Mr. Darwin, in referring to this gratuitous theory, refers to the fact of the deterioration of the turkey within the tropics, and very properly to the "improbability of a bird having long ago become extinct in these large and luxuriant islands, or of its ever having been aboriginally an inhabitant of the lowlands of the tropics." (Animals and Plants under Domestication, Am. ed., Vol. I, p. 353, note.)

† But does it explain the frequent occurrence of domestic ones so closely resembling the wild ones as to be quite undistinguishable from them?

‡ Dr. Cooper, who considers the western wild turkey specifically distinct from the wild turkey of the east, appears to believe that the domestic turkey originated from the wild turkey of Mexico. He says: "It is well known that at the period of the Spanish discovery the native turkey was widely domesticated in Mexico, and was introduced thence first into Europe, and thence into North America. Furthermore, the native bird of Eastern North America does not occur in Mexico at all. The markings of the domestic turkey are sometimes exactly like those of the wild bird of Mexico, while they never assume the plumage of the wild *Meleagris gallopavo* of the north." (Orn. Cal., Vol. I, p. 523, 1870.) Dr. Cooper's last remark is unfortunately erroneous, since domestic birds do often occur, especially females, that cannot well be distinguished from wild northern birds.

wild blood, as the case might be, and which differed in habits in some respects from the common breeds. I have also been long conversant with the fact that in the Western States, and in those other parts of the country where the turkey exists in its native state, that the eggs of the wild bird are frequently taken and hatched under the domesticated turkey, the young carefully raised and held at high prices, they being considered as highly valuable for the purpose of improving the domestic breeds. In a recent correspondence with Mr. D. Darwin Hughes, an able ornithologist of Marshall, Michigan, I alluded to the fact that the domestication of the wild bird had been disputed, and requested him to give me any facts he might possess in reference to the subject. The facts given in the following extracts from his letters are fully corroborated by other private testimony in my possession.

Under date of October 25, 1869, he wrote me respecting the domestication of the wild bird as follows: "Here [Calhoun County, Michigan], where the wild bird is abundant, they mix freely with the tame ones, and it is a common thing to see large flocks of half-breeds; I have owned them myself. They are fond of roaming and are apt to stray; not to the woods exclusively, but also to other farms. I have known the pure wild bird, hatched from wild eggs and raised in the poultry-yard, to remain for years in the yard without being confined; but this is not usual. One fine gobbler, as beautiful a bird as I ever saw, was hatched from a wild egg and headed a flock of mixed turkeys in a barn-yard. He was tame, like the others, but easily distinguished by his wild plumage; at night the flock roosted in the yard, but this bird could not brook so low a perch, and when the flock went to roost he invariably took wing and perched on an immense forest-tree one fourth of a mile away, where he spent the night; but in the morning he always returned to the barn-yard. Such instances are not uncommon. The eggs are eagerly sought for for hatching, and in this manner, as I have before said, there is a liberal sprinkling of wild blood in domestic birds, where the wild birds are abundant. The eggs of the wild bird are found every year, and although I have offered at the rate of six to eight dollars per dozen for them, there is not one in my collection of eggs, which numbers over two hundred species, so eager are the finders of them to hatch them, the chicks selling for a large price."

In another letter, dated November 5, 1869, Mr. Hughes wrote me further concerning this subject, in which he remarks as follows: "I have already said that the wild bird has been so domesticated as to reproduce its kind in the poultry-yard, and inquiries made since my last letter show that in the more northern counties of the State such cases are quite common. I cannot agree with what is said in the ninth volume of the Pacific Railroad Reports (p. 617), that there is an appreciable difference in the color of the flesh of the wild and tame birds when cooked. There probably is some difference in color, but so little that one must have very acute powers of observation to tell the difference when brought to the table roasted. There is a difference in the color of the head, caruncles, and dewlaps, as stated by Professor Baird, but with my present means of knowledge, having no fresh specimens before me, I will not undertake to describe the differences. One thing, however, should not be forgotten; that we see the tame bird under all circumstances of passion, — in fear and when proudly strutting; in short, under all the different emotions that turkeys are heirs to, while we rarely or never see the wild turkey under such varied circumstances, but only when they are terror-stricken or dead. The head and neck in the tame bird makes rapid and surprising changes in sympathy with its emotions, and it may be so, and probably is, with the wild."

From the evidence that has now been given, it is sufficiently apparent that Major LeConte's two fundamental assumptions, — first, that the wild bird will not mix or breed with the domesticated; and, second, that the wild bird never has been and cannot be domesticated, — upon which was erected an hypothesis to explain the origin of the domesticated bird by referring it to an extinct ancestor that probably inhabited some of the West Indian Islands, are entirely groundless, and never had for their support only the negative evidence afforded by the limited experience of Major LeConte and a few of his friends.

Inasmuch as the domestic turkey was first introduced into Europe from Mexico, it may be well in this connection to inquire further into the relationship of the so-called *M. mexicana*, or Mexican turkey, to the wild turkey of the eastern part of the United States. As already stated, the *M. mexicana* was originally described by Mr. Gould from a single specimen from Mexico. This specimen differs but slightly from the common wild turkey of the eastern part of the continent. But like many other merely nominal species, this "Mexican turkey" has been since generally recognized by writers on American ornithology, doubtless mainly because its describer was deemed too eminent a naturalist to be mistaken on such a point. Its habitat has been since extended to embrace half of that portion of the continent over which the wild turkey ranges, — the entire western half of the United States; yet the point at which the habitat of the eastern species ceases and that of the western begins, no one has yet ventured to attempt to definitely indicate. It is universally conceded to be exceedingly closely allied to the *M. gallopavo*, as the latter is now defined. Though admitted provisionally as a valid species by Professor Baird in his work already cited, he says that "whether these differences can be considered as establishing a second species for the United States is a question yet to be decided." Dr. Coues, however, in his "List of the Birds of Fort Whipple, Arizona," * says he thinks there can be no doubt respecting the propriety of separating the "western turkey from the common species of the Eastern United States"; but he has given us no information as to how great the differences between them are, or in what they consist. As mentioned by Gould and by Baird, the Mexican bird differs from the eastern one only in being lighter colored, and in having, in correlation with the generally lighter color of the plumage, the terminal band of the tail, as also the tips of the tail coverts, whitish instead of pale brown, as the eastern bird usually has them. This, however, seems by no means necessarily a specific difference, it being only a slight geographical variation, not restricted to the turkey, but which runs through most species of both birds and mammals that have the same distribution; the probable cause of which variation I have already adverted to in Part III. The common eastern turkey occasionally approaches much nearer to the so-called Mexican bird than appears to be generally supposed. According to some authors, the tip of the tail in *M. gallopavo* is never whitish, but "plain chestnut, lighter than the ground color" of the tail. Yet of five specimens in the Museum of Comparative Zoölogy from one of the Western States, probably either Ohio or Michigan, two correspond with the description of the assumed typical *M. gallopavo*, two very nearly as well with that of the so-called *M. mexicana*, and one is intermediate between them. Three of them are decidedly lighter colored, and possess a lighter terminal band to the tail than they should to correspond with the true *M. gallopavo* as recently defined. I have, on the whole, no hesitancy in referring the *M. mexicana* Gould to the *M. gallopavo* Linné. The unquestionable specific identity of the domestic turkey with the wild one of the Eastern United States, though originally derived from the Mexican bird, seems further to support this view. From the great constancy of the white on the tail and its coverts in the domestic turkey, it has been thought to more resemble the western bird, or the *M. mexicana*, than the eastern. I need, however, only to recall the testimony of Dr. Bachman, already given in discussing another point, to show that it has necessarily no such significance. It will be remembered that Dr. Bachman states that he had known the wild birds of the Atlantic States, when kept entirely by themselves, to become more or less white under confinement in three generations.† Instead of this being either a "reversion" or a distinctive specific feature, it can be regarded only as the result of a diminution of the coloring matter through degeneracy, under the influences of domestication.

* Proc. Phil. Acad. Nat. Sci., Vol. XVIII, p. 93, 1866. Republished under the title of "Prodrome of a Work on the Ornithology of Arizona Territory."

† Mr. Darwin mentions a similar fact as having happened in England. (Animals and Plants under Domestication, Vol. I, p. 354).

As the whole plumage becomes lighter, those portions that are naturally lightest are those we should expect would soonest become white; and such is actually the case. Under domestication the turkey not only degenerates in size and hardiness, but is well known to soon lose much of the brilliancy of plumage that characterizes it in a state of nature. In a few generations it loses to a great extent its metallic tints, and becomes much lighter colored; the terminal band of the tail, as well as its coverts, changes to white, and in succeeding generations the cream-colored and pure white birds often seen in our poultry-yards are gradually developed.

The fact of the domestic turkey having been first introduced into Europe from Mexico, and into the United States from Europe, admits of easy explanation; since the advanced state of civilization enjoyed by the native Mexicans had enabled them to domesticate the turkey, while their more degraded neighbors of the north had accomplished nothing of the kind. The turkey having been introduced into Europe nearly a century before the establishment of permanent settlements in the northern portions of the continent, it was, of course, as naturally introduced thence into this country as were our other domesticated animals.

PERDICIDÆ.

101.* **Ortyx virginianus** *Bonaparte.* QUAIL.

Tetrao virginianus LINNÉ, Syst. Nat., I, 277, 1766.

Tetrao marilandicus LINNÉ, Syst. Nat., I, 277, 1766.

Ortyx borealis STEPHENS, Shaw's Zoöl., XI, 377, 1819.

Perdix (*Ortyx*) *virginiana* BONAP., Obs. on Wils. Nomen., Journ. Phil. Acad. Nat. Sci., 1st Ser., IV, 268, 1825.

Ortyx virginianus BAIRD, Birds N. Am., 640, 1838. — MARCH, "Notes on Birds of Jamaica," Proc. Phil. Acad. Nat. Sci., XV, 303, 1863.

Ortyx texanus LAWRENCE, Ann. N. Y. Lyc. Nat. Hist., VI, 1, 1853. — BAIRD, Birds N. Amer., 641, 1858.

Abundant.

The quails of Florida differ from those of the Northern States in being smaller, larger billed, and darker colored. While the difference in size is very appreciable, as is also that in respect to the size of the bill, — the bill being actually larger while there is a general decrease in the size of the individual, — the most marked dissimilarity is in the coloration, through the darker color of the Florida birds. In the latter the ground color above is rufous instead of ashen, as in northern specimens, and the transverse black markings are broader. In average northern specimens the transverse black bars on the lower surface of the body are scarcely half the breadth of the intervening white spaces; in the Florida specimens they are much more than half, and in some cases nearly equal them. In general the proportion of black in the Florida *females* is the same as that in the northern *males*. There is a similar relative increase in the extent of the black markings on the wing coverts, scapulars, and interscapulars, and on the dorsal surface generally. The black border to the white throat-patch is also broader, and extends back on the sides of the head so as usually to cover the auriculars, which in average northern specimens are dark rufous. The bill is also much darker, being generally jet black; in Massachusetts specimens it is brownish black, with the tip decidedly lighter than the other parts.

The so-called Texas quail (*Ortyx texanus* Lawr.) does not differ very greatly from either the Florida or the northern ones, it combining some of the essential characters of each, but more resembling Florida specimens than northern ones. Lawrence and Baird mention the ashen or decided gray hue on portions of the dorsal surface as distinguishing it from the *O. virginianus*, which has these parts of a "dull pinkish red." "A dull pinkish red," however, is just the color of these parts in my Florida specimens; but the Massachusetts specimens, on the contrary, are ashen, as already stated, and in this respect agree with the descriptions of the Texas form, and differ from the Florida ones in the same way that the Texas ones are said to do from those of the Atlantic coast of the Middle and Southern States. In both the Florida and Texas specimens there is a similar increase in the breadth of the black transverse markings, Lawrence describing them as being twice as broad in the Texas specimens as in the northern ones.

The *Ortyx cubanensis* of Cabanis appears scarcely to differ from the quails of Florida and Texas. D'Orbigny and Lembeye were hence doubtless correct in believing the so-called *Ortyx cubanensis* to be identical with the *O. virginianus*.

The following summary of the subjoined tables shows the difference in size that obtains between northern and southern specimens, and also in the sexes. The largest Florida specimen, it will be seen, scarcely equals the smallest northern one, when those of the same sex are compared.

No. of Specimens.	Sex.	Locality.		Length.	Alar Extent.	Wing.	Tail.
7	♂	Illinois	Average	10.18	15.44	4.47	2.82
16	♂	Florida	Average	9.46	14 16	4.22	2.52
6	♀	Illinois	Average	9.83	15.10	4.36	2 67
10	♀	Florida	Average	9.37	14.02	4 17	2.54
10	♀	"	Maximum	10.00	14 50	4.40	2.77
10	♀	"	Minimum	9 00	13 10	3.35	2.50
16	♂	"	Maximum	10.00	14 75	4.50	3.00
16	♂	"	Minimum	9.00	13.80	4.00	2 30
7	♂	Illinois	Maximum	10 50	15.60	4.60	3.00
7	♂	"	Minimum	10.00	15.00	4.37	2.55
6	♀	"	Maximum	10.25	15.50	4 50	2.85
6	♀	"	Minimum	9.50	14.50	4.25	2.45

Measurements of Florida Specimens of Ortyx virginianus.

M. C. Z. No.	Coll. No	Sex.	Locality.	Date	Collector.	Length	Alar Extent.	Wing.	Tail.
5151	—	♂	Hibernia	Jan. 30, '69	J A. Allen	9.25	14.75	4.15	2.40
5152	—	♂	"	Jan 30, '69	"	9 25	14.10	4.00	2.60
5183	—	♂	"	Jan. 30, '69	"	9.00	14 00	4 00	2.30
5184	—	♂	"	Jan. 30, '69	"	9 25	14.25	4.10	2.50
5337	—	♂	Enterprise	Mar 4. '69	"	9 65	14 50	4.40	2.40
5336	—	♂	"	Mar. 4, '69	"	9.50	14.25	4.15	2.50
10578	1990	♂	Jacksonville	Jan. 9, '69	C. J. Maynard	9.50	13.80	4.30	2 80
10579	1990	♂	"	Jan 9, '69	"	9 35	14.15	4.45	2 53
10580	1991	♂	"	Jan. 9, '69	"	9.30	14.30	4.00	2 30
—	2547	♂	Dummitt's	Mar. 8, '69	"	10 00	14.08	4.10	2 65
—	2546	♂	"	Mar. 7, '69	"	9.30	14.05	4 25	3.00
—	2562	♂	"	Mar. 9, '69	"	9.85	13.80	4.45	2 84
10583	2472	♂	"	Feb. 24, '69	"	9.50	14.00	4 25	2.50
—	2517	♂	"	Mar. 4, '69	"	9.25	14.00	4.40	2.70
—	2561	♂	"	Mar. 9, '69	"	9.70	14.08	4.25	2.65
10581	2356	♂	"	Feb. 16, '69	"	9.70	14.50	4.50	2.70
10582	2456	♀	"	Feb. 24, '69	"	10.00	14.50	4.25	2 55
—	2795	♀	"	Feb. 16, '69	"	9.00	13.75	3 35	2.70
—	2615	♀	"	Mar. 8, '69	"	9.50	14 20	4.40	2 57
—	1993	♀	Jacksonville	Jan 9, '69	"	9 35	14.10	4 35	2.70
—	1994	♀	"	Jan. 9, '69	"	9.40	13.10	4 35	2.65
—	1995	♀	"	Jan. 9, '69	"	9 50	13.60	4.40	2.77
5182	—	♀	Hibernia	Jan. 30, '69	J. A. Allen	9.35	14.25	4.10	2.30
5338	—	♀	Enterprise	Mar. 4, '69	"	9 00	14 00	4 05	2.33
5351	—	♀	"	Mar. 5, '69	"	9.40	14 50	4.30	2.45
5352	—	♀	"	Mar. 5, '69	"	9.25	14.25	4.15	2.47

Measurements of Northern Specimens of Ortyx virginianus.

M. C. Z. No.	Sex.	Locality.	Date.	Collector.	Length	Alar Extent.	Wing.	Tail.
13096	♂	Northern Illinois	Jan. 18, '71	—	10.25	15.00	4 45	2.72
10410	♂	"	Jan. 18, '71	—	10.00	15 45	4.60	2.75
10408	♂	"	Jan. 18, '71	—	10 00	15.00	4 40	2.85
10411	♂	"	Jan. 18, '71	—	10 50	15.50	4.50	2 75
13099	♂	"	Jan. 18, '71	—	10.25	15.60	4.60	3 00
13098	♂	"	Jan. 18, '71	—	10 28	15.25	4 50	2.90
13097	♂	"	Jan. 18, '71	—	10.00	15 25	4 37	2.55
13101	♀	"	Jan. 18, '71	—	10.25	15 50	4.45	2.72
10407	♀	"	Jan. 18, '71	—	9.50	14 50	4.25	2.73
10409	♀	"	Jan. 18, '71	—	10 00	14.85	4.50	2.85
10412	♀	"	Jan. 18, '71	—	9 85	15 25	4 38	2.48
10406	♀	"	Jan. 18, '71	—	9.50	15.20	4.50	2.45
13100	♀	"	Jan. 18, '71	—	9.85	15.10	4 30	2.60

CHARADRIIDÆ.

102.† **Squartarola helvetica** *Cuvier.* Black-bellied Plover.

"Some remain on the shores of the Floridas in winter." — *Audubon.**

103.† **Charadrius virginicus** *Borck.* Golden Plover.

"St. Augustine; rare." — *Boardman.*

* Birds of America, Vol. V, p. 200.

104.* **Ægialitis vociferus** *Cassin.* Killdee Plover.

Abundant.

105.* **Ægialitis Wilsonius** *Cassin.* Wilson's Plover.

Not recently reported as found in Florida in the winter months. Audubon observes: " While in the Floridas, near St. Augustine, in the months of December and January, I found this species much more abundant than any other." *

106.† **Ægialitis semipalmatus** *Cabanis.* Semi-palmated Plover.

" Not uncommon at St. Augustine throughout the winter." — *Boardman.*

107.† **Ægialitis melodus** *Cabanis.* Piping Plover.

Observed at St. Augustine in the winter months by Mr. Boardman.

HÆMATOPODIDÆ.

108.† **Hæmatopus palliatus** *Temminck.* Oyster-Catcher.

Given by Mr. Boardman as rare in winter at St. Augustine.

109.† **Strepsilas interpres** *Illiger.* Turnstone.

" Rare at St. Augustine in winter." — *Boardman.*

SCOLOPACIDÆ.

110.* **Philohela minor** *Gray.* Woodcock.

More or less common. Probably resident.

111. († ?) **Gallinago Wilsoni** *Bonaparte.* Snipe.

Abundant. Probably resident. Florida specimens are darker colored and have longer bills than northern ones.

112.† **Calidris arenaria** *Illiger.* Sanderling.

" Common at St. Augustine." — *Boardman.* " Abundant on Indian River." — *Maynard.*

113.† **Pelidna americana** *Coues.* Red-backed Sandpiper.

" Common." — *Maynard. Boardman.*

114.† **Ereunetes pusillus** *Cassin.* Semi-palmated Sandpiper.

" Common." — *Maynard.*

* Ibid., p. 216.

115.† **Actodromas minutilla** *Coues.* LEAST SANDPIPER.

"Common." — *Maynard.*

116.† **Actodromas Bonapartei** *Cassin.* WHITE-RUMPED SANDPIPER.

"St. Augustine." — *Audubon.*

117.* **Symphemia semipalmata** *Hartlaub.* WILLET.

"Indian River to St. Augustine. Breeds in March." — *Maynard.*

118.† **Gambetta flavipes** *Bonaparte.* YELLOW-LEGS.

Common.

119.† **Gambetta melanoleuca** *Bonaparte.* GREATER YELLOW-LEGS.

Common.

120.* **Tringoides macularius** *Gray.* SPOTTED SANDPIPER.

Common.

121.* **Limosa fedoa** *Ord.* MARBLED GODWIT.

Common. Reported to Mr. Maynard as common all the year near St. Augustine, but where it nested was unknown to his informants.

122.† **Numenius hudsonicus** *Latham.* HUDSONIAN CURLEW.

123.† **Numenius borealis** *Latham.* ESQUIMAUX CURLEW.

I have no knowledge of the actual occurrence of these two species in East Florida, yet they apparently must occur as winter visitors. Dr. Coues gives them as winter visitors in his South Carolina list, and they are well known to range at this season southward into the tropics.

124.† **Numenius longirostris** *Wilson.* LONG-BILLED CURLEW.

"Very abundant on the coast." — *Boardman.*

Several other species of this family are well known to pass through East Florida in their migrations, and perhaps a few others are winter residents there.

RECURVIROSTRIDÆ.

125.* **Himantopus nigricollis** *Vieillot.* BLACK-NECKED STILT.

Audubon says it is found in Florida in winter.* Mr. Boardman gives it as "quite common at Enterprise after the 15th of March."

* Birds of America, Vol. VI, p. 85.

126.† **Recurvirostra americana** *Gmelin.* Avoset.

This species must occur in Florida as a winter visitor, but I have as yet seen no specimens that were collected there.

GRUIDÆ.

127.* **Grus canadensis** *Temminck.* Brown Crane.

Abundant.

In 1853, in the Proceedings of the Boston Society of Natural History,* Dr. Bryant discussed at length the question of the relationship of *G americana* Ord to the *G. canadensis*, and arrived at the conclusion that while the young of the *G. americana*, or white whooping crane, might be brown like the mature *G. canadensis*, or sand-hill crane, that the two were distinct species; and this conclusion ornithologists seem to have generally adopted. I saw none of the white birds in Florida, where the brown were very numerous. In Iowa I have seen both, but only at a distance. The account given by Dr. Bryant of the breeding of the sand-hill crane in Florida is very complete and interesting. According to this author the eggs, two in number, are laid from early in February till about the middle of April.†

RALLIDÆ.

128.* **Rallus elegans** *Audubon.* Marsh Hen.

Common.

129.* **Rallus crepitans** *Gmelin.* Clapper Rail.

Common.

130.† **Rallus virginianus** *Linné.* Virginia Rail.

"Common along the St. John's River." — *Boardman.*

131.† **Porzana carolina** *Vieillot.* Carolina Rail.

"Common." — *Maynard.*

132.(†?) **Porzana noveboracensis** *Cassin.* Yellow Rail.

"Common throughout the winter along the St. John's." — *Boardman.*

133.† **Fulica americana** *Gmelin.* Coot.

Abundant. As numerous the 1st of April as during the winter.

134.* **Gallinula galeata** *Bonaparte.* Florida Gallinule.

Abundant.

* Vol. IV, p. 303.

† See also on this point the same Proceedings, Vol. VII, p. 14.

135.* **Gallinula martinica** *Latham.* PURPLE GALLINULE.

Well known as a resident bird of Florida, but not observed by either Messrs. Maynard and Boardman or myself.

ARDEIDÆ.

136.* **Demiegretta ludoviciana** *Baird.* LOUISIANA HERON.

Common.

137.* **Demiegretta Pealei** *Baird.* PEALE'S EGRET.

Several specimens of this beautiful species were brought home by Mr. Maynard from Indian River, taken at Dummitt's. This is somewhat farther north than any point from which it has been previously reported.

138.* **Garzetta candidissima** *Bonaparte.* LITTLE WHITE HERON.

Abundant. Breeds in February and March.

139.* **Herodias egretta** *Gray.* WHITE HERON.

Abundant. Breeds early in the season. At a small heronry on an islet in Lake Dexter I found several nests containing nearly fledged young, March 23d. The nests, built eight to fifteen feet above the ground, were composed of a few sticks loosely put together. Often they were placed in the tops of bushes which were thickly overgrown with woody vines. The young, when shaken from the nest, climbed through the vines, using their bills as an organ of prehension, either seizing the branches between their mandibles or hooking their bills over them, and clung so closely that it was exceedingly difficult to dislodge them.

This and the preceding species are greatly persecuted by the hunters, who sometimes destroy great numbers at their breeding places, so many of the birds being killed and the others so much alarmed, that large heronries are thus completely broken up. Some gunners make it their business to hunt them for their plumes. Some means should be devised, however, for the protection of these beautiful birds, as at their present rate of decrease their number will soon be greatly diminished.

140.* **Ardea herodias** *Linné.* GREAT BLUE HERON.

Abundant. Breeds in the retired swamps, nesting in the highest cypress-trees. It is rare that more than a single nest is seen in one tree, but often several pairs breed near each other. Young, a third grown, were met with as early as the 12th of March. This species breeds while in immature plumage, young females being found mated with adult males, and *vice versa*. The only very appreciable external sexual difference is that of size, the males, as is generally the case in this family, being much larger than the females.

141.* **Florida cærulea** *Baird.* SMALL BLUE HERON.

Common.

142.* **Ardetta exilis** *Gray.* LITTLE BITTERN.

Not common.

143.† **Botaurus lentiginosus** *Stephens.* BITTERN.

Very common at some localities.

144.* **Butorides virescens** *Bonaparte.* GREEN HERON.

Not uncommon. Smaller than northern specimens, the Florida examples being intermediate in size between those from New England and the West Indies, the latter of which are usually regarded as a distinct species, under the name of *B. brunnescens.* They also decidedly approach the West Indian type in coloration.

145.* **Nycticorax griseus** *Gray.* NIGHT HERON.

Ardea nycticorax LINNÉ, Syst. Nat., I, 235. — WILSON, AUDUBON, NUTTALL, BONAPARTE, etc.

Ardea grisea LINNÉ, Syst. Nat., I, 239, 1766.

Ardea Gardeni GMELIN, Syst. Nat., I, 644, 1788.

Nycticorax europæus STEPH., Gen. Zoöl., XI, 609, pl. xlvii.

Nycticorax americana BONAP., Geog. and Comp. List, 48, 1838.

Nycticorax Gardeni JARDINE, Notes to Wilson's Orn. — BONAP., Conspectus Gen. Avium, II, 141, 1855.

Nyctiardea Gardeni BAIRD, Birds N. Am., 678, 1858, and subsequent American authors.

I did not observe this species on the St. John's, but Mr. Maynard found it more or less common on Indian River and Mosquito Lagoon. Mr. Boardman gives it as "not rare." It is said to be resident the whole year in Florida, by Audubon.

Having compared specimens of the American night heron with others from various parts of the Old World, I see no reason for considering them specifically distinct, though so considered by all American and some European ornithologists. The differences between them are scarcely appreciable.

TANTALIDÆ.

146.* **Tantalus loculator** *Linné.* Wood Ibis. "Gannet."

Common on the Upper St. John's. In March they were undergoing their spring moult, and were consequently in poor plumage. According to Dr. Bryant, who is the first and only writer, so far as I am aware, who has minutely described their eggs and breeding habits, incubation is generally commenced by the 1st of April. Dr. Bryant visited two of their breeding places, one of which was between New Smyrna and Enterprise, in a large cypress swamp on the southern border of Lake Ashby. He estimated that a thousand pairs were breeding there.

There is a singular discrepancy in the accounts of authors in respect to the habits of this bird. Bartram mentions it as solitary in its habits, not associating in flocks. Audubon, always finding it in large flocks, calls attention to this remark of Mr. Bartram as being wholly erroneous, and regrets that his account had been so extensively copied by authors. Dr. Bryant fully corroborates Bartram's account, and censures Audubon for not remembering that birds vary in their habits at different times and places. He says he never saw it in flocks except at its breeding places, and that they usually went off and returned either singly or in pairs. I saw wood ibises more or less frequently on the Upper St. John's for four or five weeks, and only in two or three instances singly or in pairs. I almost invariably saw them in flocks, both at their feeding grounds and flying in the air, they varying in number from a dozen to a hundred. While more or less gregarious at all times, they often doubtless also separate into pairs or wander singly.

In East Florida the wood ibises are called "gannets." Under this name they were described to Audubon when he visited that country, and concerning which he remarks: "On asking the appearance of the Gannets, I was told they were large white birds, with wings black at the end, a long neck, and a large sharp bill. The description so far agreeing with that of the common gannet or solan goose, I proposed no questions respecting the legs or tail, but went off." On visiting the locality where they were said to occur, he was surprised to find the trees covered with wood ibises. He hence adds: "Now as the good people who gave the information spoke according to their knowledge, and agreeably to their custom of calling the ibises gannets, had I not gone to the pond, I might have written this day that gannets are found in the interior of the woods in the Floridas, that they alight on trees, etc., which, if *once* published, would in all probability have gone down to future times through the medium of compilers." * Numbers of similar errors have in fact crept into our natural-history literature, and after they have become well known as such to investigators, they are perpetuated for a generation or two by superficial compilers. The same may almost equally well be said in respect to nominal species.

147.* **Ibis alba** *Vieillot.* WHITE IBIS.

Abundant. Towards the end of February they were moulting and in very poor plumage. Most of the young still retained their brown dress, but in a large proportion the moulting was considerably advanced. Before the end of March it was completed, and April 1st I saw large flocks passing northward high in the air, apparently migrating.

During the winter these birds have the peculiar habit, on the Upper St. John's, of daily flying up the river at evening and down again early in the morning. They usually fly very low, passing just over the tree-tops when cutting across a bend in the river, and at other times close to the water. They are hence in easy gun-shot range from the river or its banks, and, flying in dense flocks, afford fine sport to the numerous sportsmen camping along its banks, who make great havoc among them. They breed much later in the season than the herons. Dr. Bryant states that as late as the 20th of April they had not commenced laying, and that they fly up and down Indian River in the same manner as on the St. John's.† Mr. Maynard informs me he did not meet with this bird on Mosquito Lagoon.

148. **Ibis falcinellus** *Linné.* GLOSSY IBIS.

Tantalus mexicanus ORD., Journ. Phil. Acad. Nat. Sci., I, 53, 1817.

Ibis falcinellus BONAP., Obs. on Nomencl. Wilson's Orn., Ibid., V, 70, 1825. — IBID., Am. Orn., IV, 23, pl. xxiii, 1831. — AUDUBON, Orn. Biog., IV, 608, pl. ccclxxxvii, 1838.

Ibis Ordi BONAP., Geog. and Comp. List, 1838. — BAIRD, Birds N. Amer., 685, 1858.

"Pine barrens between Lake Harney and Indian River, in the ponds, in flocks of twelve to twenty." ‡

* Birds of America, Vol. VI, p. 68.

† Proc. Bost. Soc. Nat. Hist., Vol. VII, 15.

‡ The above is a memorandum of the recent occurrence of this species in East Florida, obtained from Mr. Maynard, but whether given by him on his own authority or on that of Mr. C. H. Nauman, I am at present uncertain.

ARAMIDÆ.

149.* **Aramus giganteus** *Baird.* Crying Bird. "Limpkin."

This singular and stupid bird is at present more or less common about the grassy lakes and bayous from Lake Dexter southward. Now that Florida has become such a favorite winter resort for health-seekers, pleasure-seekers, and sportsmen, it will be surprising if it is not soon exterminated, as it seems to have almost no fear of man or the gun. They are generally seen in pairs, rarely, however, more than a few occupying the same vicinity; and when one of a party of them is shot, the others, instead of seeking safety by flight, remain and salute the intruder with their singularly discordant cries. Their excellent flesh will tend to favor their rapid extermination. They build their nests in bushes along the river and its bayous, occasionally at a considerable height, but make no effort to conceal them. At Hawkinsville I found a newly built nest, containing a single egg, March 20th, and a few days later, at Lake Dexter, I met with young nearly full grown. Hence they must breed very early, and, perhaps, somewhat irregularly. Dr. Bryant gave the first detailed account of the habits of this bird,* to which there is little to be added. He says he found it more or less common on the St. John's from Lake George to Lake Harney, but most abundant on the Wikiva Creek, which empties into the St. John's about twenty-five miles below Enterprise. This account agrees with my own experience in respect to its distribution. I did not ascend the Wikiva, but was informed that this bird was much more abundant there than on the St. John's. Dr. Bryant says that incubation usually commences in February, and that the number of eggs it lays is very large, sometimes numbering fifteen. Its popular name in Florida is "limpkin."

Possessing many features that ally them to the rails, they in other respects resemble the herons, and especially the ibises, besides having peculiar characters which mark them as a group distinct from either.

ANATIDÆ.

150.† **Anas boschas** *Linné.* Mallard.

"Common all winter in very large flocks." — *Boardman.* Audubon speaks of their occurring in such numbers in portions of Florida, when

* Proc. Bost. Soc. Nat. Hist., Vol. VII, p. 12.

he was there in 1831, as to darken the air, and the noise of their wings, when rising from the large submerged savannas, he compares to the rumbling of thunder. Mr. Maynard also found them in vast numbers in 1869 on Indian River.

151.† **Anas obscura** *Linné.* BLACK DUCK.

"Quite common." — *Maynard.*

152.† **Dafila acuta** *Jenyns.* PINTAIL DUCK.

"St. John's River; not common." — *Boardman.* Mr. Maynard says that on Indian River he found them in immense numbers, passing over in clouds for hours together.

153.† **Nettion carolinensis** *Baird.* GREEN-WINGED TEAL.

Abundant.

154.† **Querquedula cyanoptera** *Cassin.* RED-BREASTED TEAL.

This species was found by Mr. Maynard in great numbers in the savannas of the upper part of Indian River, but unfortunately the specimens he obtained were lost. This, I believe, is the first time it has been reported from any of the Atlantic States.

155.† **Querquedula discors** *Stephens.* BLUE-WINGED TEAL.

Abundant.

156.† **Spatula clypeata** *Boie.* SHOVELLER.

"Common." — *Maynard. Boardman.*

157.† **Mareca americana** *Stephens.* BALDPATE.

"Common." — *Boardman.*

158.* **Aix sponsa** *Boie.* WOOD DUCK.

Abundant. Breeds early. Saw young March 15th.

159.† **Fulix marila** *Baird.* SCAUP DUCK.

Anas marila LINNÉ, Syst. Nat., I, 1766, 196. — WILSON, Am. Orn., VIII, 84, pl. lxix, 1814.

Fuligula marila AUD., Birds of America, VII, 355, pl. ccccxcviii, 1843.

Fuligula affinis EYTON, Mon. Anat., 157, 1838.

Fuligula mariloides VIGORS, Zoöl. Blossom, 31, 1839.

Fuligula minor GIRAUD, Birds of Long Island, 323, 1844. — BELL, Proc. Phil. Acad. Nat. Sci., I, 141, 1842.

Fulix marila et affinis BAIRD, Birds N. Amer., 791, 1858.

Very abundant. By far the most numerous duck on the St. John's River. Quite common at Jacksonville as late as April 1st.

The *Fulix*, or *Fuligula*, *affinis* auct. is evidently only the smaller, darker southern form of the *F. marila* auct. Most of the specimens collected in Florida were of the so-called *F. affinis* type.

160.† **Aythya americana** *Bonaparte*. Red-head.

Abundant in the marshes near St. Augustine, in 1831.—*Audubon*.* I find the *A. vallisneria* recorded in my notes made at Jacksonville. I saw none, however, myself, but it was reported by sportsmen to not unfrequently occur there.

161.† **Bucephala albeola** *Baird*. Butter-Ball.

Observed in Florida by Audubon.†

162.† **Erismatura rubida** *Bonaparte*. Ruddy Duck.

More or less common on the Lower St. John's. Also observed by Audubon when he was on the plantation of General Hernandez, in East Florida, and "in immense flocks" about a hundred miles up the St. John's River, in February, 1832.‡ Also obtained by Mr. Maynard at Dummitt's.

163.† **Lophodytes cucullatus** *Reichenbach*. Hooded Merganser.

"Very abundant on the coast." — *Boardman*. "Numerous at Dummitt's." — *Maynard*. Occasional on the St. John's.

Geese are currently reported by the inhabitants to occur in winter in North Florida, but I am unable to state what species. Probably *Bernicla canadensis* and *B. brenta*, and perhaps others, are at times more or less common, since they are well known to occasionally visit Cuba.

PELECANIDÆ.

164.* **Pelecanus erythrorhynchus** *Gmelin*. White Pelican.

"Seen in large flocks near the mouth of the St. John's all winter." — *Boardman*. "Common on Indian River. Said to breed on an island near Dummitt's, and at Jupiter Inlet." — *Maynard*.

165.* **Pelecanus fuscus** *Linné*. Brown Pelican.

"Abundant on the coast in winter." — *Boardman*.

* Birds of America, Vol. VI, p. 312.

† Ibid., p. 370.

‡ Ibid., p. 325.

SULIDÆ.

166.† **Sula bassana** *Brisson.* Common Gannet.

"Abundant on the coast." — *Boardman.*

167.* **Sula fusca** *Linné.* Booby Gannet.

A few were seen on the coast near St. Augustine by Mr. Boardman. Mr. Maynard also observed it at Cape Canaveral

PHALACROCORACIDÆ

168.* **Graculus floridanus** *Bonaparte.* Florida Cormorant.

Common on the St. John's, and, according to Mr. Boardman, abundant on the coast.

PLOTIDÆ.

169.* **Plotus anhinga** *Linné.* Snake Bird. Water Turkey.

Abundant. Breeds in February and March, sometimes nesting in the tops of the highest trees, and sometimes quite low. Both sexes incubate.

PROCELLARIDÆ.

170.† **Oceanites oceanica** *Coues.* Wilson's Stormy Petrel.

"A few about the coast at Fernandina." — *Boardman.*

171.† **Puffinus major** *Fabricius.* Greater Shearwater.

"A few about the coast at Fernandina." — *Boardman.*

LARIDÆ.

172.† **Larus argentatus** *Brünnich.* Herring Gull.

Common. Seen up the St. John's as far as Hibernia.

On my voyage from New York to Augusta, Ga., on my way to Florida, small parties of these gulls, numbering usually six to twenty, were almost constantly hovering near the vessel. In the Bay of New York, as along the coast of New England, and doubtless along that of all the Atlantic States at this season, the birds in immature plumage far outnumbered the others; but a hundred miles from land all the gulls of this species seen were old birds, which accords with observations of mine made on other winter voyages in the North Atlantic. It hence appears that the young birds are less venturesome than the adult, and keep mainly near the land. This accords also with the well-known fact that young birds, in migratory species, do not generally attain so high latitudes in the breeding season as the fully adult. It is also highly probable that, generally, the young birds of this family do not range quite so far southward in winter as the older. The mature herring gulls, so far as I had an opportunity of observing, far outnumbered the young ones along the Carolina coast and on the St. John's River.

173.† **Larus delawarensis** *Ord.* RING-BILLED GULL.

"Not numerous." — *Boardman.*

174.* **Chrœcocephalus atricilla** *Lawrence.* LAUGHING GULL.

Common along the coast and on the Lower St. John's.

175.† **Chrœcocephalus philadelphia** *Lawrence.* BONAPARTE'S GULL.

With the preceding, and equally numerous. Also common, according to Mr. Maynard, on Indian River.

176.† **Gelochelidon anglica** *Bonaparte.* MARSH TERN.

Obtained by Mr. Maynard on Indian River.

177.* **Thalasseus regius** *Gambel.* ROYAL TERN.

"Abundant about the coast." — *Boardman. Maynard.*

178. **Sterna hirundo** *Linné.* COMMON TERN.

"Common at Dummitt's." — *Maynard.*

The following table of measurements of sixty-five specimens (forty-five males and twenty females) of this species, taken in the breeding season at Muskeget Island, Massachusetts, indicates the considerable range of individual differentiation that obtains in this species. Though so great, it does appear to be greater than occurs in *Sterna macrura*, of which I have the measurements of twenty-five specimens taken at the same locality and during the same excursion, nor is it probably greater than most of the terns and gulls present, as is evidently indicated by the great number of measurements of specimens of other species of the *Laridæ* of our coast now before me.

The average dimensions of the specimens cited in the subjoined table are as follows: —

Males: Length, 14.51; alar extent, 30.72; wing, 10.47; tail, 5.80; culmen, 1.40; tarsus, .78. *Females:* Length, 13.85; alar extent, 30.59; wing, 10.57; tail, 5.74; culmen, 1.36; tarsus, .77. The extremes of the same are as follows: —

Males: Length, 13.00 to 15.77; alar extent, 29.00 to 32.00; wing, 9.65 to 11.70; tail, 5.00 (4.81?) to 7.00; bill (culmen), 1.28 to 1.55; tarsus, .70 to .87.

Females: Length, 13.10 to 15.50; alar extent, 28.20 to 32.00; wing, 9.90 to 11.50; tail, 5.20 (4.75?) to 6.11; bill (culmen), 1.25 to 1.55; tarsus .70 to .90.

Measurements of Massachusetts Specimens of STERNA HIRUNDO, *Taken in the Breeding Season.*

M. C. Z. No.	Coll. No.	Sex.	Locality.	Date.	Collector.	Length.	Alar Extent.	Wing.	Tail.	Bill.	Tarsus.
—	814	♂	Ipswich	June 16, '68	Allen & Maynard	14 00	30 50	10.62	6.90	1.33	.73
—	807	♂	"	June 16, '68	"	14.36	29.00	10.10	6 56	1.33	.70
10477	905	♂	Wellfleet	June 26, '68	"	14 75	31.90	10.50	6.50	1.35	.80
10478	906	♂	"	June 26, '68	"	14.30	31.70	10.45	6.00	1.41	.76
10479	907	♂	"	June 26, '68	"	14.00	31 00	10.60	5.50	1 33	.74
10480	908	♂	"	June 26, '68	"	13 75	31.60	10.75	5.40	1.28	.76
—	911	♂	Muskeget Isl.	June 29, '68	"	14.75	30.50	10.50	6 00	1.30	.87
10481	913	♂	"	June 29, '68	"	14.40	29.30	10.15	6.00	1.50	.80
10485	916	♂	"	June 29, '68	"	14.80	29.30	10.40	5.50	1.45	—
10486	917	♂	"	June 29, '68	"	14.90	29.60	10.40	5.55	1.36	.85
—	920	♂	"	June 29, '68	"	14 00	30.00	11.00	5.75	1.35	.76
—	923	♂	"	June 29, '68	"	14.00	30.50	10 40	5.55	1 40	.77
10489	925	♂	"	June 29, '68	"	14.40	29.80	10.25	5 45	1 37	.81
10490	926	♂	"	June 29, '68	"	14.50	30.25	10.30	5.40	1.35	.80
—	927	♂	"	June 29, '68	"	14.60	31.00	10.50	6.00	1 40	.75
10491	928	♂	"	June 29, '68	"	14 50	30.80	10.15	5.60	1.52	.74
—	940	♂	"	June 29, '68	"	13.60	31.15	10.25	5.60	—	—
—	941	♂	"	June 30, '68	"	14.50	31.65	10.15	6.10	—	—
—	942	♂	"	June 30, '68	"	14.50	31 50	9.65	6 90	—	—
—	943	♂	"	June 30, '68	"	14.25	30.25	9.75	5.60	—	—
—	944	♂	"	June 30, '68	"	14.60	30.20	10 80	6.00	—	—
10492	945	♂	"	June 30, '68	"	14.10	30.50	10.25	5.50	—	—
—	946	♂	"	June 30, '68	"	15.50	31.85	11.30	7.00	—	80
—	947	♂	"	June 30, '68	"	15.75	31.50	10.75	6.00	—	.80
—	949	♂	"	July 2, '68	"	13.75	29.90	10 45	5.85	—	.79
—	957	♂	"	July 2, '68	"	15.65	32.00	11.50	5.95	1.50	.75
10498	935	♂	"	July 2, '68	"	14.00	30.25	11 70	5.00	1.45	.77
10500	963	♂	"	July 2, '68	"	14.30	31.27	10.70	5.01	1.33	.77
10501	937	♂	"	July 2, '68	"	14.26	31.00	10.65	5.61	1.30	.76
—	969	♂	"	July 2, '68	"	15.60	31.60	10 85	6.70	1.39	.75
—	970	♂	"	July 2, '68	"	14.28	30.80	10.50	5.40	1 35	.81
—	971	♂	"	July 2, '68	"	14 40	31.60	10.30	5.70	1.40	.75
—	972	♂	"	July 2, '68	"	14.00	30.00	9.80	5.15	1.40	.78
—	973	♂	"	July 2, '68	"	15.00	31.00	9.90	5.80	1.50	.75
10503	975	♂	"	July 2, '68	"	15.20	30.50	10.56	5.85	1.43	.85
—	977	♂	"	July 2, '68	"	14.25	31.20	10.25	5.70	1.51	.80
10504	979	♂	"	July 2, '68	"	15 25	31.00	10.00	6 27	1.45	.81
—	930	♂	"	July 2, '68	"	14.70	30.55	10 40	5.45	1.51	.85
—	931	♂	"	July 2, '68	"	14 55	31.00	10.55	5.55	1.41	.75
—	932	♂	"	July 2, '68	"	13.00	29.00	10.30	4.81	1 35	.76
—	933	♂	"	July 2, '68	"	15.00	31.43	10 80	6.11	1 35	.75
—	993	♂	"	July 2, '68	"	14 50	31.50	10 70	5.80	1 45	.85
—	1000	♂	"	July 2, '68	"	15.77	30.00	10 50	5.75	1 55	.77
—	1002	♂	"	July 2, '68	"	14.25	31 00	10.65	5 75	1.50	.70
—	1003	♂	"	July 2, '68	"	14.00	30.30	10.35	5.60	1.41	.70
10476	904	♀	Wellfleet	June 26, '68	"	14.25	30.60	9.90	6.00	1.35	.70
10481	912	♀	Muskeget Isl.	June 29. '68	"	14.20	30.00	10.00	6.00	1.40	.76
10484	915	♀	"	June 29, '68	"	14.75	30.75	10.55	6.07	1 42	.75
10483	914	♀	"	June 29, '68	"	13.90	29.80	10.05	5.75	1.30	.75
—	918	♀	"	June 29, '68	"	13.60	28.50	10.00	5 50	1.36	.74
—	919	♀	"	June 29, '68	"	13.50	28.20	10.30	5.85	1.25	.75
—	921	♀	"	June 29, '68	"	13.60	30.25	10.25	5.65	1.26	.71
10487	922	♀	"	June 29, '68	"	13.55	30.55	10.63	5.70	1.25	.80
10488	924	♀	"	June 29, '68	"	13.10	29.50	10.50	5.20	1.35	.73
—	948	♀	"	June 30, '68	"	14.50	31.75	10.80	5.90	—	.80
10494	950	♀	"	July 2, '68	"	14.30	31 00	10.50	5.80	1 28	.80
10495	959	♀	"	July 2, '68	"	13.60	32 00	11 50	5.75	1 30	.80
—	960	♀	"	July 2, '68	"	15 50	31.75	11.25	5.41	1.43	.71
10498	965	♀	"	July 2, '68	"	13.56	30.00	10 30	5.14	1.30	.74
—	974	♀	"	July 2, '68	"	15.25	32 00	11.25	6.11	1 34	.90
—	976	♀	"	July 2, '68	"	14.20	30.20	10.26	5.55	1.31	.75
—	978	♀	"	July 2, '68	"	14.60	31.80	10.70	5.45	1.55	.80
10504	997	♀	"	July 2, '68	"	14.45	31.70	10.45	6.46	1.41	.80
10505	999	♀	"	July 2, '68	"	14.35	30.50	10.45	5 60	1.49	.80
—	1001	♀	"	July 2, '68	"	14.40	31.00	10.65	5.85	1.40	.85

179. **Sterna macrura** *Naumann.* ARCTIC TERN.

"Common at Dummitt's." — *Maynard.*

As already remarked under *Sterna hirundo* the individual variation in the present species is very great. The largest and smallest specimens in a series of twenty-five, taken at Muskeget Island in the breeding season measured as follows: —

Largest (♂): Length, 16.00; alar extent, 32.75; wing, 11.75; tail, 6.00.

Smallest (♀): Length, 14.33; alar extent, 27.52; wing, 9.85; tail, 4.26.

The maxima and minima of this series are as follows: —

Length, 14.10 and 17.00; alar extent, 27.52 and 32.75; wing, 9.85 and 11.84; tail, 4.26 and 8.25.

While the females average a very little smaller than the males, several of the females are very nearly as large as the largest males.

The *Sterna Forsteri* may also occur as a winter resident, but I have at present no evidence of its occurrence there at this season. A specimen from the "St. John's River, Florida," collected by Dr. Würdemann, is cited by Mr. Lawrence * and Dr. Coues † (Smithsonian collection No. 4928), but no information is given as to when it was collected.

180.* **Rhynchops nigra** *Linné.* BLACK SKIMMER.

Abundant on the coast, occurring in large flocks. Not observed by me on the St. John's.

COLYMBIDÆ.

181.† **Colymbus torquatus** *Brünnich.* LOON.

"A single specimen at Mandarin, on the Lower St. John's; abundant off Fernandina harbor." — *Maynard.*

The considerable number of specimens of this species in the Museum of Comparative Zoölogy show a wide range of individual variation. In a series of fifteen specimens from various localities in New England, but mainly from Massachusetts, the variation in the length of the folded wing amounts to twenty per cent of its average length in the whole series; in the length of the tarsus, to twenty-nine per cent; in the length of the outer toe, to thirty per cent; in the length of the head, to twenty-eight per cent; and in the length of the culmen to twenty-three per cent.

The form described some years since as *Colymbus Adamsi* seems to have been founded on very old specimens of the large northern race of *C. tor-*

* Baird's Birds of North America, p. 863.

† Proc. Acad. Nat. Sci. Phila., 1862, p. 547.

quatus, in which the color of the bill is unusually light, and the bill itself unusually produced.

182.† **Podiceps cornutus** *Latham.* Horned Grebe.

"Not uncommon on the St. John's." — *Boardman.*

183.† **Podilymbus podiceps** *Lawrence.* Carolina Grebe.

Abundant on the St. John's.

Résumé of the preceding Tables of Measurements, with supplemental Remarks.

The following tables present a brief summary of the measurements given in Part IV. In the first table is given the average dimensions of thirty-two species, based on specimens collected, in each case, essentially from the same locality, and generally based on twenty or more specimens, the number varying in the different species from thirteen to sixty-five specimens. In all cases where the average sexual difference in size is appreciable, the dimensions are given for each sex. In most cases very nearly all the specimens are from Eastern Massachusetts, a few being from different localities in Southern Maine, and a few from Northern Illinois. In a few species all the specimens cited are from Eastern Florida; in a few other species part of the specimens are from Southern New England and a part from Eastern Florida; but in these cases a separate average is made of those from each of the two localities. The number of the specimens on which the average is based is given in each instance.

The second table shows the range of individual variation in size in the same species, based also on the same specimens.

The third table shows the amount of geographical variation in size in specimens of the same species from northern and southern localities, these localities being generally Southern New England (Eastern Massachusetts in the main) and East Florida. Only seven species are cited, but I have traced about the same ratio of difference in a score or more of others, of which the measurements have not yet been published. Although the number of specimens compared from the two localities has in many of these cases been comparatively small, enough have been examined to show the general constancy of the variation in all the species which breed at both these localities.

It should be added that the specimens on which the generalizations given in Table III are based were not taken at the seasons likely to give the greatest differences, the northern specimens having been taken in summer and the southern ones in winter. Had *summer* Florida specimens been used instead of *winter* specimens, the differences would have been doubtless much greater, since in some cases, and especially in the cases of *Agelæus phœniceus* and *Quiscalus purpureus*, the summer home of a part at least of the Florida specimens must have been somewhat to the northward of Florida.

I. *Table showing the Average Dimensions of Thirty-two Species of American Birds, based on Measurements of Thirteen to Sixty-five Specimens of each Species.*

Species.	Locality.	No. of Spec'ns.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
Turdus Swainsoni	Southern New England	24	—	7.17	11.65	3.86	2.88	1.15
Turdus Pallasi	" "	46	—	7.04	11.17	3.97	2.72	1.15
Turdus fuscescens	" "	40	—	7.38	11.83	3.82	2.88	1 13
Harporhynchus rufus	" "	17	—	11.29	13.09	4.15	5.00	1.31
Mimus polyglottus	Florida	37	—	9.91	13.69	4.28	4.87	—
Galeoscoptes carolinensis	Southern New England	20	—	8.60	11.16	3.53	3.76	1.10
Sialia sialis	" "	20	♂	6.80	11.93	3.94	2.55	.78
Geothlypis trichas	" "	20	♂	5.10	6.93	2.17	2.00	.77
Parus atricapillus	Eastern Massachusetts	27	—	5.38	8.37	2.47	2.50	.70
Tyrannus carolinensis	Southern New England	20	—	8.00	13.77	4.49	3 30	.73
Pyranga rubra	" "	13	♂	7.05	11.33	3 76	2.69	.75
Troglodytes aëdon	Florida	15	—	4.89	6.61	2.05	1.80	.52
Passerculus savanna	Massachusetts	26	—	5.20	8 79	2.70	1.96	.84
Peucæa æstivalis	Florida	22	—	5.88	8 99	2.40	2.49	.70
Cardinalis virginianus	"	32	♂	8.46	11.43	3.63	3.87	—
	"	26	♀	8.27	11.27	3.53	3.77	—
Pipilo erythrophthalmus	Southern New England	30	♂	8.19	11.32	3 43	3.36	1.06
	Florida	19	♂	7.88	9.88	3.13	3.56	.94
Hedymeles ludoviciana	Southern New England	17	♂	7.77	12 15	3 93	2.82	.86
Icterus Baltimore	" "	20	♂	7.52	11.55	3 71	2.92	.92
Dolichonyx oryzivorus	" "	20	♂	7.24	11.67	3.78	2 67	1.00
Agelæus phœniceus	" "	40	♂	9.16	14.71	4.69	3.63	—
	" "	28	♀	7.53	12.24	3 86	2 93	—
Sturnella ludoviciana	Northern States	15	♂	10.43	16.30	4 91	3.16	—
	Florida	12	♂	9.81	15 70	4.47	2.85	—
	Northern States	8	♀	9 55	14.43	4.29	2.82	—
	Florida	9	♀	8.96	14.09	4 22	2.57	—
Quiscalus purpureus	Northern States	15	♂	10.43	16.30	4.91	3.16	—
	Florida	12	♂	9.81	15.70	4 47	2.85	—
	Northern States	8	♀	9.55	14.43	4.29	2.82	—
	Florida	9	♀	8.96	14.09	4.22	2.57	—
Quiscalus major	"	24	♂	16.51	22.48	7.19	7.00	—
	"	8	♀	12.95	17.94	5.67	5.11	—
Cyanura cristata	Massachusetts	18	—	11.71	16.87	5.13	4.89	—
	Florida	11	—	10.98	15 11	4 75	5.00	—
Cyanocitta floridana	"	12	—	11.74	14.44	4.41	4 80	—
Hylotomus pileatus	"	7	♂	17.48	28 07	9.21	6.82	—
	"	7	♀	16 44	26.80	8 98	6.54	—
Picus borealis	"	28	—	8.34	14.46	4.71	3.41	—
Colaptes auratus	Massachusetts	18	—	12.45	19.94	6.24	4.35	—
	Florida	11	—	11.66	18.82	5.84	4.40	—
Conurus carolinensis	"	19	—	13.10	21.76	7 59	—	—
Oxtyx virginianus	Illinois	7	♂	10.18	15.44	4.47	2.82	—
	Florida	16	♂	9 46	14.16	4.22	2.52	—
	Illinois	6	♀	9.83	15 10	4.36	2.67	—
	Florida	10	♀	9.37	14.02	4.17	2.54	—
Sterna hirundo	Massachusetts	45	♂	14.51	30.72	10.47	5.80	.78
	"	20	♀	13.85	30.59	10.57	5.74	.77

II. *Table showing the Range of Individual Variation in Thirty Species of American Birds, based on the Measurements of Thirteen to Sixty-five Specimens of each Species, collected at the same Locality.*

Species.	Locality.		No. of Speci'ns	Sex	Length	Alar Extent.	Wing.	Tail	Tarsus
Turdus Swainsoni	Southern New England	Min.	24	—	6.62	10 75	3.47	2.40	1.02
	" "	Max.	24	—	7 75	12 65	4.30	3.40	1.27
Turdus Pallasi	" "	Min.	46	—	6.50	10.00	3.30	2.47	1.12
	" "	Max.	46	—	7.65	12.25	3 90	3 17	1.33
Turdus fuscescens	" "	Min.	40	—	6 95	10.05	3.55	2 63	1 06
	" "	Max.	40	—	7.87	12.70	4 16	3.02	1 18
Harporhynchus rufus	" "	Min.	17	—	10 55	12 55	3.80	4.50	1 20
	" "	Max.	17	—	11.85	14.00	4.25	5.30	1.42
Galeoscoptes carolinensis	" "	Min.	20	—	7.80	10.50	3.25	3 35	1 05
	" "	Max.	20	—	9 00	11.95	3.85	4 10	1.18
Mimus polyglottus	Florida	Min.	37	—	9 27	13.00	4.00	4.10	—
	"	Max.	37	—	11.00	14 75	4 75	5 15	—
Sialia sialis	Southern New England	Min.	20	♂	6.10	11.10	3 85	2.33	.74
	" "	Max.	20	♂	7.00	12.55	4.10	2 77	.83
Geothlypis trichas	" "	Min.	20	♂	4.60	6.30	1.95	1 78	.72
	" "	Max.	20	♂	5.63	7.50	2 37	2.10	82
Pyranga rubra	" "	Min.	13	♂	6.75	10 65	3.57	2 55	.67
	" "	Max.	13	♂	7.30	11.75	4 00	2 85	.86
Parus atricapillus	Eastern Massachusetts	Min.	27	—	4.70	7.50	2 33	2.15	.62
	" "	Max.	27	—	5.75	8.60	2.63	2.67	.77
Troglodytes aëdon	Florida	Min.	15	—	4.30	6.10	1.90	1 30	.50
	"	Max.	15	—	5.10	6.95	2 44	2.40	.68
Passerculus savanna	Eastern Massachusetts	Min.	26	—	5.20	7.61	2.44	1.64	.75
	" "	Max.	26	—	6 00	9.75	2.95	2 25	.88
Peucæa æstivalis	Florida	Min.	22	—	5.75	7.60	2.17	2.25	—
	"	Max.	22	—	6.20	8.30	2 55	2.68	—
Cardinalis virginianus	"	Min.	32	♂	7.75	11.00	3.50	3 40	.62
	"	Max.	32	♂	9.10	11.78	3.85	4.20	.80
	"	Min.	26	♀	7.50	10.70	3.25	3 40	.62
	"	Max.	26	♀	8.75	11.75	3.85	4.10	.75
Pipilo erythrophthalmus	Southern New England	Min.	30	♂	7.50	10.00	3.17	3.30	.98
	" "	Max.	30	♂	8.80	12.25	3 90	3 93	1.13
	Florida	Min.	19	♂	7.20	9.50	2.80	3.25	.80
	"	Max.	19	♂	8.50	11.30	3.50	3.90	1.09
Hedymeles ludovicianus	Southern New England	Min.	17	♂	7.15	11.50	3 83	2 70	80
	" "	Max.	17	♂	8.30	12 90	4.25	3.08	93
Icterus Baltimore	" "	Min.	20	♂	7.00	10.40	3.45	2 70	.83
	" "	Max.	20	♂	8.00	12.00	3.85	3 10	1.02
Dolichonyx oryzivorus	" "	Min.	20	♂	6.65	11.00	3 53	2 45	.98
	" "	Max.	20	♂	7.70	12 15	4 00	2.82	1.15
Agelæus phœniceus	Massachusetts	Min.	40	♂	8.40	13.95	4.43	2 99	—
	"	Max.	40	♂	9 85	15.35	5.00	3 90	—
	"	Min.	28	♀	7.35	11.25	4.26	2.65	—
	"	Max.	28	♀	8.55	13.55	4.43	3 15	—
Sturnella ludoviciana	"	Min.	15	♂	10.00	15.05	4.74	2.82	—
	"	Max.	15	♂	11.00	17.00	5.15	3.58	—
	Florida	Min.	12	♂	8.50	13.00	3 90	2.40	—
	"	Max.	12	♂	9 50	4 75	4 65	2.90	—
Quiscalus purpureus	Northern States	Min.	13	♂	12 00	17.00	5.20	4 58	—
	" "	Max.	13	♂	13.50	18 43	6.05	6.00	—
	Florida	Min.	23	♂	11.00	15.25	5 00	4.55	—
	"	Max.	23	♂	13 00	17.80	5 75	5.50	—
Quiscalus major	"	Min	24	♂	15.50	21.10	6 25	6 25	—
	"	Max	24	♂	16.80	23.50	8.35	7 60	—
	"	Min.	8	♀	12.10	17 25	5.25	4.75	—
	"	Max.	8	♀	13.40	18.25	5.95	5.60	—
Cyanura cristata	Massachusetts	Min	18	—	11 00	16.00	4 33	4.25	—
	"	Max.	18	—	12 25	17.50	5.65	5.65	—
	Florida	Min.	11	—	10.70	14.75	4 00	4 80	—
	"	Max.	11	—	11 25	16 00	5.00	5.15	—
Cyanocitta floridana	"	Min.	12	—	11.00	13.50	4.00	4.25	—
	"	Max.	12	—	12.50	15.00	4 75	5.35	—
Tyrannus carolinensis	Southern New England	Min.	20	—	7.00	12 50	4.17	2.93	.67
	" "	Max.	20	—	8 65	14.80	4.85	3.54	.80
Picus borealis	Florida	Min	22	—	7 90	14.10	4.40	3.15	—
	"	Max.	22	—	8.60	15.20	4.95	3.75	—

Table II. (Continued.)

Species.	Locality.		No of Speci'ns.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Tarsus
Colaptes auratus	Massachusetts	Min.	18	—	12 00	19.00	6 00	4.00	—
	"	Max.	18	—	13.00	20.75	6 60	4.70	—
	Florida	Min.	11	—	10.60	17.60	5 60	4.10	—
	"	Max.	11	—	12.75	19.75	6.25	4.85	—
Conurus carolinensis	"	Min.	19	—	12 50	21 10	7.00	—	—
	"	Max.	19	—	13.60	22.50	7.85	—	—
Ortyx virginianus	Illinois	Min.	7	♂	10 00	15.00	4.37	2.55	—
	"	Max.	7	♂	10.50	15.60	4.60	3.00	—
	Florida	Min.	16	♂	9.00	13.80	4.00	2.30	—
	"	Max.	16	♂	10.00	14.75	4.50	3.00	—
	Illinois	Min.	6	♀	9.50	14.50	4.25	2.45	—
	"	Max.	6	♀	10.25	15.50	4.50	2.85	—
	Florida	Min.	10	♀	9.00	13.10	3.35	2.50	—
	"	Max.	10	♀	10.00	14 50	4.40	2.77	—
Sterna hirundo	Massachusetts	Min.	45	♂	13.00	29.00	9.65	4.81	—
	"	Max.	45	♂	15.70	32 00	11.70	7.00	—
	"	Min.	20	♀	13.10	28.20	9.90	4 75	—
	"	Max.	20	♀	15.50	32.00	11.50	6.11	—

III. *Table showing the Geographical Variation in Size in Seven Species of American Birds, between Specimens from Florida and the Northern States.*

Species.	Locality.	No. of Speci'ns.	Sex.	Length.	Alar Extent.	Wing.	Tail.	Tarsus.
Pipilo erythrophthalmus	Southern New England	32	♂	8.19	11 32	3.43	3 36	1.06
	Florida	26	♂	7.88	9.88	3.13	3.56	.94
Agelæus phœniceus	Southern New England	40	♂	9.16	14 71	4.69	3.63	—
	South Carolina & Florida	11	♂	9 02	14.41	4.62	3.61	—
Sturnella ludoviciana	Northern States	15	♂	10.43	16.30	4 91	3.16	—
	Florida	12	♂	9.81	15 70	4 47	2.85	—
	Northern States	8	♀	9.55	14.43	4.29	2.82	—
	Florida	9	♀	8 96	14.09	4.22	2.57	—
Quiscalus purpureus	Northern States	15	♂	10.43	16.30	4.91	3 16	—
	Florida	12	♂	9.81	15.70	4.47	2.85	—
	Northern States	8	♀	9.55	14.43	4.29	2 82	—
	Florida	9	♀	8.96	14 09	4.22	2.57	—
Cyanura cristata	Massachusetts	18	—	11.71	16.87	5.13	4.89	—
	Florida	11	—	10.98	15.11	4.75	5.00	—
Colaptes auratus	Massachusetts	18	—	12.45	19 94	6.24	4.35	—
	Florida	11	—	11 66	18.82	5.84	4.40	—
Ortyx virginianus	Illinois	7	♂	10 18	15 44	4.47	2.82	—
	Florida	16	♂	9.46	14.16	4.22	2.52	—
	Illinois	6	♀	9.83	15.10	4.36	2 67	—
	Florida	10	♀	9.37	14.02	4.17	2.54	—

In the tables and remarks contained in the preceding pages many facts have been given bearing upon the subject of geographical variation in birds, and especially in reference to the differences that almost universally obtain between specimens of the same species from northern and southern localities. In addition to the smaller size of the southern specimens, — a fact which has been for some time quite generally recognized, — attention has been called to the differences in color and in the form of the bill that seem almost equally constant and easy of recognition. In several species that range in the breeding season from Florida to Maine, a tendency to a relatively greater elongation of the tail in the Florida specimens has also been noticed, — a feature so well known to characterize a large proportion of the birds of Lower California, as pointed out some years since by Professor Baird, — but this variation is not so frequent as the differences in size, color, and in the length and form of the bill. As already remarked, the tail is not usually abbreviated proportionally to the general diminution in size in the southern or Florida forms of the birds of Eastern North America, and in some species it is actually longer than in the larger northern birds. As shown in the above tables, this is the case in *Pipilo erythrophthalmus*, *Cyanura cristata*, and *Colaptes auratus*, or in three species out of the seven cited in the last table.

In numerous instances the southern forms of the birds enumerated in Part IV of this paper have already been specifically separated from their northern relatives; and if the example of some previous writers was to be followed at least a dozen other similar species might still be added from among the birds of Florida. Some, indeed, might be referred to the already separated West Indian and Mexican or Central American so-called species rather than to the northern type. As already stated, I consider this almost universal similar variation of the southern representatives of species from their northern representatives to be the result of a law of gradual geographical differentiation, and that the interest of science is better subserved by simply recognizing these differences, and the law of geographical variation of which they are the result, than by giving to each newly discovered race a distinctive binomial name; and the more especially since in numerous instances there is the most indubitable proof of the gradual and almost imperceptibly minute intergradation of the extreme northern and extreme southern types, even in cases where they are the most widely diverse.

In conclusion, it may be stated that the differential diagnoses of the southern types, in cases where they have been specifically separated from the northern, and the comparisons of them made with the northern for the purpose of showing their specific distinctness, are in many cases admirable descriptions of the usual differences found to distinguish the Florida-born birds from their co-specific representatives born in the Northern States. These differences are commonly solely the following: In the southern types the size is smaller, the bill longer, and the colors generally darker; the latter resulting from the greater predominance of the black in those in which portions of the plumage are mottled with this color, and the greater breadth of the dark transverse bars, and the correspondingly diminished breadth of the alternating lighter ones. To illustrate this point more fully, I herewith append a list of some of the so-called species of American birds that have been specifically separated by different authors from their northern representatives, but which are in reality only the extreme southern forms of species previously well known, with which they were considered by the older writers to be specifically identical, the most of them having been separated within the last ten or fifteen years: —

Accipiter Gundlachi,	*separated from*	Accipiter Cooperi.
Accipiter fringilloides,	"	Accipiter fuscus.
Falco dominicensis, cinnamominus et sparveroides, etc.	"	Falco sparverius.
Mimus Gundlachi et Hillii, etc.	"	Mimus polyglottus.
Seiurus ludovicianus,	"	Seiurus noveboracensis.
Thryothorus Berlandieri,	"	Thryothorus ludovicianus.
Dendrœca Gundlachi, etc.	"	Dendrœca æstiva.
Chordeiles minor et Gundlachi, etc.	"	Chordeiles popetue.
Antrostomus cubanensis,	"	Antrostomus vociferus.
Xanthornus affinis,	"	Icterus spurius.
Sturnella hippocrepis et mexicana,	"	Sturnella ludoviciana.
Quiscalus baritus,	"	Quiscalus purpureus.
Corvus minutus,	"	Corvus americanus.
Ortyx cubanensis et texanus,	"	Ortyx virginianus.
Campephilus Bairdii,	"	Campephilus principalis.
Colaptes chrysocaulosus,	"	Colaptes auratus.
Butorides brunnescens,	"	Butorides virescens.
Actiturus longicaudus,	"	Actiturus Bartramius.
Macrorhamphus scolopaceus	"	Macrorhamphus griseus.
Charadrius tenuirostris,	"	Charadrius melodus
Larus argentatoides et Smithsonianus,	"	Larus argentatus.

In other cases the arctic forms, or the northern types, having been discovered subsequently to the southern ones, these have been described as specifically distinct from the latter. The *Bucephala islandica*, separated from the *B. americana* et *clangula*, and the *Collurio excubitoroides* from the *C. ludovicianus*, will serve to indicate the class of so-called species here referred to.

The Pacific Slope of North America furnishes a similar list of species, based on either southern or northern forms of others previously known; and the middle region of the continent its list of similar nominal species, mainly based on the desert forms of widely ranging species. In the northern half of the Old World, also, have the northern and southern geographical forms of the same species been specifically separated; but it is not my intention to call farther attention to them at present.

As already remarked, the American representatives of circumpolar species differ from the European and Asiatic principally in two ways, namely, in the apparently slightly larger size of the American, and in their somewhat brighter colors; but specific separations seem to have been based almost as frequently upon some theory of geographical distribution, or upon the individual variation of single specimens, as upon the real though slight differences that frequently obtain in such cases.

PART V.

On the Geographical Distribution of the Birds of Eastern North America, with special reference to the Number and Circumscription of the Ornithological Faunæ.

1. Introductory Remarks.

The distribution of plants and animals in circumpolar zones over the earth's surface has been long recognized; Humboldt* first making known the fact of such a natural distribution of the plants, and Agassiz,†

* Humboldt, A. von, et Bonpland, Aimé. "Essai sur la Géographie des Plantes," etc. 4to. Paris. 1805.

† Agassiz, Louis. "Essai sur la Géographie des Animaux," Revue Suisse et Chronique Littéraire, Tome VIII, pp. 441-452, 538-585, 1845. "Note sur la Distribution Géographique des Animaux et de l'Homme," Bulletin de la Société des Sciences Naturelles de Neuchatel, Tome I, pp. 162-166, 357-361, 366-369, 1845. "Sur la Distribution Géographique actuelle et le mode de l'apparition actuelle des Animaux à la surface du Globe." Ibid., Tom. 2, pp. 347-351, 1847. "Geographical Distribution of Animals," Edinburgh New Philosophical Magazine, Vol. XLVI, pp. 1-25, 1850. Ibid., Christian Examiner, Vol. XLVIII, pp. 184-204, 1850. "Sketch of the Natural Provinces of the Animal World and their Relation to the different Types of Man," Nott and Gliddon's Types of Mankind, pp. lviii-lxxxii, 1854. Also especially insisted upon in a course of unpublished Lectures delivered before the Lowell Institute, Boston, December, 1869.

Wagner,* Dana,† and others, subsequently establishing the same in regard to animals; the distribution of both plants and animals being primarily determined by the same influences. It has been further shown that these influences are mainly climatic, temperature having been justly recognized as governing the limitation, especially in latitude, of not only the species, but of faunæ and floræ. Their limitation in longitude is likewise as directly determined by climatic influences,‡ though indirectly by physical barriers, as oceans, mountain chains, and deserts. Humidity, in many instances, is scarcely a less, and in some cases a more, powerful limiting agent than temperature, plants being highly sensitive to hygrometric conditions, and their distribution intimately affects that of animals, since the existence of the latter is dependent upon the presence of the former, and their variety and numbers upon the degree of luxuriance of the vegetation. The faunal and floral zones hence coincide in their limitation in latitude with the climatic zones, but by no means necessarily with the geographical circles; isothermal lines, and not parallels of latitude, forming their boundaries. Their limits in longitude are determined by the influence geographical barriers, especially long chains of high mountains, exert upon climate.

* WAGNER, ANDREAS. "Die geographische Verbreitung der Säugethiere," Abhandlungen der baierischen Akademie der Wissenschaften, Math. Phys. Classe, Band IV, Abth. I, pp. 1-146, 2d Abth., pp. 1-108, 3d Abth., pp. 3-114. Mit 9 Karten, 1844-1846.

† U. S. Exploring Expedition Report, Crustacea, Vol. II, pp. 1451-1500, 1852.

‡ I am aware of the diversity of opinions still prevalent among naturalists in regard to the influence climate exerts in determining the geographical distribution of species, and that many writers on this subject attribute to it only a slight importance, or altogether ignore it. The limits of these preliminary remarks will not allow of an extended comparison of the views of different authors on this point, nor a detailed consideration of the supposed objections that have been raised against the proposition above expressed. I agree with Mr. Andrew Murray in his remark, that, although "various authors have endeavored to embody the differences between the faunas and floras of the different regions of the globe into some kind of system, ... they, with one or two exceptions, have worked upon no definite principle, and the result has been a mere catalogue of regions which possessed peculiarities without distinguishing their relative importance, or their relation to each other" (Geographical Distribution of Mammals, p. 296, 4to, London, 1866), — a remark which unfortunately seems in some degree applicable to Mr. Murray's own generalizations. That temperature is a powerful limiting influence affecting the range of species, especially in respect to their northward and southward extension, is so easily demonstrable that I am surprised to see it still questioned. I have myself subjected this principle to a rigid examination in studying the distribution of the animals and plants of Eastern North America, and have been surprised at the exact coincidence I have almost constantly met with between their northern and southern

The uniform character of both the flora and the fauna throughout the arctic zone is one of the most striking onto-geographical features thus far known, and one of primary importance, especially when taken in connection with its relation to the faunæ and floræ of more southern latitudes. Not less significant is the fact that in the temperate zone there is still a prevalence of identical forms in each of the three northern continents, where the resemblance of the animals and plants of either continent to those of the others is far greater than is the resemblance of those of the temperate regions of either continent to those of the tropical portions of the same continent.

Different animals and plants, as every one recognizes, are differently limited in respect to their geographical range. A small proportion of the species are almost or quite cosmopolitan; others range over the greater part of the northern hemisphere, finding their southern limit of distribution near the tropics. A few are exclusively arctic, or range only over the arctic and cold-temperate zones. Many are limited to the temperate zone, throughout nearly the whole of which they find a congenial home. A large number can only exist within the tropics, often

limits of distribution and isothermal lines, they following them in all their numerous undulations, sweeping northward in the valleys and southward along the sides of mountain ranges. The occurrence on isolated alpine summits of species existing at a lower level only far to the northward, is of itself suggestive of the powerful influence temperature has on the distribution of animals and plants. In the northern hemisphere a northern fauna and flora everywhere extends along the mountains hundreds of miles to the southward of their respective limits in the adjoining plains and valleys. Various other causes have, of course, a greater or less influence in determining the range of species, but none other, on the land areas, humidity perhaps alone excepted, is nearly so potent. The want of conformity of isothermal lines with parallels of latitude has doubtless led to confusion in regard to this subject, since vain attempts have often been made to circumscribe the botanical and zoölogical zones by the latter.

Differences of temperature evidently explain many of the otherwise seemingly inexplicable sudden transitions in the faunæ and floræ of adjoining regions, especially in regard to the marine animals and plants, temperature forming a strong barrier to the commingling of species inhabiting the waters of opposite sides of peninsulas having a north and south trend, or such long narrow points of land as terminate the South American and African continents. Those of the one side cannot pass to the other without passing through a zone of colder water than their organization will allow them to sustain. The isotherms of the continents are widely deflected by the irregularities of the surface of the land, running nearly straight and parallel across level areas; but in mountainous districts they bend abruptly northward or southward, following along the sides of mountains instead of crossing them. In the same manner are species, and faunæ and floræ, limited, — a coincidence clearly indicative of the strong influence climates exert in determining their geographical limits.

embracing whole families, none of whose representatives are found outside of the torrid zone of a single continent. Others are again equally at home in the torrid and warm temperate zones, but which do not exist either in the arctic or cold temperate zones; others range throughout the temperate and subtorrid. Nearly an equal number, some tropical, but the greater part temperate species, range across continental areas, within which, however, they are restricted. A great number of others find their range limited in longitude to the half or the third of a continent, and others within still more circumscribed boundaries, fluviatile species being frequently confined to single river basins. Through this diversity of geographical range we have what may be termed *cosmopolitan*, *semi-cosmopolitan*, *circumpolar*, *continental*, *semi-continental*, and (relatively speaking) *restricted* species. The circumpolar and the continental are again *realm* species, the semi-continental and restricted, *province* species. Rarely is any species limited to a narrower area than that of two or three faunæ or floræ. Hence faunæ and floræ — which terms, in their restricted sense, are properly applied only to the smallest of the onto-geographical divisions — are determined by the peculiar association of species, and not by the range of a single or of a few "restricted" species; hence by their general facies. Provinces, and realms, on the other hand, may have species, and even genera and families, exclusively distinctive of them. As there are cosmopolitan, circumpolar, continental, and other kinds of species, so there must be cosmopolitan, circumpolar, continental, and other kinds of genera and families; the latter, as well as species, having each a definite or specific geographical range as distinctive of them as any biological or anatomical character may be. They are each circumscribed within definite areas, beyond which their special adaptation to their natural surroundings forbids their extension, unless aided by extraneous and unusual circumstances.

The three divisions of zones, realms (or "regions"), provinces, and faunæ and floræ,* comprise the phyto-zoölogic divisions usually recog-

* *Zone*, *realm*, *region*, *kingdom*, and *province*, are terms which have been used by different authors to designate the primary natural-history divisions of the earth's surface. In deciding as to which of these terms should be exclusively applied to these divisions, not only priority of use, but appropriateness, should of course be considered, and also the sense in which they are at present currently employed, in order to avoid, as far as possible, the confusion necessarily attending changes of nomenclature. So far as priority is concerned, zone undoubtedly has the precedence, it having been used for animals by Wagner in 1844, by Agassiz in 1845, and much earlier than this by Humboldt and others in relation to the distribution of plants. It is, however, not always a strictly convenient

nized. The boundaries of realms and provinces have often been arbitrarily fixed, inasmuch as they have been frequently limited and named in conformity to the continental areas, regardless of the fundamental law of the distribution of life in circumpolar zones.*

In addition to the law of the circumpolar distribution of life in zones, another may be recognized, namely, that *of a differentiation from the north southward*, since in passing from the northern pole to the equator we meet with a constant and accelerated divergence in the character of the animals and plants of successive regions of the continent. More or less related to the last is a third law of differentiation, namely, *a divergence of the life of given portions of continental areas from that of the corresponding portions of other continents, in proportion to the oceanic space separating such corresponding regions.* As evidence of this fact we have but to compare successively the life of the north temperate, tropical, and south temperate zones of the Western hemisphere with the life of the corresponding zones of the Eastern hemisphere; or that of Australia with the life of the other continents, as a whole; or that of tropical Asia with Africa or South America. A comparison of Africa with South America, and the faunæ and floræ of islands with those of the different continents, further corroborates this law. There is, furthermore, a correlation between the diversity

term. Realm, region, fauna and flora, and province, have been also successively used in the same sense, and also for divisions of subordinate rank, and in different ways by even the same writers. In regard to the names of the divisions of the second, third, and fourth rank, there is an equal want of uniformity in the use of the terms by which they have been designated. As being most convenient and least opposed to current usage, the following schedule of names for the primary and subordinate divisions has been adopted in the present paper: —

Realms for divisions of the first rank.

Regions for divisions of the second rank.

Provinces for divisions of the third rank.

Districts for divisions of the fourth rank.

Faunæ and *floræ* for the smallest or ultimate divisions, like the bird faunæ of Eastern North America, presently to be characterized.

Intermediate divisions to some of those above mentioned may in special cases be required; but until the necessity for them is made apparent, no names for such need be proposed.

* SCLATER, P. L. "On the general Geographical Distribution of the Members of the Class Aves," Jour. of the Proc. of the Linnæan Society, Vol. II, Zoölogy, pp. 130 – 149, 1858. The divisions proposed by this author have been quite generally adopted, but without corroboration, or apparently a critical examination of their merits.

of life in a given area and the relative temperature of that area, the number of distinct forms increasing directly with the increase in the temperature, other conditions remaining essentially unchanged. The number of distinct species and geographical races also increases directly with the increase in the diversity of the conditions of life resulting from differences of geographical configuration. Hence faunæ and floræ cover a smaller area in the warm temperate and tropical latitudes than at the northward, and in a mountainous region than in a level region. Hence within the torrid zone, where a maximum temperature is generally associated with a highly diversified surface, species, genera, and families are the most numerous, and faunæ and floræ, as well as species, are ordinarily the most narrowly circumscribed.

In accordance with the facts stated above respecting the mode of the distribution of animals and plants over the earth's surface, and the zoölogical and botanical laws of the differentiation and mutual relations of the different regions, the following primary natural-history divisions may be recognized: I, an *Arctic Realm;* II, a *North Temperate Realm;* III, an *American* Tropical Realm;* IV, an *Indo-African Tropical Realm;* V, a *South American Temperate Realm;* VI, an *African Temperate Realm;* VII, an *Antarctic Realm;* VIII, an *Australian Realm.*

The *Arctic Realm* presents a nearly uniform character throughout its extent, and, though embracing several faunæ, is not divisible into

* The terms "Palæogean" and "Neogean," "Palæarctic" and "Nearctic," etc., like those of "Old World" and "New World," have been given with reference solely to the length of time the different land areas of the earth's surface have been known to the dominant race of mankind, and hence regardless of the zoölogical history of these different land areas. Modern science has taught us that the latest discovered continent (Australia) is peopled with the most ancient types of animals and plants now in existence, and that it is, zoölogically considered, the ancient continent. Also that North and South America are behind Europe, Asia, and Africa in their zoölogical and geological development, while they are far in advance of Australia. To apply the term "ancient" to what is really the most recent, and "modern" to what is mediæval, is evidently too great a misuse of language to be allowable in scientific nomenclature. The sciences of geographical zoölogy and geographical botany concern not merely the geographical distribution of the animals and plants now living, but also those of the past. If such descriptive terms as the above are to be employed, it is evidently important that they should be used in their legitimate sense. In the present paper it has hence been considered advisable to altogether discard these terms, since to use them properly would necessitate their adoption in a manner directly opposite to their original and generally accepted application.

provinces. Its southern boundary may be considered as the northern limit of forest-trees, or about the isotheral of 50° F.

The *North Temperate Realm* presents a more varied character, and is divisible into an *American Region* and an *Europæo-Asiatic Region,* each of which is divisible into provinces, districts, and faunæ and floræ. Its boundaries may be provisionally considered as the isotherms of 32° and 70° F.

The *American Tropical Realm*, and also the *Indo-African Tropical Realm*, may be regarded as bounded by the isotherms of 70° F. The first is far more homogeneous than the second. Though the American Tropical Realm is perhaps not divisible into distinct regions, it certainly embraces several provinces and districts, and is rich in faunæ and floræ. The Indo-African Tropical Realm may be divided into an African Region and an Indian Region, each composed of several provinces and districts, and a great number of faunæ and floræ.

The *South American Temperate Realm* embraces that part of South America south of the isotherm of 70° F.; the *African Temperate Realm* includes that part of Africa south of the same isotherm, whilst the *Antarctic Realm* is restricted to the antarctic islands.

The *Australian Realm*, embracing Australia, New Zealand, New Guinea, and their dependent islands, including those to the eastward as far as Timor and Celebes, is zoölogically as distinct from the other primary regions as it is in its geographical position. It is divisible into a Temperate and a Tropical Region, the former embracing New Zealand and the southern third of Australia. Each of these regions includes two or three well-marked provinces.

The above division of the earth's surface* avoids the arbitrary partitioning of an almost homogeneous Arctic Realm between two

* It is not within the scope of the present article to trace the subdivisions of the earth's surface in relation to the distribution of its organic life any further than to furnish illustrations of the general principles according to which it is believed animals and plants are distributed, and by which the land surface of the earth is divided. Determining the rank of the several divisions by the amount of variation from others they present, it is found, as indicated above, that the divisions of co-ordinate rank increase in number to the southward. The Arctic Realm is homogeneous to such an extent as not to admit of divisions of a higher grade than faunæ and floræ. In the Temperate Realm the animals and plants of the Eastern and Western hemispheres are, as a whole, so far different as to admit of the division of this zone into two grand divisions (divisions of the second order), with other divisions between these and the ultimate ones. In the Tropical Realm the differences in the life of the two hemispheres is so great as

implied totally distinct life regions, and also a similar division of the two slightly differentiated regions of the North Temperate Realm. For nearly all the species, and hence of course the genera and families, of the Arctic Realm, and a considerable percentage of the species, a larger proportion of the genera, and nearly all the families of the Temperate Realm, occur in the northern parts of both the so-called "Neogean" and "Palæogean Creations."* It is thus seen that the life of the North Temperate Realm differs far more from that of the Tropical Realms than the life of the Old World does from that of the New. Hence the subdivision of the earth's surface into primary ontological regions, according in area with the two primary divisions of the land, now so generally adopted, is contrary to the facts, since it wholly ignores the close resemblance of the animals and plants inhabiting the north temperate and arctic regions, and the striking differences between them and those of the intertropical zone. The recognition of a "Nearctic" as contradistinguished from a "Palæarctic Region" is almost equally arbitrary and at variance with the law of the distribution of life in circumpolar zones.†

Dana, in his map of the geographical distribution of marine animals,‡ divided the Tropical Zone into four subzones, — a North and a South Torrid and a North and a South Subtorrid; and each temper-

to require a division of the torrid zone, considered as a *climatic* zone, into two primary divisions, with subdivisions of each of several ranks. The south temperate (climatic) zone is similarly divisible, while the Australian Realm, from its isolated position and its remarkable individualization, forms a primary region, with subdivisions of various grades.

* Dr. Sclater properly observes: "It cannot be denied that the ornithology of the Palæarctic, or great temperate region of the Old World, is more easily characterized *by what it has not rather than by what it has.* There are certainly few among the groups of birds occurring in this region which do not develop themselves [to an equal or] to a greater extent elsewhere," etc. — *Journ. of Proc. Linn. Soc., Zoölogy,* Vol. II, p. 137.

† I may here add that the homogeneousness of the life of the boreal regions has been recognized by a number of recent writers, among whom are Dr. L. K. Schmarda, Dr. Von Middendorff, and Professor Huxley, who have each recognized a circumpolar region. Professor Huxley has also called attention (see Proc. Zoöl. Soc. Lond., 1868, pp. 313–319) to the wide divergence of the life of the tropics from that of the north-temperate regions of even the same continents, and the individualization of Australia and its adjacent islands. He considers that the whole surface of the globe may be "primarily subdivided into two principal areæ, — a northern and a southern," for which he has proposed the names *Arctogæa* and *Notogæa*. The latter he has divided into three regions, — *Austro-Columbia* (= Neotropical Region of Sclater), *Australasia*, and *New Zealand.*

‡ Rep. on Crust. of U. S. Expl. Exped (Vol II), under Capt. Wilkes.

ate zone into five subzones, — a Temperate proper, a Subtemperate, a Warm Temperate, a Cold Temperate, and a Subfrigid. These zones are equally recognizable in the distribution of terrestrial life; but, owing to inequalities of its surface, they are of course less regular on the land than on the oceans.

The zones and subzones, or the Provinces and the minor phytological and zoölogical divisions of the globe, are usually not trenchantly defined. Their boundaries being determined by climatic conditions, the transition between adjacent zones, or between ontological divisions of whatever rank, is rarely abrupt; like the climatic zones, they blend more or less at their edges, their boundaries being strongly marked only in regions possessing a highly varied surface, as in mountainous districts. They are, nevertheless, easily recognizable, and can be approximately defined. Generally the dividing lines are more or less undulating, and, being determined indirectly by chains of mountains and other physical barriers, adjoining faunæ and floræ, and even adjoining provinces and realms, almost always interdigitate, and frequently enclose isolated areas of others, as will be presently shown in describing the ornithological faunæ of Eastern North America.

The boundaries of faunæ and floræ, like the range of species, are determined indirectly by elevations and depressions of the earth's surface, these variations in the altitude of the land producing varying conditions of temperature and humidity, which latter, as already stated, are the direct limiting influences of species, and of the botanical and zoölogical divisions of the globe. The permanency of their boundaries hence depends upon the constancy of the physiographic conditions of these areas, a migration of species, and of faunæ and floræ, necessarily following changes in these conditions. That such migrations have taken place is evident from the occurrence in the post-tertiary deposits of the warm temperate latitudes of the fossil remains of species found now only in the cold temperate and arctic regions, and in the tertiary strata of high latitudes of the remains of other species whose nearest allies are now found in the warm temperate and subtropical zones. These facts indicate clearly the great changes in temperature that have repeatedly occurred at given localities during the earth's history. In respect to existing animals, however, it is difficult to determine how much their known recession northward, as of the reindeer, for example, is due to climatic changes, and how much to human agency, or whether it may not be due exclusively to the latter cause.

2. The Natural Provinces of the North American Temperate Region.*

Before passing to the special subject of the present article, it will be necessary to consider briefly the North American continent as a whole. As already shown, North America embraces portions of three realms, the Arctic, the North Temperate, and the Tropical. It belongs mainly, however, to the North Temperate Realm, of which the temperate portions of North America form the Western Region. Within this Region may be recognized two Provinces, — an Eastern and a Western, — quite distinct from each other in their general features as well as in many special characteristics. The Eastern Province is characterized by the uniformity of its geographical and climatic features and by a corresponding uniformity in its faunal and floral aspects. The Western Province, on the other hand, is characterized by the diversity of its geographical and climatic features, — different areas situated under the same parallels differing greatly in these respects, — and by the number and small extent of its zoölogical and botanical areas, and its comparatively numerous restricted floræ and faunæ.

The Eastern Province † extends in the United States from the Atlantic seaboard to the vicinity of the 100th meridian, but to the northward its western boundary sweeps rapidly westward, and extends to the Rocky Mountains, whilst farther northward, where it approaches the Arctic Realm, it occupies the whole breadth of the continent. Its western border is not generally abruptly defined, and is, moreover, quite irregular, through its extension up the valleys of the numerous rivers which enter it from the westward. According to Professor Baird, its western boundary "starts on the Gulf of Mexico near the eastern border of Texas, perhaps between the Brazos and the Sabine, and follow-

* The "Districts" of the North American Region. or the ontological divisions of this region of the fourth rank, can be more conveniently characterized after the several faunæ have been defined, to which point in the paper their consideration is accordingly deferred.

† The boundaries of these two regions have been sketched with apparent accuracy by Professor Baird. See American Journal of Science and Arts, 2d Series, Vol. XLI, pp. 82-85, Jan., 1866.

ing up the direction of the former river to the approaches of the Great Desert, nearly on the meridian mentioned [the 100th], proceeds northward, forced sometimes more or less westward, especially along the Platte, sometimes eastward. It crosses the Platte between Forts Kearney and Laramie and intersects the Missouri between Fort Randall and Fort Pierre, perhaps near Fort Lookout, as it is between the first mentioned two points that in ascending the river we find the change to take place in the ornithology of the country. Soon after crossing the northern boundary of the United States the line rapidly inclines westward and extends to the Rocky Mountains." To the southeastward this region embraces the whole of the United States, except perhaps the southern portion of Florida, which is decidedly West Indian and tropical in its affinities. To the northward it embraces the whole northern and eastern portions of the continent up to the Arctic Realm.

The Western Region commences at the western border of the Eastern, and extends thence to the Pacific coast. In the United States its area is about two thirds that of the Eastern Province, but a little farther to the northward it narrows rapidly, and is finally bounded in this direction by the Alaskan mountains.* To the southward it of course merges in Mexico into the Tropical Realm, but its southern limit is not as yet well known. While its varied character renders it subdivisible into several more or less distinct longitudinal areas, each of which may be again divided transversely into numerous faunæ and floræ, many species range throughout its whole extent and give to it a certain degree of homogeneousness. This portion of North America is, however, as yet too indefinitely known, geographically and meteorologically, as well as ontologically, to admit of the exact definition of its primary and ultimate life regions.

The Eastern Province, notwithstanding its larger area, has not only a less number of ornithological faunæ than the Western, but has also a smaller number of species represented in it, as well as a smaller number exclusively restricted to it. The following list of one hundred and eight species embraces most of the birds that are exclusively restricted to the Eastern Province, and hence those that distinctively characterize this Province.

* According to Mr. W. H. Dall. See Proc. Bost. Soc. Nat. Hist., Vol. XII, p. 144, Dec., 1868.

List of Species limited in their Longitudinal Distribution to the Eastern Province of the North American Temperate Region.

1. Turdus mustelinus.
2. Sialia sialis.
3. Mniotilta varia.
4. Parula americana.
5. Prothonotaria citrea.
6. Geothlypis philadelphia.
7. Oporornis agilis.
8. Oporornis formosa.
9. Helmitherus vermivorus.
10. Helminthophaga Swainsoni.
11. Helminthophaga pinus.
12. Helminthophaga chrysoptera.
13. Helminthophaga Bachmani.
14. Helminthophaga ruficapilla.
15. Helminthophaga peregrina.
16. Seiurus aurocapillus.
17. Seiurus noveboracensis.
18. Dendrœca virens.
19 Dendrœca cærulescens.
20. Dendrœca coronata.
21. Dendrœca blackburniæ.
22. Dendrœca castanea.
23. Dendrœca pennsylvanica.
24. Dendrœca cærulea.
25. Dendrœca striata.
26. Dendrœca maculosa.
27. Dendrœca palmarum.
28. Dendrœca dominica.
29. Dendrœca discolor.
30. Perisoglossa tigrina.
31. Wilsonia mitrata.
32. Euthlypis canadensis.
33. Setophaga ruticilla.
34. Pyranga rubra.
35. Pyranga æstiva.
36. Vireosylvia olivacea.
37. Vireosylvia philadelphica.
38. Lanivireo flavifrons.
39. Vireo noveboracensis.
40. Galeoscoptes carolinensis.
41. Harporhynchus rufus.
42. Thryothorus ludovicianus.
43. Cistothorus stellaris.
44. Lophophanes bicolor.
45. Parus hudsonicus.
46. Coturniculus passerinus.
47. Coturniculus Henslowi.
48. Ammodromus caudacutus.
49. Ammodromus maritimus.
50. Zonotrichia albicollis.
51. Junco hyemalis.
52. Spizella monticola.
53. Spizella pusilla.
54. Peucæa æstivalis.
55. Passerella iliaca.
56. Euspiza americana.
57. Hedymeles ludoviciana.
58. Cyanospiza ciris.
59. Cyanospiza cyanea.
60. Cardinalis virginianus.
61. Pipilo erythrophthalmus.
62. Dolichonyx oryzivorus.
63. Icterus spurius.
64. Icterus baltimore.
65. Quiscalus purpureus.
66. Corvus ossifragus.
67. Cyanura cristata.
68. Sayornis fuscus.
69. Campephilus principalis.
70 Picus borealis.
71. Sphyrapicus varius.
72. Centurus carolinus.
73. Melanerpes erythrocephalus.
74. Colaptes auratus.
75. Coccygus americanus.
76. Coccygus erythrophthalmus.
77. Conurus carolinensis.
78. Trochilus colubris.

79. ?Chætura pelasgia.
80. Antrostomus vociferus.
81. Antrostomus carolinensis.
82. Nauclerus furcatus.
83. Ictinia mississippiensis.
84. Rosthramus sociabilis.
85. ?Tetrao canadensis.
86. Cupidonia cupido.
87. Ortyx virginianus.
88. Grus americanus.
89. Florida cærulea.
90. Ibis alba.
91. Platalea ajaja.
92. Ægialitis Wilsonius.
93. Ægialitis melodus.
94. ?Actiturus Bartramius.
95. Limosa hudsonica.
96. ?Numenius borealis.
97. Rallus crepitans.
98. Porzana jamaicensis.
99. Porzana noveboracensis.
100. Gallinula galeata.
101. Gallinula martinica.
102. Anas obscura.
103. Querquedula discors.
104. Camptolæmus labradorius.
105. Sula fiber.
106. Graculus floridanus.
107. Plotus anhinga.
108. Chrœcocephalus atricilla.

3. The Ornithological Faunæ of the Eastern Province of the North American Temperate Region.

Passing to the Eastern Province of the North American Region, the distribution of the birds will be now mainly considered. But a somewhat detailed comparison of the distribution of the representatives of this class with the distribution of the mammals and reptiles, and to some extent with the insects, mollusks, and plants, shows that the same divisions apply almost equally well to all. The distribution of plants, however, is everywhere greatly affected by the nature of the soil, as well as by humidity and temperature; and the character of the vegetation is also intimately connected with the distribution of the insects. The character of the soil, and especially the nature and amount of the mineral matter held in solution in the waters of the streams and lakes, has much to do with the relative abundance and distribution of the terrestrial and fluviatile mollusca, neither of which influences materially affects the distribution of the birds and mammals. The presence or absence of forests only, in respect to vegetation* and the soil, has much

* At the junction of the prairies with the eastern wooded districts there is quite an appreciable change in the fauna, especially in respect to the birds and mammals. The faunal differences between these regions, in respect to these two classes, result mainly through the addition of a relatively small number of strictly prairie species, the westward extension of none of the species of the Eastern Province wholly terminating at this point. The number of their representatives, however, becomes greatly reduced, and their distribution from being general and uniform is restricted to the belts of

influence on the distribution of the terrestrial vertebrates. The distribution of the fishes, the aquatic reptiles and certain groups of batrachians is, however, in great measure determined by the hydrographic basins. Hence we meet with relatively more restricted forms among the latter, as well as in insects, mollusks, and plants, than we find in either mammals or birds, the latter class being the most independent of all animals of geographical barriers.

It has been remarked that the great extent of the Eastern Province, as compared with the Western, is due to the great extent of the lowlands of Eastern North America, or of that area which has an elevation not exceeding eight hundred feet above the sea.* This is unquestionably the true reason, there being no highlands of sufficient altitude to interpose serious obstacles to the range of species. Some portions of this area, however, as the Arctic lowlands, do not belong to this region, while large portions of the country included in the Eastern Province more or less exceed that altitude. These differences of elevation are sufficient to cause the marked interdigitation of the faunæ of contiguous regions lying under the same parallels, as in the Eastern United States, where the upper portions of the Appalachian system support a Canadian or subalpine fauna and flora as far south as Georgia. Yet this elevation, in consequence of its nearly meridional trend and its lack of perfect continuity, forms a barrier to but few vertebrates except the strictly aquatic ones. If, however, the trend of the Appalachian range had been an easterly and westerly one, the influence of these highlands as a geographical barrier would have been most marked. Without the differences in altitude it affords, the faunæ and floræ of Eastern North

forest skirting the streams. At the eastern limit of the prairies, in fact, the distinctively western species begin to appear, thence westward few additional western species being met with till the edge of the great central plateau of the continent is reached, where the differentiation is further increased not only by the addition of many new forms, but by the gradual disappearance of eastern types. Whether the addition of a few prairie species be sufficient reason for recognizing a western subdivision of each of the faunæ of the Eastern Province may perhaps be thought questionable.

The forested portion of the Eastern Province also presents a lack of total uniformity between its eastern and western portions, a few species of birds occurring east of the Appalachians in the Eastern States only as stragglers, whilst they are quite common west of these highlands. About half a dozen species avoid the region circumscribed by the valleys of the St. Lawrence, Lake Champlain, the Hudson River, and the Atlantic Coast, that are found west of this area.

* See Baird, Am. Journ. of Science and Arts, 2d Series, Vol. XLI, p. 86.

America would have extended in regular and parallel zones from the Atlantic seaboard to the central plateau of the continent, whereas they now sweep far southward near the coast, and passing around the Appalachian highlands extend northward again along their western base.

In attempting to determine the number and limits of the ornithological faunæ of a large area, it is evident that the distribution of the birds in the breeding season should be taken as the basis for the investigation rather than their entire range, since during no other portion of the year can the migratory species be regarded as being at their true homes. The species numerously represented are also of far greater importance than those having but few representatives, as it is the common species which are not only the most characteristic, but those whose distribution is at present best known.

Applying the term *fauna*, when used in a special sense, to the smallest of the natural divisions in zoölogical geography, and considering faunæ to be characterized by their general facies, as determined by a peculiar assemblage of species, rather than by the restriction of a certain number of specific forms within their areas, Eastern North America may be considered as embracing seven ornithological faunæ, which occupy narrow, somewhat parallel zones or belts of varying breadth, extending from the Atlantic coast westward to the great middle plateau of the continent. The extent of each in an east and west direction is generally many times greater than what may be considered as its meridional extent. Their breadth, however, is quite unequal, not only as compared with each other, but that of the same fauna varies greatly at different points. They have their minimum breadth on the slopes of the mountains, and attain their maximum breadth on the plains. Each species having its own peculiar limits, which may or may not coincide with those of other species, it usually happens that at somewhat regular intervals, in passing either northward or southward from a given point, a greater number of species disappear at some points than at others, at which point also other species first appear. These divisional lines usually coincide with some marked physical change in the general character of the country, more especially in respect to its elevation, and form the boundaries between adjoining faunæ.* These faunal boundaries, as has been before remarked, coin-

* The first terrace of the Atlantic slope, which marks not only the transition from the tertiary deposits of the coast of the Middle and South Atlantic States to the older forma-

cide with isothermal lines. These isothermal lines, however, are not so often the yearly isotherms as those of particular seasons. While some writers have considered isocrymal lines as those having the greatest amount of limiting influence, as Dana has supposed to be the case with marine animals,* and as may be true in the case of plants, and possibly also of some terrestrial animals, † the mean temperature of the breeding season must necessarily more affect birds, especially the migratory species, than that of any other part of the year, or than the mean annual temperature. Isotherals hence most nearly coincide with the lines limiting the distribution of birds in the breeding season, and also the ornithological faunæ, since the majority of the species in the region now under consideration breed almost exclusively during the summer months, and mainly in June and July. Some breed in May, and a few of the rapacious birds in April, and even in March, but they are the exceptions to the general rule. The isotheral lines are hence adopted in the present essay in giving the boundaries of the ornithological faunæ. ‡

Owing to the imperfect state of our knowledge of the summer distribution of the birds of North America, the present attempt at a defini-

tions of the interior, as well as forming the limit of steam navigation on the rivers of the lower Atlantic States, forms also the dividing line between the faunæ of the coast and those situated next to them in the interior, although having an altitude of generally less than three hundred feet. The rise from the succeeding plateau to the more abrupt slope of the Appalachians forms likewise the boundary between the second and third tiers of faunæ in the Atlantic States. The terrace forming the northern boundary of the tertiary deposits of the Gulf States, and of the lower Mississippi Valley generally, coincides likewise with faunal boundaries, as do similar slight changes in elevation elsewhere.

* See Report on the Crustacea collected by the U. S. Expl. Expd. under the command of Captain Wilkes, Vol. II, p. 1452.

† There must, however, be many exceptions, since in cold climates many mammals and all reptiles, as well as a large proportion of the mollusca and insects, hibernate, and thus are to a great degree (especially the reptiles) beyond the influence of excessive cold. In regard to plants, also, their northward range seems to be limited more by the amount of heat in summer than by the cold of winter, particularly in the case of annuals. As soon as the sum of the heat of summer is diminished to such a degree as to be insufficient to mature the plant, or to allow it to ripen its fruit, whether an annual, a shrub or tree, it must at that point cease to propagate, and there find its polar limit.

‡ Professor A. E. Verrill states that he has found the "boundaries between the Canadian and Alleghanian Faunæ" to be "coincident with a line which shall indicate a mean temperature of 50° Fahrenheit during the months of April, May, and June." *Proc. Bost. Soc. Nat. Hist.*, Vol. XII, p. 260, May, 1866.

tion of the faunæ of this region is to be regarded as merely a provisional one, to be perfected as the required data become known. The distribution in summer of the birds of the United States, even of that portion situated east of the Mississippi River, is still too little known to afford even there entirely satisfactory data. The data are tolerably full only for the region embraced between the St. Lawrence and the Upper Lakes on the north, and the Ohio River and Virginia on the south. Much is also known, however, in regard to the summer distribution of the birds in the other Atlantic States; but in respect to the whole region of the lower Mississippi and the Gulf States, the recorded facts bearing on this subject are lamentably few.* The isothermal lines of even our best climatological charts are also obviously more or less erroneous, and are nowhere laid down with sufficient detail to meet the wants of the student of zoölogical geography. The following lists of those species which by their presence or absence determine the facies of the several faunæ of the Eastern Province are hence not only often incomplete, but will in some cases, doubtless, require more or less modification as our knowledge of the subject increases.† The facts at hand for the work herein attempted are, however, far more numerous than would at first seem probable; ‡ and doubtless the general conclusions reached in the following pages will be in the main substantiated by future investigations.

Beginning with Florida and passing northward, we meet with the following ornithological Faunæ: —

I. Floridian Fauna. As stated in Part I (p. 164), that part of Florida south of Lake George in the interior, and of Cape Canaveral

* The importance of complete and carefully annotated lists of the birds of many localities in the South Atlantic and Gulf States, and in the Mississippi Valley, is hence clearly manifest. Now that the necessity of a precise knowledge of the habitats of animals is so generally recognized, it is to be hoped that every year will add something to our knowledge in regard to these regions.

† This is especially true in respect to the Floridian, Louisianian, and Carolinian Faunæ. Over this large area I have been unable to determine satisfactorily the exact southern limit of the breeding range of any species. Their northern limit, however, is readily approximately determined.

‡ See the Appendix to Part V for a list of the special papers that have been consulted in the present connection. In addition to these papers the specimens of birds in the collection of the Museum of Comparative Zoölogy have been of great use, whilst many additional facts have been gathered from correspondents and from other sources not there indicated.

on the coast, differs quite sensibly in its general faunal and floral characteristics from that part of the State situated farther to the northward, its fauna, especially the ornithological portion, having a decidedly West Indian or tropical aspect, as has also its flora. Dr. Stimpson has recently shown that on the Gulf coast of the State the southern forms, among the marine animals, extend considerably farther north than they do on the Atlantic coast; * but whether the warm waters of the Gulf of Mexico sensibly modify the land fauna of the northern coast of the Gulf sufficiently to affect the distribution of the birds is a point I have been as yet unable to determine. As it seems probable, however, that it does not to any great degree, the Floridian Fauna may accordingly be provisionally regarded as terminating near the latitude of Lake George.

The peculiarities of the bird fauna of Southern Florida in summer is still too imperfectly known to admit of the Floridian ornithological fauna being fully characterized. The occurrence within it of the following species which do not appear to extend much, if any, to the north of it, may serve for the present to distinguish this fauna from the Louisianian.

Species limited in their Northward Range by the Floridian Fauna.

1. Vireosylvia barbatula.
2. Certhiola flaveola.
3. Icterus vulgaris.
4. Cyanocitta floridana.
5. Tyrannus dominicensis.
6. Coccygus minor.
7. Crotophaga ani.
8. " Crotophaga rugirostris."
9. Columba leucocephala.
10. Zenæda amabilis.
11. Oreopelia martinica.
12. Starnænus cyanocephalus.
13. Rostrhamus sociabilis.
14. Polyborus tharus.
15. Aramus giganteus.
16. Demiegretta Pealei.
17. Demiegretta rufa.
18. Audubonia occidentalis.
19. Ibis rubra.
20. Phœnicopterus ruber.
21. Haliplana fuliginosa.
22. Anoüs stolidus.

II. Louisianian Fauna. The Louisianian Fauna may be provisionally considered as limited at the northward by the isotheral line of 77° F., it embracing all that part of the United States south of this line east of the Great Plains, except the Floridian Fauna. Beginning on the Atlantic coast apparently as far north as Norfolk, Virginia, it oc-

* See American Naturalist, Vol. IV, p. 536, December, 1870.

cupies a narrow belt thence southward along the coast, and in the latitude of Columbia, South Carolina, begins to expand to the westward. Farther southward its northern boundary passes to the southward of the mountains in Georgia, west of which it rises obliquely northward, and extends in a narrow point up the valley of the Mississippi as far as the mouth of the Ohio. West of the Mississippi it bends again somewhat to the southward.

The Louisianian Fauna hence embraces the coast of North Carolina, the lowlands of South Carolina and Georgia, nearly all of Alabama, all of Mississippi and Louisiana, nearly all of Arkansas, Western Tennessee, the extreme western part of Kentucky, Southern Missouri, the extreme southern part of Illinois, and a small portion of Eastern Texas. Most of the following species range throughout its entire extent, but appear farther to the northward only as stragglers. The presence of these species, and the absence of those given in the preceding list, will serve to distinguish it from the Floridian Fauna. It is similarly distinguished from the Carolinian Fauna, as will be presently shown.

Species limited in their Northward Range by the Louisianian Fauna.

1. Peucæa æstivalis.
2. Cyanospiza ciris.
3. Quiscalus major.
4. Helminthophaga Swainsoni.
5. Helminthophaga Bachmani.
6. ?Prothonotaria citrea.
7. Dendrœca dominica.
8. Sitta pusilla.
9. Antrostomus carolinensis.
10. Campephilus principalis.
11. Picus borealis.
12. Conurus carolinensis.
13. Chamæpelia passerina.
14. Cathartes atratus.
15. Ictinia mississippiensis.
16. Elanus leucurus.
17. Demiegretta ludoviciana.
18. Platalea ajaja.
19. Ibis alba.
20. Tantalus loculator.
21. Porzana jamaicensis.
22. Plotus anhinga.
23. Graculus floridanus.
24. Puffinus obscurus.

III. Carolinian Fauna. The Carolinian Fauna extends from the northern boundary of the Louisianian Fauna northward to about the isotheral line of 71° F. On the Atlantic coast this fauna includes Long Island and a small portion of Southeastern New York, which form its northern limit. In New Jersey it is restricted to the lowlands, extending westward in Southern Pennsylvania, Maryland, and Virginia to the Appalachian highlands. It embraces the middle portion of the Carolinas, and a narrow belt in Northern Georgia. West of the Appalachian highlands its northern boundary sweeps to the northeastward as far as Northern Ohio, and thence runs westward, probably along the water-shed of that State ; rising somewhat to the northward in passing farther west, it crosses Michigan near the southern border of that State, and embraces a portion of Southern Wisconsin and Southern Minnesota.

The Carolinian Fauna hence embraces Long Island and Southeastern New York, the greater part of New Jersey, all of Delaware, a small portion of Southeastern Pennsylvania, the greater part of Maryland and East Virginia, all of North Carolina, except the extreme eastern and western portions, the northwestern half of South Carolina, a narrow belt of Northern Georgia south of the mountains, the eastern part of Tennessee, the larger part of West Virginia, nearly all of Ohio and Kentucky, all of Indiana, nearly all of Illinois, a narrow strip of Michigan and Wisconsin, nearly all of Iowa and the greater part of Missouri, and the eastern portions of Nebraska and Kansas. It also occupies the lower Appalachian valleys.

It is distinguished from the Louisianian Fauna by the absence of the species mentioned in the preceding list, and by the presence of those given in the list next following. The features distinguishing it from the Alleghanian will be presently given in the diagnosis of that fauna.

*Species limited in their Northward Range by the Carolinian Fauna.**

1. Cardinalis virginianus.
2. Euspiza americana.
3. Guiraca cærulea.
4. Helmitherus vermivorus.
5. Icteria virens.
6. ?Prothonotaria citrea.
7. Wilsonia mitrata.
8. ?Dendrœca cærulea.
9. Pyranga æstiva.
10. Mimus polyglottus.
11. Thryothorus ludovicianus.
12. Polioptila cærulea.
13. Lophophanes bicolor.
14. Corvus ossifragus.
15. Centurus carolinus.
16. Stelgidopteryx serripennis.
17. Nauclerus furcatus.
18. Strix flammea.
19. Cathartes aura.
20. Ægialitis Wilsonius.
21. Gallinula galeata.
22. Gallinula martinica.
23. Garzetta candidissima.
24. Herodias egretta.
25. Florida cærulea.
26. Nyctherodius violaceus.

* A few of these species occur as stragglers in the Alleghanian Fauna.

27. Rallus elegans.
28. Rallus crepitans.
29. ?Hæmatopus palliatus
30. Recurvirostra americana.
31. Himantopus nigricollis.
32. Sterna aranea.
33. Rhynchops nigra.

IV. Alleghanian Fauna. The Alleghanian Fauna has the Carolinian for its southern boundary. Its northern boundary, from the ample data for its determination at the eastward, appears to nearly coincide with the isotheral line of 65° F. It is, however, an extremely irregular line, with abrupt and deep sinuosities. Beginning on the coast to the eastward of the Penobscot Bay, it sweeps first somewhat to the northeast, nearly or quite reaching Bangor; thence passing westward and southward, it follows the northern boundary of the lowlands through Southern Maine and Southern New Hampshire. In the Connecticut valley it rises farther to the northward, and in its southern descent skirts the eastern base of the Green Mountains, passing to the southward and westward of these highlands in Connecticut, and thence abruptly to the northward. Skirting the eastern boarder of the Champlain valley, it continues still northward to the valley of the St. Lawrence as far as Quebec; thence turning again southwestward, it passes along the northern border of the lowlands east of the Lawrentian Hills (including the valley of the Ottawa), and crosses the southern peninsula of Michigan near the forty-fifth parallel; continuing thence northwestward it passes near Fort Ripley. Reaching the valley of the Red River of the North, it turns abruptly to the northward, enclosing the lowlands around Lake Winnipeg and embracing the valley of the Saskatchewan and those of its northern and southern branches, passing westward till it meets the higher plateau forming the eastern slope of the Rocky Mountains. This may be considered as *approximately* the northern boundary of the Alleghanian Fauna; the physical, climatic, and phytozoölogical character of the interior of British North America being at present too imperfectly known to render it easy to determine definitely the northwestern limit of the Alleghanian Fauna.*

* As already stated, the mean temperature of the breeding season (May, June, and July) has been taken as limiting the breeding range of the species. But this criterion associates regions which have very different *climatic* peculiarities, when the temperature of the whole year is considered, the isotheral lines diverging more widely from the isothermal or yearly lines in the interior than on the Atlantic coast. While in the Winnipeg basin the summer heat is sufficient to ripen corn and to permit of the cultiva-

The Alleghanian Fauna hence includes all of Southern New England, except the higher parts of the Green Mountain ranges, including even the southern third of Maine and a considerable part of New Hampshire and Vermont; all of New York, except the higher portions of the Adirondacks and the southeastern extremity of that State (which belongs to the Carolinian Fauna), all the lowlands of the Canadas, as far east at least as the vicinity of Quebec; the northern border of Ohio, the greater part of Wisconsin and Minnesota (in fact, very nearly all of these two States), and the valleys of the Red River of the North, the Assinniboine, and large portions of the valleys of the Saskatchewan and its two main branches, including also the extensive lowlands surrounding Lake Winnipeg. It also embraces all the Appalachian highlands southward to Georgia, except the higher parts (which belong to the Canadian Fauna), and hence includes a large part of Pennsylvania, the greater part of the highlands of Maryland, Virginia, and the Carolinas. The isolated areas within this region belonging to the Canadian Fauna are the highlands of Northeastern New York, and the most elevated parts of Pennsylvania, the Virginias, North Carolina, and Georgia. The northwestern part of New Jersey seems also to belong to the Canadian Fauna.

The Alleghanian Fauna is characterized by the absence of those species already mentioned as finding their northern limit within the Carolinian Fauna, by the presence of those mentioned below as limited in their northward range by the Alleghanian Fauna, and by the absence of a considerable number which occur abundantly in the Canadian Fauna. It is further distinguished from the Carolinian Fauna by the occurrence within it in the breeding season of the species enumer-

tion of tobacco, the winter climate is almost arctic, ice remaining in the lakes in sheltered places till late in May. Yet in summer the Winnipeg district is frequented by birds that find their northern range limited on the Atlantic coast to Southern Maine, where the winters are much shorter and the cold far less severe than on the prairies of the Saskatchewan. The same continental character of the climate of the interior is similarly seen as far south as the prairies of the Upper Mississippi, to which the northern birds descend in winter in greater numbers and with greater regularity than in the corresponding latitudes near the Atlantic coast. A limitation of the ornithological faunæ by the distribution of the birds in winter, — in other words, by their maximum range, — would hence differ considerably from the circumscription of these faunæ based on the breeding range of the species. This remark applies, of course, not only to the present fauna (Alleghanian), but to Eastern North America as a whole, especially to that portion north of the Louisianian Fauna.

ated in the second list next subjoined, to which the present fauna forms the southern limit of their breeding range.

1 *Species limited in their Northward Range by the Alleghanian Fauna.**

1. Turdus mustelinus.
2. Sialia sialis.
3. Pyranga rubra.
4. Dendrœca discolor.
5. Lanivireo flavifrons.
6. Vireo noveboracensis.
7. Troglodytes aëdon.
8. Harporhynchus rufus.
9. Cyanospiza cyanea.
10. Pipilo erythrophthalmus.
11. Spizella pusilla.
12. Coturniculus passerinus.
13. Ammodromus caudacutus
14. Ammodromus maritimus.
15. Icterus Baltimore.
16. Icterus spurius.
17. Sturnella ludoviciana.
18. ?Antrostomus vociferus.
19. Zenædura carolinensis.
20. Cupidonia cupido.
21. Ortyx virginianus.
22. Meleagris gallopavo.
23. Ardetta exilis.
24. Rallus virginianus.
25. Chrœcocephalus atricilla.
26. Sterna paradisea.
27. Hydrochelidon fissipes.

2. *Species limited by the Alleghanian Fauna in their Southward Range in the Breeding Season.*

1. Turdus fuscescens.
2. Dendrœca pennsylvanica.
3. Parula americana.
4. Helminthophaga ruficapilla.
5. Helminthophaga chrysoptera.
6. Hirundo bicolor.
7. Lanivireo solitarius.
8. Carpodacus purpureus.
9. Melospiza palustris.
10. Passerculus savanna.
11. Dolichonyx oryzivorus.
12. Contopus borealis.
13. Empidonax minimus.
14. Empidonax flaviventris.
15. Pediœcetes phasianellus.
16. Rallus virginianus.
17. Porzana carolina.
18. Ægialitis melodus.
19. Nettion carolinensis.
20. Querquedula discors.
21. Mareca americana.
22. Anas boschas.
23. Anas obscura.
24. Mergus merganser.
25. Lophodytes cucullatus.
26. Berniela canadensis.
27. Colymbus torquatus.
28. Podilymbus podiceps.
29. Larus argentatus.
30. Sterna macrura.

* A few of the species mentioned in this list are more or less frequent stragglers into the Canadian Fauna, but none of them seem to occur there except as irregular and infrequent visitors.

V. Canadian Fauna. The next fauna to the northward of the Alleghanian is the Canadian. The southern boundary of the Canadian is hence, of course, the northern limit of the Alleghanian, which boundary has been already defined. Its northern limit coincides very nearly with the isotheral line of 57° F. The region to the northward of the Alleghanian Fauna is unfortunately too little known to permit of a very satisfactory determination of the northern boundary of either the Canadian Fauna or of the faunæ to the northward of the Canadian. On the Atlantic coast the Canadian Fauna appears to embrace the greater part of Newfoundland, nearly or quite all of Nova Scotia * and New Brunswick, Northern New England, including the crests of the Green Mountain ranges southward to Connecticut, the greater part of the province of Quebec, including the Lower St. Lawrence valley as far up as the city of Quebec, the southern slope of the Height of Land in Northern Ontario, and the highlands on both sides of Lake Superior. To the southward it also embraces as outlying islands the Adirondacks of Northern New York, and the higher crests of the Appalachians southward to Georgia. To the northward it probably extends nearly to the summit of the Height of Land, and may embrace part of the lowlands bordering the southwestern shore of Hudson's Bay. Its northern boundary hence sweeps northwestward in the interior nearly or quite to Fort Resolution, on the southern shore of Great Bear Lake.

The Canadian Fauna, as above limited, may be characterized as follows. It is distinguished from the Alleghanian Fauna by the absence of the species mentioned above as limited in their northward range by that fauna, and by the presence in the breeding season of those mentioned in the first subjoined list; from the Hudsonian Fauna by the presence of those given in the second subjoined list, and by the absence of those given in the first list under the Hudsonian Fauna. It is further distinguished by its forming the breeding haunts of a large proportion of the *Sylvicolidæ*, especially of the species of *Dendrœca*, several of which are in summer mainly restricted to it.

* Nova Scotia, zoölogically considered, presents somewhat anomalous characters. In summer a number of birds which are reported as either rare or accidental at Calais, Me., are represented as common summer residents in Nova Scotia, while other northern species breed there in numbers which do not usually breed at localities where the other species referred to are summer residents. The half-insular position of Nova Scotia is doubtless the explanation of the faunal peculiarities above mentioned.

1. *Species limited by the Canadian Fauna in their Southward Range in the Breeding Season.*

1. Turdus Pallasi.
2. Turdus Swainsoni.
3. Regulus satrapa.
4. Regulus calendula.
5. Dendrœca castanea.
6. Dendrœca Blackburniæ.
7. Dendrœca coronata.
8. Dendrœca cærulescen
9. Dendrœca striata.
10. Dendrœca palmarum.
11. Dendrœca maculosa.
12. Euthlypis canadensis.
13. Troglodytes hyemalis.
14. Parus hudsonicus.
15. Pinicola enucleator.
16. Curvirostra americana.
17. Curvirostra leucoptera.
18. Chrysomitris pinus.
19. Zonotrichia leucophrys.
20. Zonotrichia albicollis.
21. Junco hyemalis.
22. Spizella monticola.
23. Passerella iliaca.
24. Scolecophagus ferrugineus.
25. Perisoreus canadensis.
26. Picoides hirsutus.
27. Picoides arcticus.
28. Falco columbarius.
29. Astur atricapillus.
30. Surnia ulula.
31. Nyctale Tengmalmi.
32. Tetrao canadensis.
33. Calidris arenaria.
34. Macrorhamphus griseus.
35. Phalaropus Wilsoni.
36. Aythya vallisneria.
37. Aythya americana.
38. Fulix marila.
39. Fulix collaris.
40. Erismatura rubida.
41. Bucephala clangula.
42. Bucephala albeola.
43. Mergus serrator.
44. Somateria mollissima.
45. Cymochorea leucorrhea.
46. Puffinus anglorum.
47. Larus marinus.
48. Rissa tridactylus.
49. ?Chrœcocephalus philadelphia.
50. Pelecanus erythrorhynchus.
51. Sula bassana.
52. Graculus carbo.
53. Graculus dilophus.
54. Podiceps cristatus.
55. Podiceps cornutus.
56. Podiceps Holbölli.
57. Fratercula arctica.
58. Utamania torda.
59. Uria grylle.
60. Lomvia ringvia.
61. Lomvia svarbag.

2. *Species limited by the Canadian Fauna in their Northward Range.*

1. ?Turdus Pallasi.
2. Mimus carolinensis.
3. Dendrœca virens.
4. Dendrœca cærulescens.
5. Dendrœca castanea.
6. Dendrœca Blackburniæ.
7. Euthlypis canadensis.
8. Parus atricapillus.
9. Chrysomitris tristis.
10. Chrysomitris pinus.
11. Curvirostra americana.
12. Poocætes gramineus.

13. Melospiza melodia.
14. Melospiza palustris.
15. Dolichonyx oryzivorus.
16. Tyrannus carolinensis.
17. Myiarchus crinitus.
18. Contopus virens.
19. Trochilus colubris.
20. Antrostomus vociferus.
21. Sayornis fuscus.
22. Cyanura cristata.
23. Buteo lineatus.
24. Buteo pennsylvanicus.
25. Accipiter Cooperi.
26. ?Syrnium nebulosum.
27. Butorides virescens.
28. Porzana carolina.
29. Ægialitis vociferus.
30. Ægialitis melodus.
31. Philohela minor.
32. Actiturus Bartramius.
33. Aix sponsa.
34. Chaulelasmus streperus.
35. Aythya vallisneria.
36. Hydrochelidon fissipes.

VI. Hudsonian Fauna. The next ornithological fauna north of the Canadian may well be termed the Hudsonian Fauna. Its northern limit seems to nearly coincide with the isotheral line of 50° Fahrenheit, its southern limit being the isotheral of 57°, or the northern boundary of the Canadian Fauna. It will include at least the southern third of Labrador, the northern peninsula of Newfoundland, Anticosti Island, the more elevated parts of the Height of Land separating the lowlands bordering Hudson's Bay from the lowlands of the St. Lawrence and the Winnipeg district, and the basin of the Mackenzie's from Lake Athabasca to a point considerably north of Fort Simpson, extending in the Mackenzie's River valley some distance within the Arctic Circle, probably to the Arctic coast. Extending still westward, it embraces the valleys of Liard's and Peel's Rivers, and probably the valley and adjoining lowlands of the Youkon, including the greater part of that portion of the Territory of Alaska situated to the southward of the Arctic Circle. In other words, that portion of boreal America situated between the Canadian Fauna and the Barren Grounds. It is far from certain that a western or Alaskan Fauna will not have to be separated, embracing all the more temperate portions of Alaska. Although strictly western species occur here, they appear to be confined mainly to the western coast and the lower part of the Youkon valley. The faunal differences between the western shore of Alaska and the valley of Mackenzie's River become far greater when the marine species are taken into account; even if only the birds and mammalia are considered. The Pacific coasts of Alaska and Siberia have many species peculiar to the shores of those countries and to the intervening islands, constituting a distinct fauna, which may well be called the *Aleutian Fauna.* The mingling of Asiatic and American species forms its distinctive feature. There is also a slight commingling of western species in the valley of the Mackenzie's River, as there is also in the valley of the Saskatchewan. The Hudsonian Fauna doubtless embraces outlying islands in the Canadian Fauna, as the upper part of the White Mountains, and the summits of some of the higher peaks of the Adirondacks. The southern point of Greenland embraces many species common to the Hudsonian Fauna, and though Greenland belongs almost wholly to the Arctic Realm, its extreme southern portion is doubtless Hudsonian.*

The Hudsonian Fauna being coextensive northward with the limit of forest-trees, it forms the northern limit of distribution of all the species of birds whose mode of life renders them dependent upon a forest vegetation. The distinction between the Hudsonian Fauna and the Arctic Realm, as well as between the Temperate Realm and the Arctic Realm, is hence a strongly marked one, nearly one hundred species, nearly all of them land birds, finding their northern limit of distribution near the polar limit of forests, or at least within the Hudsonian Fauna.

The Hudscnian Fauna may be distinguished from the Canadian by the absence of the species given in the preceding lists and by the presence of those enumerated in the first of the lists next subjoined, and from the Arctic Realm by the presence of those given in the second list below.

1. *Species limited by the Hudsonian Fauna in their Southward Range in the Breeding Season.*

1. Anthus ludovicianus.	9. ?Picoides arcticus.
2. Saxicola œnanthe.	10. ?Picoides hirsutus.
3. Ampelis garrula.	11. Falco candicans.
4. Ægiothus linaria.	12. Archibuteo lagopus.
5. Plectrophanes lapponicus.	13. Syrnium cinereum.
6. Plectrophanes nivalis.	14. Nyctea nivea.
7. Plectrophanes pictus.	15. Lagopus albus.
8. Leucosticte tephrocotis.	16. Lagopus rupestris.

* For remarks respecting the similarity of the Fauna of Northern Labrador and Southern Greenland, see Dr. A. S. Packard, Proc. Bost. Soc. Nat. Hist., Vol. X, p. 255, 1866.

17. Charadrius virginicus.
18. Ægialitis semipalmatus.
19. Squartarola helvetica.
20. Strepsilas interpres.
21. Actodromas maculata.
22. Actodromas Bonapartei.
23. Actodromas minutilla.
24. Ereunetes pusillus.
25. Anser Gambeli.
26. Anser hyperboreus.
27. Bernicla brenta.
28. Dafila acuta.
29. Harelda glacialis.
30. Somateria spectabilis.
31. Pelionetta perspicillata.
32. Procellaria glacialis.
33. Sterna caspia.
34. Larus glaucus.
35. Colymbus septentrionalis.
36. Stercorarius parasiticus.

2. *Species limited in their Northward Range by the Hudsonian Fauna.*

1. Turdus migratorius.
2. Turdus Swainsoni.
3. Regulus calendula
4. Regulus satrapa.
5. Helminthophaga ruficapilla.
6. Helminthophaga peregrina.
7. Helminthophaga celata.
8. Seiurus aurocapillus.
9. Seiurus noveboracensis.
10. Dendrœca coronata.
11. Dendrœca striata.
12. Dendrœca æstiva.
13. Dendrœca maculosa.
14. Dendrœca palmarum.
15. Wilsonia pusilla.
16. Setophaga ruticilla.
17. Hirundo horreorum.
18. Hirundo lunifrons.
19. Hirundo bicolor.
20. Ampelis garrula.
21. Collurio borealis.
22. Vireo olivaceus.
23. Vireo gilvus.
24. Parus hudsonicus.
25. Pinicola enucleator.
26. Curvirostra leucoptera.
27. Ægiothus linaria.
28. Plectrophanes nivalis.
29. Plectrophanes lapponicus.
30. Plectrophanes pictus.
31. Passerculus savanna.
32. Zonotrichia leucophrys.
33. Zonotrichia albicollis.
34. Junco hyemalis.
35. Spizella monticola.
36. Spizella socialis.
37. Melospiza Lincolnii.
38. Passerella iliaca.
39. Molothrus pecoris.
40. Agelæus phœniceus.
41. Scolecophagus ferrugineus.
42. Quiscalus purpureus.
43. Corvus corax.
44. Corvus americanus.
45. Pica caudata.
46. Perisoreus canadensis.
47. Contopus borealis.
48. Empidonax minimus.
49. Empidonax Traillii.
50. Picus villosus.
51. Picus pubescens.
52. Picoides hirsutus.
53. Picoides arcticus.
54. Sphyrapicus varius.
55. Hylotomus pileatus.
56. Colaptes auratus.
57. Chordeiles popetue.
58. Ceryle alcyon.

59. Falco candicans.
60. Falco peregrinus.
61. Falco columbarius.
62. Falco sparverius.
63. Astur atricapillus.
64. Archibuteo lagopus.
65. Buteo borealis.
66. Accipiter fuscus.
67. Circus cyaneus.
68. Bubo virginianus.
69. Otus vulgaris.
70. Otus brachyotus.
71. Ectopistes migratori
72. Tetrao canadensis.
73. Pediœcetes phasianellus.
74. Bonasa umbellus.
75. Lagopus leucurus.
76. ?Grus americanus.
77. Gallinago Wilsoni.
78. Macrorhamphus griseus.
79. Ereunetes pusillus.
80. Gambetta melanoleuca.
81. Gambetta flavipes.
82. Tringoides macularius.
83. Limosa hudsonica.
84. Porzana carolina.
85. Fulica americana.
86. ?Dafila acuta.
87. Nettion carolinensis.
88. Querquedula discors.
89. Spatula clypeata.
90. Mareca americana.
91. Fulix marila.
92. Fulix collaris.
93. Erismatura rubida.
94. Lophodytes cucullatus.
95. Graculus dilophus.
96. Pelecanus erythrorhynchus.

VII. American Arctic Fauna. The Arctic Realm may be considered as occupying that portion of the northern hemisphere north of the isotheral of 50° F. Though presenting a great uniformity of character throughout its extent, it seems to be divisible into four faunæ, — an American Arctic Fauna, an Americo-Asiatic Fauna, an Europeo-Asiatic Arctic Fauna, and an Europeo-American Arctic Fauna, the second and fourth being essentially marine. While a few species of mammals seem to be almost wholly restricted within the Arctic Realm, it contains but few resident birds, and no species of birds seem to be wholly confined to it, even in the breeding season. The following species are reported to range to the Arctic coast of North America, the most of which have been observed at Melville Island and in Greenland. The greater part are *Natatores* and *Grallæ*, the only commonly so-called land birds being two or three species of grouse, a sparrow or two, and a few hawks and owls.

Species found in the American Arctic Fauna in the Breeding Season.

1. Cotyle riparia.
2. Corvus corax.
3. Aquila chrysaëtos.
4. Haliaëtus leucocephalus.
5. Pandion haliaëtus.
6. Nyctea nivea.

7. ?Surnia ulula.
8. Tetrao canadensis.
9. Lagopus albus.
10. Lagopus rupestris.
11. Grus canadensis.
12. Botaurus lentiginosus.
13. Charadrius virginicus.
14. Ægialitis semipalmatus.
15. Strepsilas interpres.
16. Phalaropus fulicarius.
17. Calidris arenaria.
18. Tringa canutus.
19. Pelidna "americana."
20. Arquatella maritima.
21. Cygnus "americanus."
22. Anser hyperboreus.
23. Anser Gambeli.
24. Bernicla canadensis.
25. Anas boschas.
26. Bucephala albeola.
27. Bucephala clangula.
28. Histrionicus torquatus.
29. Harelda glacialis.
30. Melanetta velvetina.
31. Pelionetta perspicillata.
32. Œdemia "americana."
33. Somateria spectabilis.
34. Somateria mollissima.
35. Buphagus skau *Coues.*
36. Stercorarius pomarinus.
37. Stercorarius parasiticus.
38. Stercorarius Buffoni *Coues.*
39. Fulmarus glacialis.
40. Larus argentatus.
41. Larus glaucus.
42. Larus leucopterus.
43. Rissa tridactyla.
44. Pagophila eburnea.
45. Xema Sabini.
46. Sterna arctica.
47. ?Sula bassana.
48. Colymbus septentrionalis.
49. Colymbus arcticus.
50. Colymbus torquatus.
51. Utamania torda.
52. Fratercula glacialis.
53. Lunda cirrhata.
54. Mergulus alle.
55. Uria grylle.
56. Lomvia troile.
57. Lomvia ringvia.
58. Lomvia svarbag.

The Faunæ of the Eastern Province considered in Reference to the Distribution of the Mammals and Reptiles.

The faunæ of the Eastern Province of the North American Region above characterized from the distribution of the birds seem to be equally well marked as natural zoölogical districts by the distribution of the mammals and reptiles. About the same proportionate number of mammals are limited similarly with the birds in regard to their northward and southward distribution. The correspondence in the geographical limitation of the species of the two groups will be briefly shown by the following remarks respecting the range of the mammals.

The Arctic Realm is well known to be characterized by a few species nearly or quite restricted to it, as the polar bear (*Ursus maritimus*), the artic fox (*Vulpes lagopus*), the musk ox (*Ovibos moschatus*), the lemmings (*Myodes*), the small northern race of the caribou or reindeer, the Eskimos, etc.

The Hudsonian Fauna forms the southern limit of the polar hare (*Lepus glacialis*) and the northern limit (at least in winter) of the *Lynx canadensis*, *Mustela* "*americana*," *Mustela Pennantii*, *Putorius vulgaris*, *Putorius ermineus*, *Ursus* "*americanus*," *Ursus* "*horribilis*," *Sciurus hudsonius*, *Arctomys monax*, *Vespertilio subulatus*, and others.

The Canadian Fauna forms, at present,* the southern limit of *Mustela Pennatii*, *Mustela* "*americana*," *Gulo luscus*, *Arvicola xanthognathus*, *Erethizon dorsatus*, *Alces malchis*, *Rangifer tarandus*, etc., and the northern limit of *Felis concolor*, *Lynx rufus*, *Mephitis mephitica*, *Procyon lotor*, *Bos americanus*, *Condylura cristata*, *Blarina brevicauda*, and others.

The Alleghanian Fauna forms the southern limit of *Lynx canadensis*, *Sciurus hudsonius*, *Arvicola Gapperi*, *Jaculus hudsonius*, *Lepus americanus*, *Cervus canadensis*, *Sorex platyrhinus*, *Condylura cristata*, and doubtless of several other species; and the northern limit of *Sciurus carolinensis*, *Lepus sylvaticus*, *Arvicola pinetorum*, *Cervus virginianus*, *Scalops aquaticus*, etc.

The Carolinian Fauna forms the southern limit of *Mustela vulgaris*, *Tamias striatus*, *Arctomys monax*, and *Fiber zibethicus*; and the northern limit of *Vulpes virginianus*, *Nycticejus crepuscularis*, *Didelphys virginiana*, etc.

The Louisianian Fauna seems to form the southern limit of *Putorius vison*, *Blarina brevicauda*, *Scalops aquaticus*, and doubtless thus limits several other species, though not a small proportion of those which occur in this fauna range also into South Florida, or into the Floridian Fauna. The Louisianian Fauna limits the northward range of *Neotoma floridana*, *Reithrodon humilis*, *Sigmodon hispidus*, *Hesperomys palustris*, *Geomys pineti*, and *Lepus palustris*.

In respect to reptiles, a similar proportion of species are limited in either their northward or southward range by each fauna. Several species of batrachians range into the Hudsonian Fauna, but apparently this fauna must be the northern limit of their distribution. The Cana-

* It is probable that some of the fur-bearing species, as well as *Hystrix dorsatus*, the moose and the caribou, once ranged southward throughout the Alleghanian Fauna, and have been exterminated there by man.

dian Fauna forms the northern limit of the reptiles proper, where this class is represented by two orders only, the *Testudinata* and the *Ophidia*. The *Testudinata* are there represented by only three species (*Chelydra serpentina*, *Glyptemys insculpta*, *Chrysemys picta*), and the *Ophidia* by five (*Bascanion constrictor*, *Tropidonotus sirtalis*, *Diadophis punctatus*, *Storeria occipito-maculata*). In the Alleghanian Fauna the number of species in each of these groups is more than doubled. The Carolinian Fauna forms the northern limit of the *Sauria*, of which two species (*Plestiodon fasciatus*, *Tropidolepis undulatus*) here first make their appearance, and the number of species of the other groups is still further increased, several additional generic types being added. In the Louisianian Fauna the number of species of *Sauria* becomes considerably greater, and while few of the northern species of either the true reptiles or the batrachians have disappeared, other more southern forms have been added in almost every family.

These several faunæ, it may be added, seem in general to coincide in their number and limits with the floræ of the same region. These several floræ, as thus circumscribed, form successively the northern limit of the successful cultivation of some more or less important cultivated plant. But a detailed consideration of the distribution of the vegetation of the region under consideration, in respect to the number and circumscription of the floræ, and their correspondence with the faunæ, cannot of course well be here introduced.

4. The Ornithological Districts of the North American Temperate Region.

The subdivision by Professor Dana of the tropical and temperate climatic zones of the oceanic areas into several zoölogical zones has been already alluded to as being equally applicable to the land areas. To these life zones I propose to apply the term "districts." Dana's divisions of the north temperate climatic zone correspond respectively in latitudinal extent with the several ornithological faunæ of the Eastern Province, as defined in the preceding pages. Unlike the faunæ, however, the districts extend in an east and west direction across the North American Region, each district embracing not only one of the faunæ of the Eastern Province, but also its representative fauna (or faunæ) in the Western Province. The Hudsonian Fauna corresponds in latitudinal extent with Dana's subfrigid division of the north temperate zone, and the term *Subfrigid District* may be very properly applied to that district of which this fauna forms the eastern portion. The zone corresponding with the Canadian Fauna may in like manner be termed the *Cold-temperate District;* that corresponding with the Alleghanian Fanua the *Subtemperate District;* that corresponding with the Carolinian Fauna the *Temperate District;* and that corresponding with the Louisianian Fauna the *Warm-temperate District;* the Floridian Fauna in like manner corresponding with the *Subtorrid District*, or with Dana's subtorrid zone. Each of these districts is distinguished, in contradistinction from the faunæ, by species which range across the continent, while the districts are distinguished from each other by the same kind of difference as has been shown above to characterize the several faunæ among themselves.

5. On the Geographical Range of the Species.

The preceding tables, while serving to characterize the ornithological faunæ of Eastern North America, indicate only very obscurely the range of the species. The following tables have hence been prepared in order to show more clearly the breeding range, and also the winter quarters, of those species whose distribution in the breeding season is tolerably known. For this purpose the birds occurring in the Eastern Province of the North American region have been grouped, according to their geographical distribution, into the following classes, beginning with those which have the widest breeding range: I. *Cosmopolitan Species.* II. *Circumpolar Species.* III. *Species which range across the whole breadth of the North American Temperate Region.* IV. *Species limited in longitude to the Eastern Province of this region.* The birds of the Eastern Province are further subdivided according to the range of the species in the breeding season in latitude.*

* In a preliminary notice like the present it has been found impracticable to give the authorities in detail on which the generalizations given in the following synopsis have been based. The list of papers given in the Appendix serve in a general way to indicate the principal sources from which information has been derived. It is believed, however, that the limits assigned each species will be found in the main correct, though in many cases the accessible data have been quite too few to be satisfactory. The generalizations are given, of course, as a representation of our present knowledge of the subject rather than as final. The polar and equatorial limits of the migratory range of the species varies, as is well known, more or less in different years, according to the season. It is also somewhat different on the coast from what it is in

I. Cosmopolitan Species. A large proportion of ornithologists have of late been unwilling to admit that any bird has what is usually termed a "cosmopolitan" range, while others recognize only about twenty such species, taking into account, of course, their total range. These embrace two or three species each of hawks and owls, the rest being either *Grallæ* or *Natatores.* Very few of them, however, breed within both the tropic and the polar zones; many of those which visit the shores of all lands in their migratory journeys being restricted in the breeding season to comparatively limited areas. *Pandion haliaëtus* and *Otus brachyotus* are the only examples of commonly so-called cosmopolitan species which appear to breed from the Arctic Circle southward through the tropics to the southern extremity of the southern continents. *Falco peregrinus* may form a third, but its peculiar breeding habits give it a very irregular dispersion at that season. *Strix flammea* appears to be also everywhere resident, except in the arctic and cold-temperate zones. *Cotyle riparia* and *Hirundo rufa* (including under the latter name the several slightly differing geographical races of this group, which have of late been regarded as species), seem also to be nearly cosmopolite. The list of species which are permanently cosmopolitan will hence not exceed half a dozen, and are those above enumerated.

II. Circumpolar Species. Regarding as circumpolar species only those numerously represented in both the eastern and western hemispheres, nearly one hundred species* can be included in the list of

the interior, as has been previously explained; so that an indication of only the average boreal and austral limits of the species at this season has been aimed at, and only so far as their winter range is circumscribed within the region under special consideration. The blanks in the third column of the tables hence indicate that the species winter entirely within the American Tropical Realm; those in the fourth, that the austral limit is within that realm. The few occurring in the second column of the tables indicate that the species in question also ranges southward in the breeding season into the Tropical Realm. A [?] in place of a blank indicates that the southward range of the species is supposed to be limited to the Eastern Province, but as being too vaguely known to warrant a specification of its limit in the direction indicated by the column in which the query stands.

* Dr. Richardson, in 1831 (in the "Fauna Boreali-Americana," p. xxxix), gave thirty-two species of land birds and "upwards of sixty-two species of water birds" (ninety-four in all) as "common to the Old World and the Fur Countries." A few truly circumpolar species were not included in this list, and others were included which were merely accidental visitors from one continent to the other. Since the date of that list the identity of the greater part of the species therein mentioned has been questioned by

circumpolar species. A small number of others that are properly either exclusively American or Europeo-Asiatic species occur more or less frequently as accidental visitors to the continents not embraced within their usual habitats.

one or another writer, and their representatives on the two hemispheres separated under different names. But a considerable proportion of those mentioned in the next subjoined table are still regarded as truly circumpolar by a number of leading European onithologists. Dr. Von Middendorff ("Uebersicht der Natur Nord- und Ost-Sibiriens, Theil 2, Erste Lieferung," etc.; see Newton's Ibis, April, 1870, p. 275), in 1867, gave lists of eighty-seven circumpolar species, a part of which (called "Hyperboreal Birds") are distinctive of what has been termed above the Arctic Realm, whilst many of the others range quite far southward even in summer. These lists, however, do not embrace a number of circumpolar species whose boreal limit does not extend to the districts named. A dozen or more Europeo-Asiatic species, in addition to those given below, have representatives in America so closely resembling them in habits and in geographical distribution, as well as structurally, that they have often been confounded, specimens frequently occurring on the one continent that are undistinguishable from those from the other continent.

In 1846 Professor Edm. de Selys-Longchamps, in his excellent paper entitled "Sur les Oiseaux américains admis dans la Faune européenne" (Mém. de la Soc. R. de Liège, Vol. IV, pp. 35–50, 1849), included thirteen species in his list of "Oiseaux terrestres communs à l'Europe et à l'Amérique," and mentions nine other terrestrial American species which he regards as "ne semblent être en réalité que des modifications climatiques de nos oiseaux européens." All but two of these, and also one or two in addition to them, have been regarded in the present paper as specifically identical. In his list of "Oiseaux aquatiques communs à l'Europe et à l'Amérique" he includes fifty-five species, and mentions thirteen others, "décrits comme espèces distinctes, ne semblent être que des races locales," three or four of which I have regarded as specifically identical. The whole number mentioned by Selys-Longchamps as common to Europe and boreal America is seventy-six, plus twenty-four "autres qui semblent n'être que des races légèrement modifiées par le climat." (See l. c., p. 48.) In the same paper he gives a list of twenty-eight American species as of accidental occurrence in Europe, eight of which are land birds, eight échassiers or waders, and twelve palmipèdes or swimmers, and also a list of twenty American species which he considers to have been improperly included among the birds of Europe, among which are *Haliaëtus leucocephalus*, *Strix nebulosa* (= *Syrnium nebulosum*), *Loxia* (= *Curvirostra*) *leucoptera*, *Struthus* (= *Junco*) *hyemalis*, and *Parus* (= *Lophophanes*) *bicolor*.

II. *List of Circumpolar Species, with Indications of their Boreal and Austral Limits.*

Species.	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Certhia familiaris	Canad Fauna	Allegh. Fauna	Allegh. Fauna	Carolin. Fauna
Saxicola œnanthe	Hudson. Fauna	Hudson. Fauna	———	———
Ampelis garrula	Hudson. Fauna	Hudson. Fauna	Hudson. Fauna	Canad. Fauna
Cotyle riparia	Arctic Coast	———	Louis. Fauna	———
Plectrophanes nivalis . . .	Arctic Coast	Hudson. Fauna	Hudson. Fauna	Allegh Fauna
Plectrophanes lapponica . .	Hudson. Fauna	Hudson. Fauna	———	Allegh. Fauna
Ægiothus linaria	Arctic Coast	Hudson. Fauna	Hudson. Fauna	Allegh. Fauna
Pinicola enucleator	Hudson. Fauna	Canad. Fauna	Hudson Fauna	Allegh. Fauna
Curvirostra leucoptera . . .	Hudson. Fauna	Canad. Fauna	Hudson. Fauna?	Canad. Fauna
Eremophila alpestris . . .	Hudson. Fauna	Carolin. Fauna	Canad. Fauna ?	Louis. Fauna
Corvus corax	Arctic Coast	Allegh. Fauna	Arctic Realm	?
Pica caudata	Hudson Fauna	Allegh. Fauna	Canad. Fauna	?
Aquila chrysaëtos	Hudson. Fauna	Canad. Fauna	Hudson. Fauna?	Carolin. Fauna ?
Archibuteo lagopus	Arctic Coast	Hudson. Fauna	Hudson. Fauna	Allegh. Fauna
Pandion haliaëtus	Arctic Coast	———	Carolin. Fauna	———
Falco candicans	Arctic Coast ?	Hudson. Fauna	Canad. Fauna	Canad. Fauna
Falco peregrinus	Hudson. Fauna	———	———	———
Circus cyaneus	Arctic Coast ?	Louis. Fauna ?	Canad. Fauna	———
Strix flammea	Carolin. Fauna	———	Carolin. Fauna	———
Nyctale Tengmalmi	Hudson. Fauna	Canad. Fauna	Hudson Fauna	Canad. Fauna
Syrnium cinereum	Hudson. Fauna	Hudson. Fauna	Hudson. Fauna	Canad. Fauna
Otus vulgaris	Hudson. Fauna	———	Canad. Fauna	———
Otus brachyotus	Arctic Coast	———	Hudson. Fauna?	———
Surnia ulula	Arctic Coast	Canad. Fauna	Arctic Realm	Canad. Fauna
Nyctea nivea	Arctic Coast	Hudson. Fauna?	Arctic Realm	Allegh Fauna
Lagopus albus	Arctic Coast	Hudson. Fauna	Arctic Realm	Hudson. Fauna
Lagopus rupestris	Arctic Coast	Hudson. Fauna	Arctic Realm	Hudson. Fauna
Nycticorax griseus	Hudson. Fauna	Carolin. Fauna ?	Carolin. Fauna	———
Strepsilas interpres	Arctic Coast	Hudson. Fauna	———	———
Charadrius pluvialis . . .	Arctic Coast	Arctic Realm	Tropical Amer.	———
Squartarola helvetica . . .	Arctic Coast	Hudson. Fauna	Carolin. Fauna	———
Hæmatopus palliatus . . .	Arctic Coast	———	———	———
Arquatella maritima . . .	Arctic Coast	Arctic Realm	Canad Fauna	?
Calidris arenaria	Arctic Coast	Canad. Fauna	Allegh. Fauna	———
Tringa canutus	Arctic Coast	Arctic Realm	Carolin. Fauna	———
Ancylocheilus subarquatus .	Arctic Coast	Arctic Realm ?	Carolin. Fauna ?	———
Pelidna alpina	Arctic Coast	Hudson. Fauna?	Allegh. Fauna	———
Actodromas maculata . . .	Arctic Coast	Arctic Realm	Carolin. Fauna	———
Actodromas Bonapartei .	Arctic Coast	Arctic Realm	Carolin. Fauna	———
Tringites rufescens	Arctic Coast ?	Hudson. Fauna	Louis. Fauna	———
Lobipes hyperboreus . . .	Arctic Coast	Canad. Fauna	Carolin. Fauna	?
Phalaropus fulicarius . . .	Arctic Coast	Hudson. Fauna?	Carolin. Fauna ?	?
Anser hyperboreus	Arctic Coast	Hudson. Fauna	Canad. Fauna ?	———
Anser albifrons	Arctic Coast	Hudson. Fauna	Allegh. Fauna	———
Bernicla brenta	Arctic Coast	Hudson. Fauna	Allegh. Fauna	Louis. Fauna
Anas boschas	Arctic Coast	Allegh. Fauna	Canad. Fauna	———
Dafila acuta	Arctic Coast	Hudson. Fauna	———	———
Spatula clypeata	Arctic Coast	Hudson. Fauna	Allegh. Fauna	———
Chaulelasmus streperus . .	Hudson. Fauna	Hudson. Fauna	?	Louis. Fauna
Somateria mollissima . . .	Arctic Coast	Canad. Fauna	?	Carolin. Fauna
Somateria spectabilis . . .	Arctic Coast	Hudson. Fauna	?	Allegh. Fauna
Bucephala clangula	Arctic Coast	Canad. Fauna	Canad. Fauna	Louis. Fauna
Histrionicus torquatus . . .	Arctic Coast	Canad. Fauna	Hudson. Fauna?	Allegh. Fauna
Harelda glacialis	Arctic Coast	Hudson Fauna	?	Louis. Fauna
Fulix marila	Hudson. Fauna	Canad. Fauna	———	———
Pelionettaper spicillata . .	Arctic Coast	Hudson. Fauna	Canad. Fauna ?	Louis. Fauna
Melanetta fusca	Arctic Coast	Hudson. Fauna	Canad. Fauna ?	Louis. Fauna
Mergus merganser	Hudson. Fauna	Canad. Fauna	Canad. Fauna ?	Louis. Fauna
Mergus serrator	Hudson. Fauna	Canad. Fauna	Canad. Fauna	Louis. Fauna
Graculus carbo	Arctic Coast	Hudson. Fauna	?	Allegh. Fauna
Sula bassana	Arctic Coast	Canad. Fauna	?	Louis. Fauna
Gelochelidon anglica . . .	Carolin. Fauna		———	———
Thalasseus caspius	Arctic Coast	Hudson. Fauna	?	Carolin. Fauna
Thalasseus cantiacus . . .	Louis Fauna	———	———	———
Sterna hirundo	Arctic Coast ?	Carolin. Fauna	Florid Fauna	———
Sterna macrura	Arctic Coast	Allegh. Fauna	Florid. Fauna	———
Sterna paradisea	Allegh. Fauna	———	———	———
Hydrochelidon fissipes . . .	Carolin. Fauna	———	Florid. Fauna	———

List of Circumpolar Species. (Continued.)

Species.	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Pagophila eburnea	Arctic Coast	Arctic Realm	?	Huds. Fauna
Xema Sabini	Arctic Coast	Hudson. Fauna	?	Canad. Fauna
Rissa tridactyla	Arctic Coast	Canad. Fauna	?	Allegh. Fauna
Rhodostethia rosea	Arctic Coast	Arctic Realm	?	?
Larus glaucus	Arctic Coast	Hudson Fauna	?	Canad Fauna
Larus marinus	Arctic Coast	Canad. Fauna	?	Louis. Fauna
Larus leucopterus	Arctic Coast	Hudson. Fauna	?	Allegh. Fauna
Larus argentatus	Arctic Coast	Canad. Fauna	?	Trop Realm
Buphagus skau	Arctic Coast	Hudson. Fauna	?	Canad. Fauna
Stercorarius pomarinus . .	Arctic Coast	Hudson. Fauna?	?	Canad Fauna
Stercorarius parasiticus . .	Arctic Coast	Hudson. Fauna?	?	Allegh. Fauna
Stercorarius "Buffoni" . .	Arctic Coast	Hudson. Fauna?	?	Allegh. Fauna.
Thalassidroma Leachii . . .	?	Canad. Fauna	?	Allegh. Fauna?
Podiceps griseigena	Hudson. Fauna	Allegh. Fauna	?	Louis Fauna
Podiceps cornutus	Hudson. Fauna	Allegh. Fauna	?	Louis Fauna
Podiceps cristatus	Hudson. Fauna	Allegh. Fauna	?	Louis. Fauna
Podiceps auritus	Hudson. Fauna	Allegh. Fauna?	?	Louis. Fauna
Colymbus torquatus . . .	Arctic Coast	Allegh. Fauna	?	Florid Fauna
Colymbus arcticus	Arctic Coast	Hudson. Fauna	?	Canad. Fauna
Colymbus septentrionalis . .	Arctic Coast	Canad. Fauna	?	Canad. Fauna
Fratercula arctica	Arctic Coast	Canad. Fauna	?	Allegh. Fauna
Uria grylle	Arctic Coast	Canad. Fauna	?	Carol. Fauna
Lomvia svarbag	Arctic Coast	Canad. Fauna	?	Carol. Fauna?
Lomvia troile	Arctic Coast	Canad Fauna	?	Allegh. Fauna
Mergulus alle	Arctic Coast	———	?	Allegh Fauna

Summary of the Preceding Table. — The whole number of species in the preceding list is 93. Its most striking feature is the great predominance of the water birds, less than one third of the whole being land birds. Of the 27 land birds, 7 are owls, 6 are hawks, and 5 belong to the family *Fringillidæ;* 9 species embracing all the representatives of other families. The water birds include 1 heron, 14 *Grallæ*, 17 *Anatidæ*, 19 *Laridæ*, 5 *Alcidæ*, 3 species of *Colymbus*, and 4 of *Podiceps*.

In summer 65 species are inhabitants of the Arctic coast and adjacent seas; 22 have their boreal limit near the northern border of the Hudsonian Fauna; 2 are similarly limited by the Canadian Fauna, 5 by the Alleghanian, 3 by the Carolinian, and 1 by the Louisianian; 3 are essentially tropical aquatic species.

Seven seem to be altogether restricted in the breeding season to the Arctic Realm; 36 find their austral limit during the same season near the southern border of the Hudsonian Fauna; 23 are similarly limited by the Canadian, 9 by the Alleghanian, and 3 by the Carolinian, while 10 extend nearly to or within the Tropical Realms, 4 being also inhabitants of the greater part of the southern hemisphere.

The winter quarters of the land birds of this list are the cold-temperate and middle-temperate districts of the northern hemisphere. Most of the water birds visit the warm-temperate parts of the same hemisphere; a considerable number also visit the tropics, and a few wander, at this season, over the greater part of the warmer regions of the globe.

III. Species mainly restricted in the Breeding Season to the North American Temperate Region.

1. *List of Species which breed throughout the greater Part of Temperate North America, with Indications of their Boreal and Austral Limits Distribution in the Eastern Province.*

Species	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Turdus migratorius	Hudson. Fauna	Carol Fauna	Carol. Fauna	——— *
Turdus fuscescens	Canad Fauna	Carol. Fauna	——— *	———
Geothlypis trichas	Hudson Fauna	Florid. Fauna	Florid. Fauna	———
Hirundo horreorum	Hudson. Fauna	Louis. Fauna	———	———
Petrochelidon lunifrons	Hudson. Fauna	Carol. Fauna?	———	———
Tachycineta bicolor	Hudson. Fauna	Carol. Fauna	Louis. Fauna	———
Cotyle riparia	Arctic Coast	Carol. Fauna	Florid. Fauna	———
Progne subis	Canad. Fauna	?	Louis. Fauna	———
Ampelis cedrorum	Canad. Fauna	Florid. Fauna	Allegh. Fauna	———
Collurio ludovicianus	Allegh. Fauna	Florid. Fauna	Louis. Fauna	———
Vireosylvia gilva	Canad. Fauna	Carol. Fauna	———	———
Lanivireo solitarius	Hudson. Fauna	Allegh. Fauna	Florid. Fauna	———
Cistothorus palustris	Hudson. Fauna	Louis. Fauna	Louis. Fauna	———
Troglodytes aëdon	Allegh. Fauna	Florid. Fauna	Louis. Fauna	———
? Sitta carolinensis	Canad. Fauna	Louis. Fauna	Canad Fauna	Florid. Fauna
Sitta canadensis	Canad. Fauna	Carol. Fauna	Canad. Fauna	Louis. Fauna?
Parus atricapillus	Hudson. Fauna	Florid. Fauna	Canad. Fauna	Florid. Fauna
Carpodacus purpureus	Canad. Fauna	Allegh. Fauna	Allegh. Fauna.	Louis. Fauna
Chrysomitris tristis	Canad. Fauna	Louis. Fauna	Allegh. Fauna	———
Passerculus savanna	Hudson. Fauna	Allegh. Fauna	Carol. Fauna	———
Poocætes gramineus	Canad. Fauna	Carol. Fauna	Carol. Fauna	———
Spizella socialis	Hudson. Fauna	Louis. Fauna	Carol. Fauna	———
? Melospiza melodia	Hudson. Fauna	Louis. Fauna	Carol. Fauna	Florid. Fauna
Melospiza Lincolnii	Hudson. Fauna	Allegh. Fauna	Carol. Fauna	———
Molothrus pecoris	Hudson. Fauna	Louis. Fauna	Carol. Fauna	———
Agelæus phœniceus	Hudson. Fauna	Florid. Fauna	Carol. Fauna	———
Sturnella ludoviciana	Allegh. Fauna	Florid. Fauna	Carol. Fauna	———
Corvus americanus	Hudson. Fauna	Florid. Fauna?	Canad. Fauna	———
Tyrannus carolinensis	Canad. Fauna	Louis. Fauna	———	———
? Myiarchus crinitus	Canad. Fauna	Louis. Fauna	———	———
? Sayornis fuscus	Hudson. Fauna	Louis. Fauna	Louis. Fauna	———
Contopus borealis	Hudson. Fauna	Allegh Fauna	———	———
? Contopus virens	Canad. Fauna	Louis. Fauna	———	———
? Empidonax minimus	Hudson. Fauna	Allegh. Fauna	———	———
? Empidonax acadicus	Canad. Fauna	Carol. Fauna	———	———
Empidonax flaviventris	Canad. Fauna	Carol. Fauna	———	———
Picus villosus	Hudson. Fauna	Louis. Fauna	Canad. Fauna?	Florid. Fauna
Picus pubescens	Hudson. Fauna	Louis. Fauna	Canad. Fauna?	Florid. Fauna
Hylotomus pileatus	Hudson. Fauna	Florid. Fauna	Canad. Fauna?	Florid. Fauna
Chordeiles popetue	Hudson. Fauna	——— *	———	———
Ceryle alcyon	Arctic Coast	Florid. Fauna	Carol. Fauna	———
Accipiter Cooperi	Canad. Fauna	———	Carol. Fauna	———
Accipiter fuscus	Canad. Fauna	———	Carol. Fauna	———
Buteo borealis	Hudson. Fauna	———	Canad. Fauna	———
Buteo lineatus	Canad. Fauna	Florid. Fauna	Allegh. Fauna	Florid. Fauna
Buteo pennsylvanicus	Canad. Fauna	———	Allegh. Fauna	———
Haliaëtus leucocephalus	Arctic Coast	Florid Fauna	Hudson. Fauna?	Florid. Fauna
Scops asio	Canad. Fauna	———	Canad. Fauna	———
Zenædura carolinensis	Allegh. Fauna	Florid. Fauna	Carol Fauna	Florid. Fauna
Meleagris gallopavo	Allegh. Fauna	Florid. Fauna	Allegh Fauna	Florid. Fauna
Bonasa umbellus	Hudson. Fauna	Carol. Fauna	Hudson. Fauna?	Carol. Fauna
Botaurus lentiginosus	Hudson. Fauna	Carol. Fauna	Louis. Fauna	———
Ardetta exilis	Canad. Fauna	Florid. Fauna	Louis. Fauna	———
Gallinago Wilsoni	Hudson. Fauna	Allegh Fauna	Louis. Fauna	———
Rhyacophilus solitarius	Hudson. Fauna	Allegh. Fauna	Carol. Fauna	———
Tringoides macularius	Hudson. Fauna	Louis. Fauna	Louis. Fauna	———
Limosa fedoa	Arctic Coast?	Hudson. Fauna	Louis. Fauna	———
Rallus virginianus	Allegh. Fauna	Louis. Fauna	Louis. Fauna	———
Porzana carolina	Canad. Fauna	Carol. Fauna	?	———
Fulica americana	Canad. Fauna	Carol. Fauna	Louis. Fauna	———
Nettion carolinensis	Hudson. Fauna	Canad. Fauna	Carol. Fauna	———

* Blanks in the third column indicate that the species ranges southward in the breeding season into the Tropical Realm. Blanks in the fourth column that the species retires wholly within the Tropical Realm in winter; in the fifth column, that the southern limit in winter is within the Tropical Realm.

2. *List of Species which breed throughout the greater Part of the Cold-temperate Portions of the North American Region, with Indications of their Boreal and Austral Limits of Distribution in the Eastern Province.*

Species.	Boreal Limit in Breeding Season.	Austral Limit in Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Turdus Pallasi	Hudson. Fauna	Canad Fauna	Carol. Fauna	——— *
Turdus Swainsoni	Hudson Fauna	Canad Fauna	Florid. Fauna	———
Regulus calendula	Hudson. Fauna	Canad. Fauna	Carol. Fauna	———
Regulus satrapa	Hudson Fauna	Canad. Fauna	Allegh. Fauna	———
Anthus ludovicianus	Arctic Coast	Hudson. Fauna	Carol. Fauna	———
Helminthophaga celata	Hudson. Fauna	Canad. Fauna	Carol. Fauna	———
Wilsonia pusilla	Hudson. Fauna	Allegh. Fauna	——— *	———
Collurio borealis	Hudson. Fauna	Canad. Fauna	Canad. Fauna	Carol. Fauna
Troglodytes hyemalis	Hudson. Fauna	Canad. Fauna	Allegh. Fauna	———
Chrysomitris pinus	Hudson. Fauna	Canad. Fauna	Canad. Fauna	Florid. Fauna
Curvirostra americana	Hudson Fauna	Canad Fauna	Hudson. Fauna	Allegh. Fauna
Zonotrichia leucophrys	Hudson. Fauna	Canad. Fauna	Carol. Fauna	Louis. Fauna
Scolecophagus ferrugineus	Hudson. Fauna	Canad. Fauna	Carol. Fauna	———
Perisoreus canadensis	Hudson. Fauna	Canad. Fauna	Hudson. Fauna	Canad. Fauna
Picoides arcticus	Hudson. Fauna	Canad. Fauna	Hudson. Fauna	Canad. Fauna
Picoides hirsutus	Hudson. Fauna	Carol. Fauna	Hudson. Fauna	Canad. Fauna
Falco columbarius	Hudson. Fauna	Carol. Fauna	Canad. Fauna	Louis. Fauna
Astur atricapillus	Hudson. Fauna	Canad. Fauna	Hudson. Fauna	Allegh. Fauna
Ægialitis semipalmatus	Arctic Coast	Hudson. Fauna	Louis Fauna	———
Phalaropus Wilsoni	Arctic Coast	Canad. Fauna	Louis. Fauna	———
Ereunetes pusillus	Arctic Coast	Canad. Fauna	Carol. Fauna	———
Gambetta melanoleuca	Hudson. Fauna	Carol. Fauna	Louis. Fauna	———
Gambetta flavipes	Hudson. Fauna	Canad. Fauna	Louis. Fauna	———
Numenius longirostris	Hudson. Fauna	Canad. Fauna	Louis. Fauna	———
Numenius hudsonius	Hudson. Fauna	Canad. Fauna	Louis. Fauna	———
Cygnus americanus	Arctic Coast	Canad. Fauna	Allegh. Fauna	———
Bernicla canadensis	Arctic Coast	Canad. Fauna	Allegh. Fauna	———
Mareca americana	Arctic Coast	Canad. Fauna	Allegh. Fauna	———
Fulix collaris	Arctic Coast	Canad. Fauna	Canad. Fauna	———
Aythya americana	Arctic Coast	Hudson. Fauna	Carol. Fauna	———
Aythya vallisneria	Arctic Coast	Hudson. Fauna	Carol. Fauna	———
Bucephala albeola	Arctic Coast	Hudson. Fauna	Allegh. Fauna	———
Erismatura rubida	Arctic Coast	Hudson. Fauna	Allegh. Fauna	———
Lophodytes cucullatus	Arctic Coast	Canad. Fauna	Allegh. Fauna	———
Pelecanus erythrorhynchus	Arctic Coast	Canad. Fauna	Allegh. Fauna	———
Graculus dilophus	Arctic Coast	Canad. Fauna	Canad. Fauna	———
Larus delawarensis	Arctic Coast	Hudson. Fauna	Allegh. Fauna	———
Chrœcocephalus philadephia	Arctic Coast	Hudson. Fauna	Canad. Fauna	———

3. *List of Species which breed only in the Warm-temperate Portions of the North American Temperate Region, and range Southward in the Breeding Season into the Tropical American Realm.*

Species.	Boreal Limit in Breeding Season.	Austral Limit in Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Mimus polyglottus	Carolin. Fauna	——— *	Louis. Fauna	——— *
Polioptila cærulea	Carolin. Fauna	———	Louis. Fauna	———
Icteria virens	Carolin. Fauna	———	———	———
Stelgidopteryx serripennis	Carolin. Fauna	———		———
Thryothorus Bewicki	Carolin. Fauna	———	Louis. Fauna ?	———
? Sitta pusilla	Louis. Fauna	———	Louis. Fauna	———
Guiraca cærulea	Carolin. Fauna	———	———	———
? Quiscalus major	Louis. Fauna	———	Louis. Fauna	———
Elanus leucurus	Louis. Fauna	———	———	———
Polyborus tharus	Florid. Fauna	———	Florid. Fauna	———
Craxirex unicinctus	Louis. Fauna	———	———	———
Chamapelia passerina	Louis. Fauna	———	Louis. Fauna	———
Tantalus loculator	Louis. Fauna	———	Louis. Fauna	———
Garzetta candidissima	Carolin. Fauna	———	Louis. Fauna	———
Herodias egretta	Carolin. Fauna	———	Louis. Fauna	———
Himantopus nigricollis	Carolin. Fauna?	———	———	———
Rallus elegans	Carolin. Fauna	———	Louis. Fauna	———
Phœnicopterus ruber	Florid. Fauna	———	Florid. Fauna ?	———
Querquedula cyanoptera	?	———	Florid. Fauna	———
Pelecanus fuscus	Carolin Fauna	———	Louis. Fauna	———
Tachypetes aquila	Florid. Fauna	———	———	———
Plotus anhinga	Louis. Fauna	———	Florid. Fauna	———

* Within the Tropical Realm

4. *List of Species whose Breeding Range extends throughout the greater Part of the North American Realm, and Southward into the Tropical Realm, with Indications of their Boreal and Austral Limits in the Eastern Province.*

Species.	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Dendrœca æstiva	Hudson. Fauna	——— *	———	——— *
Grus canadensis	Arctic Coast	———	Carolin. Fauna	———
Butorides virescens	Allegh. Fauna	———	Louis. Fauna	———
Ardea herodias	Hudson. Fauna	———	Carolin. Fauna	———
Hæmatopus palliatus	Arctic Coast	———	Louis. Fauna	———
Ægialitis vociferus	Allegh. Fauna	———	Louis. Fauna	———
Recurvirostra americana	Hudson. Fauna	Louis. Fauna?	Louis. Fauna	———
Symphemia semipalmata	Canad. Fauna	———	Louis. Fauna	———
Aix sponsa	Canad. Fauna	———	Carolin. Fauna	———
Podilymbus podiceps	Hudson. Fauna	———	Carolin. Fauna	———

* Within the Tropical Realm.

5. *List of Species whose Breeding Habitat includes the greater Part of both North and South America, with Indications of their Boreal Limit, both in the Breeding Season and in Winter.*

Species.	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Cathartes aura	Allegh Fauna	———	Carolin. Fauna	———
Cathartes atratus	Louis. Fauna	———	Louis. Fauna	———
* Pandion haliaëtus	Arctic Coast	———	Louis. Fauna	———
Falco sparverius	Hudson. Fauna	———	Hudson. Fauna	———
* Falco peregrinus	Hudson. Fauna	———	Canad. Fauna	———
Bubo virginianus	Hudson. Fauna	———	Hudson. Fauna	———
* Strix flammea	Carolin. Fauna	———	Carolin. Fauna	———
* Otus vulgaris	Hudson. Fauna	———	Canad. Fauna?	———
* Otus brachyotus	Arctic Coast	———	Hudson. Fauna?	———

* Also circumpolar species.

Summary of the Preceding Five Tables. — The total number of species given in the above lists of the species characteristic (mainly exclusively so) of the North American Temperate Region is 135. Of these 38 are restricted in the breeding season in their austral range to the Cold-temperate District; about one third of them, chiefly natatorial species, reach the Arctic coast; 61 are similarly mainly limited to the Middle-temperate District, but two or three reach the Arctic coast, and nearly one third range into the Hudsonian Fauna; 21 are limited in their boreal range to the Warm-temperate District, the greater part of which, even in the breeding season, range southward into the tropics. Of the whole number, 90 are land birds, 23 being raptorial species. Of the remaining 45 water birds, 7 are herons, 20 are *Grallæ*, and 18 are *Natatores*, 12 of the latter being *Anatidæ*.

In the list of those whose breeding habitat is the cold-temperate portions of the continent (Table 1), 20 of the species are aquatic and

18 terrestrial; of those breeding throughout the greater part of the continent, 10 only are aquatic and 51 are terrestrial; of those breeding in the warm-temperate portions of the continent, 9 are aquatic and 9 terrestrial; of the 10 wide-ranging species, whose breeding habitats embrace not only nearly the whole of temperate North America, but extend also into the tropics, 1 only is a land bird, 3 being *Herodiones*, 4 *Grallæ*, and 2 *Natatores*. Of the 9 species given in the Fifth Table, which range in the breeding season throughout both the North American and South American continents, none are aquatic; 4 are owls, 3 hawks, and 2 vultures. The most numerously represented family, and one of those almost exclusively characteristic of the North American Temperate Region (the *Sylvicolidæ*), has but three species which range across the continent, and only one of these is a typical representative of the family.

IV. Species limited in Longitude to the Eastern Province of the North American Temperate Region.

1. *List of Species restricted in the breeding Season to the Cold-temperate Portion of the Eastern Province, with Indications of their Boreal and Austral Limits.*

Species.	Boreal Limit in Breeding Season.	Austral Limit in Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Mniotilta varia	Hudson. Fauna	Carolin. Fauna	——— *	——— *
Parula americana	Canad. Fauna	Carolin Fauna	Florid. Fauna	———
Geothlypis philadelphia	Allegh. Fauna	?	———	———
Oporornis agilis	Canad. Fauna	Allegh. Fauna?	———	———
Helminthophaga chrysoptera	Canad. Fauna	Carolin. Fauna	———	———
? Helminthophaga peregrina	Canad. Fauna	Carolin. Fauna	———	———
Helminthophaga ruficapilla	Hudson. Fauna	Carolin. Fauna	———	———
Dendrœca coronata	Hudson. Fauna	Canad. Fauna	Carolin. Fauna	———
Dendrœca castanea	Hudson. Fauna?	Canad. Fauna	———	———
Dendrœca striata	Hudson. Fauna	Canad. Fauna	———	———
Dendrœca Blackburniæ	Canad. Fauna	Allegh. Fauna	———	———
Dendrœca cærulescens	Canad. Fauna?	Canad. Fauna	———	———
Dendrœca maculosa	Canad. Fauna?	Canad. Fauna	———	———
Dendrœca virens	Hudson. Fauna	Allegh. Fauna	———	———
Dendrœca palmarum	Hudson. Fauna	Canad. Fauna	Louis. Fauna	———
Perissoglossa tigrina	Canad. Fauna?	Allegh. Fauna	———	———
Euthlypis canadensis	Hudson. Fauna	Canad. Fauna	———	———
Setophaga ruticilla	Hudson. Fauna	Allegh. Fauna	———	———
Vireosylvia olivacea	Hudson. Fauna	Louis. Fauna	Florid. Fauna	———
Vireosylvia philadelphica	Hudson. Fauna	Allegh. Fauna	———	———
Cistothorus stellaris	Hudson. Fauna	Carolin. Fauna	Louis. Fauna	———
Parus hudsonicus	Hudson. Fauna	Canad. Fauna	Hudson. Fauna	Canad. Fauna
Zonotrichia albicollis	Hudson. Fauna	Canad. Fauna	Louis. Fauna	———
Junco hyemalis	Hudson. Fauna	Canad. Fauna	Allegh. Fauna	Louis. Fauna
Spizella monticola	Hudson. Fauna	Canad. Fauna	Allegh. Fauna	Louis. Fauna
Passerella iliaca	Hudson. Fauna	Canad. Fauna	Carolin Fauna	Louis. Fauna
Dolichonyx oryzivora	Allegh. Fauna	Allegh. Fauna	———	———
Tetrao canadensis	Arctic Coast	Canad. Fauna	Hudson. Fauna?	Canad. Fauna
Ægialitis melodus	Canad. Fauna	Carolin. Fauna	Louis. Fauna	———
Limosa hudsonica	Arctic Coast?	Hudson. Fauna	Louis. Fauna	———
Numenius borealis	Arctic Coast?	Hudson. Fauna	Louis. Fauna	———
Porzana noveboracensis	Hudson. Fauna	Carolin. Fauna	Louis. Fauna	———
Anas obscura	Hudson. Fauna	Allegh. Fauna	Allegh. Fauna	Florid. Fauna
Querquedula discors	Hudson. Fauna	Canad. Fauna	Allegh Fauna	———
Camptolæmus labradorius	Arctic Coast	Hudson. Fauna	———	Canad. Fauna

* The blanks in the fourth and fifth columns indicate that the limit in question is within the Tropical Realm.

2. *List of Species which breed throughout the Middle-temperate Portions of the Eastern Province, with Indications of their Boreal and Austral Limits in the Eastern Province.**

Species.	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Turdus mustelinus	Allegh. Fauna	Louis. Fauna?	——	——
Galeoscoptes carolinensis . .	Allegh. Fauna	Florid. Fauna?	Louis. Fauna	——
Harporhynchus rufus . . .	Allegh. Fauna	Florid. Fauna?	Louis. Fauna	——
Sialia sialis	Allegh. Fauna	Louis. Fauna	Carolin. Fauna	——
Dendrœca pennsylvanica . .	Canad. Fauna	Allegh. Fauna	——	——
Dendrœca discolor	Allegh. Fauna	——	——	——
Dendrœca cærulea	Allegh. Fauna	Carolin. Fauna	——	——
Wilsonia mitrata	Allegh. Fauna	Louis. Fauna	——	——
Pyranga rubra	Allegh. Fauna	Louis. Fauna	——	——
Vireo noveboracensis . . .	Allegh. Fauna	Florid. Fauna?	Louis. Fauna	——
Lanivireo flavifrons	Allegh. Fauna	——	——	——
Lophophanes bicolor . . .	Carolin. Fauna	Louis. Fauna?	Carolin. Fauna	Florid. Fauna
Coturniculus passerinus . .	Allegh. Fauna	Louis. Fauna	Carolin. Fauna?	——
Coturniculus Henslowi . . .	Allegh. Fauna	Louis. Fauna	Carolin. Fauna?	——
Ammodromus caudacutus . .	Allegh. Fauna	Louis. Fauna	Louis. Fauna	——
Ammodromus maritimus . .	Carolin. Fauna	Louis. Fauna	Louis. Fauna	——
Spizella pusilla	Allegh. Fauna	Louis. Fauna?	Carolin. Fauna	——
Euspiza americana	Carolin. Fauna	——	——	——
Hedymeles ludovicianus . .	Allegh. Fauna	Carolin Fauna	——	——
Cyanospiza cyanea	Allegh. Fauna	——	——	——
Cardinalis virginianus . . .	Carolin. Fauna	——	Carolin. Fauna	——
Pipilo erythrophthalmus . .	Allegh. Fauna	Florid. Fauna	Louis. Fauna	——
Icterus spurius	Allegh. Fauna	Louis. Fauna	——	——
Icterus baltimore	Allegh. Fauna	Louis. Fauna	——	——
Corvus ossifragus	Carolin. Fauna	Florid. Fauna?	Louis. Fauna	——
Centurus carolinus	Carolin. Fauna	——	Carolin. Fauna	——
Melanerpes erythrocephalus .	Allegh. Fauna	Florid. Fauna?	Louis. Fauna	——
Antrostomus vociferus . . .	Allegh. Fauna	Florid. Fauna	Louis. Fauna	——
Coccygus americanus . . .	Allegh. Fauna	——	——	——
Coccygus erythrophthalmus .	Allegh. Fauna	——	——	——
Ortyx virginianus	Allegh. Fauna	——	Allegh. Fauna	——
Cupidonia cupido	Allegh. Fauna	Carolin. Fauna?	Allegh. Fauna	Louis. Fauna

* The blanks in this and the following tables have the same significance as in the last preceding table.

3. *List of Species which breed throughout the Temperate Portions of the Eastern Province, with Indications of their Boreal and Austral Limits.*

Species.	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Seiurus aurocapillus . . .	Canad. Fauna	Carolin. Fauna	Florid Fauna	——
Seiurus noveboracensis . . .	Hudson. Fauna	Louis. Fauna	——	——
Cyanura cristata	Canad. Fauna	Florid. Fauna	Allegh. Fauna	Florid. Fauna
Sphyrapicus varius	Canad. Fauna?	Florid. Fauna?	Carolin. Fauna	——
Colaptes auratus	Hudson. Fauna	——	Carolin. Fauna	——
Trochilus colubris	Canad. Fauna	——	Florid. Fauna?	——
Chætura pelasgia	Canad. Fauna	Louis. Fauna?	——	——
Grus americanus	Canad. Fauna	Florid. Fauna	Louis. Fauna	——
Actiturus Bartramius . . .	Canad. Fauna	——	Louis. Fauna	——
Sterna antillarum	Canad Fauna	——	——	——
Dendrœca pinus	Hudson. Fauna?	Louis. Fauna?	Carolin. Fauna	——
Quiscalus purpureus . . .	Hudson. Fauna	——	Carolin. Fauna	——

4. *List of Species which breed in the Eastern Province only within the Warm-temperate and Subtropical Districts.*

Species.	Boreal Limit in the Breeding Season.	Austral Limit in the Breeding Season.	Boreal Limit in Winter.	Austral Limit in Winter.
Prothonotaria citrea	Carolin. Fauna	——	——	——
Oporornis formosus	Allegh. Fauna	Louis. Fauna ?	——	——
Helmitherus vermivorus	Carolin. Fauna	Florid. Fauna?	——	——
Helmitherus Swainsoni	Louis. Fauna	——	——	——
Helminthophaga pinus	Carolin. Fauna?	——	——	——
Helminthophaga Bachmani	Louis. Fauna	——	——	——
Dendrœca dominica	Louis. Fauna	——	——	——
Vireosylvia barbatula	Florid. Fauna	——	——	——
Pyranga æstiva	Carolin. Fauna	——	——	——
Thryothorus ludovicianus	Carolin. Fauna	——	Louis. Fauna	——
Peucæa æstivalis	Louis. Fauna	——	Florid. Fauna	——
Cyanospiza ciris	Louis. Fauna	——	——	——
Tyrannus dominicensis	Florid. Fauna	——	——	——
Campephilus principalis	Carolin. Fauna	——	Louis. Fauna	——
Picus borealis	Louis. Fauna	——	Louis. Fauna	——
Conurus carolinensis	Louis. Fauna	——	Louis. Fauna	——
Crotophaga ani	Florid. Fauna	——	——	——
Antrostomus carolinensis	Louis. Fauna	——	Louis. Fauna	——
Nauclerus furcatus	Carolin. Fauna	——	——	——
Ictinia mississippiensis	Louis. Fauna	——	——	——
Rosthramus sociabilis	Florid. Fauna	——	——	——
Florida cærulea	Carolin. Fauna	——	Louis. Fauna	——
Nyctherodius violaceus	Carolin. Fauna	——	——	——
Demiegretta Pealei	Florid Fauna	——	Florid. Fauna	——
Demiegretta ludoviciana	Carolin Fauna	——	Louis. Fauna	——
Ibis alba	Carolin Fauna	——	Louis. Fauna	——
Platalea ajaja	Louis. Fauna	——	——	——
Ægialitis Wilsonius	Carolin. Fauna	——	Louis. Fauna	——
Aramus giganteus	Florid Fauna	——	Florid. Fauna	——
Rallus crepitans	Carolin Fauna	——	Louis. Fauna	——
Porzana jamaicensis	Carolin. Fauna	——	Florid. Fauna	——
Gallinula galeata	Carolin. Fauna	——	Louis. Fauna	——
Gallinula martinica	Carolin. Fauna	——	Louis Fauna	——
Sula fiber	Louis. Fauna	——	Florid Fauna	——
Graculus floridanus	Louis. Fauna	——	Florid. Fauna	——
Plotus anhinga	Carolin Fauna	——	Florid. Fauna	——
Chrœcocephalus atricilla	Allegh. Fauna	——	Florid. Fauna	——
Thalasseus acuflavidus	Louis. Fauna	——	——	——
Anoüs stolidus	Florid. Fauna	——	——	——
Haliplana fuliginosa	Florid. Fauna	——	——	——
Rhynchops nigra	Carolin. Fauna	——	Florid. Fauna	——

Summary of the Four Preceding Tables. — About one hundred and twenty species occur in the Eastern Province of the North American Temperate Region that do not appear as regular residents in the Western Province of the same region, of which a small proportion are in part tropical. Of these one hundred and twenty, thirty-five are northern, or range in the breeding season only over the cold-temperate portions of the Eastern Province; twenty-eight of the latter being land birds, and only seven aquatic. Eighteen species of the land birds belong to the single family of the *Sylvicolidæ*. About one fourth of the Eastern Province species (thirty-two), *all land birds*, range in the breeding season over only the middle-temperate part of the province. Of these only three belong to the family *Sylvicolidæ*, and only one is a typical representative of that group; ten belong to the family *Fringillidæ*, three to the *Turdidæ*, and two each to the *Icteridæ, Picidæ, Cuculidæ*, and *Tetraonidæ ;* several other families have one representative each. The total absence of any species of *Falconidæ, Strigidæ, Herodiones, Grallæ*, and *Natatores* is one of the most striking features in the list of the species restricted to the Eastern Province.

Twelve of the Eastern Province species breed throughout the greater part of the province, three of which are *Sylvicolidæ*, two are *Picidæ*, one is a humming-bird, one a wader, and one a tern.

Forty-one of the one hundred and twenty species restricted in longitudinal range to the Eastern Province extend so far into the Tropical American Realm in the breeding season as to be essentially tropical species, exclusive of a considerable number that appear only in the Floridian Fauna. Twenty-one of these are land birds and twenty aquatic; the latter embracing six *Herodiones*, six *Grallæ*, and eight *Natatores*, five of which are terns. The land species embrace three hawks, two species of *Fringillidæ*, seven of *Sylvicolidæ*, two of *Picidæ*, and one each of seven other families.

General Remarks on the Distribution and Migration of the Birds of the Eastern Province.

The preceding tables, illustrative of the geographical distribution of the birds of the Eastern Province of the North American Temperate Region, and the summary remarks already given respecting them, indicate a number of interesting general facts.

I. The species which have the greatest longitudinal range in the breeding season are the hawks, owls, and vultures, the swallows, the *Turdinæ* or typical thrushes, the woodpeckers and flycatchers, and the water birds; among the latter, especially the *Scolopacidæ*, the *Charadriidæ* and their allies, the *Anatidæ*, and the *Laridæ ;* in fact, nearly all the *Natatores.* All the land birds ranging widely in longitude are hence species which possess highly developed powers of flight, and have also a wide latitudinal range. The few circumboreal *Natatores*, which have only moderate or greatly reduced powers of flight, possess great power of locomotion in the water. Their habitat is, moreover, not only generally the sea-shores, but the boreal shores of the converging continents of the northern hemisphere. Hence all the species having a wide geographical range — as the circumpolar and continental — are either pre-eminently strong fliers or powerful swimmers. It also explains the occurrence of the large proportion of long-winged birds, and especially of the preponderance of the water birds, in the three first primary divisions given above of the birds of the Eastern Province, namely, the cosmopolitan, the circumpolar, and the continental, and the small proportion of such species among those restricted in their longitudinal range to the Eastern Province. Most of the circumpolar species are also boreal ones.

II. The aquatic species, while forming only about four tenths of the birds found in the Eastern Province, greatly predominate over the land species in the boreal regions, in the Arctic Realm they outnumbering the land birds in the proportion of five to one, or form eight tenths of the whole. In the Cold-temperate District of the North American Region the water birds form about six tenths of the whole; in the Middle-temperate Districts, between four and five tenths; in the Warm-temperate District, rather less than four tenths. Farther southward, although a few groups (as the *Rallidæ*, *Herodiones*, and *Sterninæ*) are more numerously represented, the relative proportion of water birds to the terrestrial seems scarcely to increase. In the breeding season, however, a numerical comparison of the land and water birds yields very different results, in respect to the proportion characteristic of localities situated under different parallels of latitude. Passing from the extreme boreal regions southward, the number of *Grallæ* (exclusive of the *Paludicolæ*), *Anatidæ*, *Larinæ*, and *Lestridinæ* decreases rapidly, so that the number of the *Grallæ* (exclusive of the rails and their allies) is reduced in the breeding season, in the warm-temperate parts of the Eastern Province, to only seven or eight species, the *Anatidæ* to one (*Aix sponsa*), the *Larinæ* to one (*Chræcocephalus atricilla*), and the *Lestridinæ* disappear entirely.

III. A large proportion of the accessions to the land birds near the tropics being species of a comparatively low grade of structure, the prevalence of the water birds in the arctic and subarctic faunæ, the comparative absence of water birds in the temperate latitudes, and the great development here of the higher groups of the land birds, give to the temperate regions the maximum proportion of high forms of avine life, — a fact as true in respect to mammalian life as it is of birds.

IV. In respect to the distribution and relative development of particular families, the *Sittidæ* (*Sittæ*), the *Paridæ*, and the *Alcidæ* are alone restricted to the North Temperate Realm. The species of these groups (except the *Alcidæ*) are also sedentary throughout nearly their whole range. In the Eastern Province, *Larus*, *Stercorarius*, and their allies, as well as *Colymbus*, are restricted in the breeding season to its northern half, as are also, as already remarked, most of the water birds, except the *Rallidæ* and the *Herodiones*, which are chiefly southern. The representatives of the *Troglodytidæ* and *Icteridæ* increase rapidly in number towards the tropics, while the *Miminæ* and several genera of the more brightly colored *Fringillidæ* are confined to the southern half of the province. The *Sylvicolidæ*, the most exclusively distinctive family of the North American temperate region, reaches its maximum development in the Middle and Cold-temperate Districts. The section *Sylvicoleæ*, and especially the genus *Dendrœca*, is more numerously represented in the Eastern Province than in the Western, and the greater part breed in the colder latitudes, their "metropolis" during the breeding season being the Canadian Fauna of the Eastern Province and the corresponding fauna of the Western. The species of the section *Vermivoreæ* (genera *Helmitherus* and *Helminthophaga*) have a wider longitudinal distribution than the *Dendrœcæ*, the species of which genus are mainly restricted either to the Eastern or to the Western Province. The two species of *Helmitherus* are southern in their distribution, while four or five of the six *Helminthophagæ* are northern.

V. At the extreme north, or from the Arctic coast southward to the Canadian Fauna, nearly all the birds are migratory, owing to the extreme severity of the winter season; they also spend a smaller portion of the year at their breeding stations than do the species which breed farther to the southward. Even as far south as the Alleghanian and Carolinian Faunæ, the greater proportion of the species are to a greater or less extent migratory. In the Carolinian and Louisianian Faunæ a much greater proportion are resident, even including many species whose boreal limit of distribution is the Carolinian Fauna. From the Hudsonian Fauna southward many species are found the whole year at the same localities, and are hence termed "resident," though the individuals representing such species are migratory, there being a general movement of the winter habitat southward, but too limited to carry the wave of migration entirely beyond the southern limit of the summer habitat of these species.

VI. The representatives of the various groups differ from each other widely, as is well known, in respect to the extent of their migrations. Those of a few families (as the *Tetraonidæ*, the *Picidæ*, *Sittidæ*, *Corvidæ*, and *Strigidæ*) are nearly sedentary, the nature of their food being such that the supply is almost equally sure at all seasons. The insectivorous species have the most extended migratory range; the piscivorous, the graminivorous, and the raptorial the least of the non-sedentary species, the migrations of the latter being mainly governed by those of their prey. Hence the wood warblers (*Sylvicolidæ*), the flycatchers (*Tyrannidæ*), and the swallows make the longest journeys, and leave their breeding stations the earliest. Requiring apparently a temperature in winter similar to that of their summer habitats, as well as a constant supply of insect food, they begin their southward journeys almost before the close of the short northern summer, proceeding gradually southward during the autumn months to pass the winter in the tropics. The *Grallæ* have also to seek districts almost wholly beyond the reach of severe frosts, their food being only accessible to them where the ground continues unfrozen. The *Natatores* also necessarily migrate to localities where the streams and estuaries are nearly free from ice; the strictly littoral and pelagic species hence making shorter journeys than the inland species.

The migratory insessorial birds that pass the winter wholly or in part within the Eastern Province are principally fringilline species. The others are a single flycatcher (*Sayornis fuscus*), the northern members of the *Icteridæ*, two species of *Turdus*, three of *Miminæ*, three wrens, and three or four sparrows. All of these species are resident the whole year in those sections to which the northern members of these species mainly resort in winter. In these species there is hence only a partial recession southward in winter from the northern portions of their respective summer habitats. Most of the *Fringillidæ*, however, which pass the summer within or to the northward of the Alleghanian Fauna, remove wholly in winter from their summer stations. While some in winter barely abandon their summer stations, as shown in the preceding tables, of distribution, others pass entirely over one fauna, throughout which they occur only as spring and autumn passengers; others in a similar way pass over two faunæ in reaching their winter quarters. Hence some which breed in the Canadian Fauna and farther northward pass only into the Alleghanian and Carolinian Faunæ in winter, while others pass over the Alleghanian into the Carolinian, and others over both the Alleghanian and the Carolinian into the Louisianian.

Some species which in general breed far to the northward of the tropics, to which they retire in winter, are also known to breed on the mountains within the tropics (as *Dendrœca coronata* and *Perissoglossa tigrina*), and doubtless many others will be found to do so when the mountain faunæ of these regions become fully known; it being already well ascertained that there is a migration from the plains and lowlands to the mountains (more especially in the Tropical Realms) as well as (in the northern hemisphere) from the south northward.

VII. The lack of suitable food and the low temperature in winter in northern latitudes are evidently the causes which impel so many species to leave their breeding stations at that season to seek a warmer zone. While in most cases a degree of cold sufficient to cut off the supply of food of any species, especially of the insectivorous ones, would of itself also prove fatal to the birds themselves, it is by no means the case with the baccivorous and graminivorous species, their winter migrations appearing to be primarily and principally controlled by the accessibility of their food. This is evidently indicated by the irregular dispersion in winter of such species near the boreal limit of their range at that season, they being numerous where their food abounds and entirely absent in the immediately adjoining districts.*

VIII. The breeding range, as well as the migratory range, differs greatly not only among the species of different families (nearly all the species of some families having a wide range, while nearly all the species of other families have a quite restricted range, as in the *Corvidæ* and *Picidæ*, for instance, as compared with the *Sylvicolidæ*), but also among those of the same family and even of the same genus. The two extremes are well illustrated by the osprey or fish-hawk and

* These remarks are illustrated by the winter distribution of the robin and the cedar-bird in the Alleghanian Fauna, and by the sudden southward incursion of the snow-buntings and other northern sparrows when deep snows suddenly render their food more than usually difficult to procure in their usual winter resorts. The early return of birds to their breeding stations, — their real homes, — as soon as the causes that impelled their winter migration are removed, is further corroborative of the same view. Most of even the insectivorous species visit regions in winter whose average winter temperature differs but little from that of their breeding stations, and when the excessive heats of spring and summer arrive in the southern latitudes, they gradually retire again to their northern breeding stations, keeping pace in their migration with the northward advance of the summer warmth.

the bobolink, the one having an almost cosmopolitan breeding range, while the breeding range of the other is nearly or quite restricted to the Alleghanian Fauna. Several of the *Sylvicolidæ* have a breeding range as restricted as the bobolink, while a few other species of the same family breed throughout nearly the whole of North America. One of the species of *Dendrœca* (*D. æstiva*) has this wide breeding range, while other species of the same genus appear to breed only in the Canadian Fauna.

IX. Species which have a wide breeding range usually present a greater or less number of easily distinguishable local forms, which merge generally the one into the other in the regions lying between the localities at which these several forms are most fully developed. A part of these local forms have received distinctive names, and have of late been quite commonly regarded as distinct species, while many are as yet not so regarded. Every year additional races of this character are discovered, and doubtless many still remain unknown. Much time will probably elapse before naturalists will generally agree as to their true character and relations, though evidence indicative of their being the result of general and uniformly acting laws of geographical variation is apparently by no means wanting. The difference in color, size, form of the bill, length of the tail, etc., that appear almost universally to obtain between the northern and southern representatives of the same species, have already been sufficiently dwelt upon in the preceding pages; but the insertion of a few species in the list of those alleged above (Class IV of the preceding tables) to range across the North American continent calls for an additional word in respect to the differences which have led to the specific separation of the western representatives of these species from their eastern representatives, or to suggestions that they might prove to be specifically distinct. Most of the cases of this kind have been distinguished in the tables under Class IV by the prefix of a [?] before their names. In all these cases almost the sole difference alleged for the separation of the western forms is that of either the darker or brighter or, in other words, the more intense colors of those from the Pacific coast; this character being always the one most strongly urged as distinguishing them, and not unfrequently the only one, especially in those species that breed wholly to the northward of the latitude of San Francisco. The frequency of this difference seems to be a strong reason for regarding it as the result of a general law, and to remove it from the category of genuine specific distinctions.*

X. The number of species which breed in the American Arctic Fauna appears to be not far from sixty. In the Hudsonian Fauna the number is increased to upwards of one hundred and fifty, in the Canadian to probably about one hundred and sixty. In the Alleghanian the number is nearly one hundred and forty; in the Carolinian about one hundred and thirty-five; in the Louisianian about one hundred and thirty. The Hudsonian and Canadian Faunæ hence have a greater number of species, in areas of the same extent, and probably a far greater number of individuals, than the Carolinian and Louisianian Faunæ. In respect to the number of individuals, it is evident that this must result, in consequence of the hordes of wading and swimming birds, of thrushes, sparrows, and *Sylvicolidæ* that pass through the southern and middle districts of the Eastern Province to breed in its boreal portions; few of the species that breed at the southward being there as numerously represented as are scores of species that breed exclusively at the northward. Taking the whole number of species found at particular localities during the year, there is a constant increase in number to the southward, the increase, however, being less rapid from the southern boundary of the Canadian Fauna southward than from that point northward.† There is also a steady

* In addition to the list of examples of this variation already cited in Part III of this paper, the following may be added as marked instances: *Regulus satrapa*, Pacific coast specimens forming the variety *olivaceus* Baird; *Troglodytes hyemalis*, Pacific coast specimens forming the variety *pacificus* Baird; *Cistothorus palustris*, Pacific coast specimens forming the variety *paludicola* Baird; *Helminthophaga celata*, Pacific coast specimens being, according to Professor Baird, "much brighter and clearer yellowish beneath and olivaceous above," than those from the interior of North America; *Myiodioctes* (= *Wilsonia*) *pusilla*; *Hirundo bicolor*; *Collurio excubitoroides* (= *C. ludovicianus*), Pacific coast specimens being darker than those from the Mississippi Valley, and much darker than those from the Plains (*Baird*); *Carpodacus purpureus*, Pacific coast specimens being darker and forming the *C. californicus* of Baird: *Melospiza melodia*, the darker Pacific coast specimens forming the *M. Heermanni* Baird, etc.

† There seems to have been no exhaustive list published of the birds occurring at any locality north of the Alleghanian Fauna. Dr. Richardson's list is the largest, and gives two hundred and thirty-eight as the whole number known in 1831 to inhabit British North America north of the Canadas and east of the Rocky Mountains. Probably this number, and even more, may occur at a single locality on the Saskatchewan; but probably not more than two hundred and sixty or seventy. Three hundred and ten have been detected in Massachusetts, including those of irregular and very rare

increase southwards in the number and even in the proportion of species which are resident at the same locality the whole year. But from the absence of exhaustive lists of the species occurring at numerous localities, differing in latitude, it is difficult to make at present a wholly satisfactory numerical comparison of the different ornithological faunæ.*

occurrence ; three hundred and twenty-seven in the vicinity of New York City (*Lawrence*), and three hundred and forty-three in New Jersey (*Turnbull*). The number given by Ross as observed by him in the "Mackenzie's River District" is one hundred and ninety-two. The greatest number I have seen recorded from any restricted locality within the American tropical Realm is five hundred and forty, the number given from Costa Rica by Messrs. Lawrence and Salvin.

* Dr. Richardson in 1831, found that the number of species "known to rear their young on the banks of the Saskatchewan" amounted to one hundred and forty-one. At least twenty species more may now be safely added. Bonaparte, in 1827, estimated the number of species breeding at Philadelphia to be one hundred and four. Messrs. Coues and Prentiss in their list of the birds of the District of Columbia, published in 1861, mention forty-four species as being permanent residents, and fifty-nine others as summering, making one hundred and three that probably breed in the District, — one less than the number given by Bonaparte as breeding at Philadelphia. Messrs. S. F. and W. M. Baird gave, in 1844, one hundred and nine species as breeding at Carlisle, Pennsylvania. The three latter being inland localities, they may properly be compared with the Saskatchewan district. The numerous lakes at the latter locality, however, afford favorite breeding places for numerous water birds, while few such localities are afforded by the other localities mentioned; but since few water birds breed so far south as these localities, the difference in this respect is a fact of small importance. Dr. Turnbull, in 1869, gave the number of permanently resident species in "East Pennsylvania and New Jersey" as fifty-two, and the number of summer visitors as one hundred and fourteen, making a total of one hundred and sixty-six species that occur there in summer; but the area included in this list is more extended, and embraces a greater variety of surface than in the other cases, and includes several strictly coast species. Farther than this, an examination of his list shows that at least thirty of the one hundred and sixty-six are either wholly of accidental or of very rare occurrence, and hence do not regularly (many of them never) breed at the locality named. The number of resident species in Massachusetts is not far from thirty, of summer visitors one hundred and six, making one hundred and thirty-six that are more or less frequent in summer, — a number considerably less than undoubtedly occur in an equal area on the Saskatchewan. Mr. C. J. Maynard, in his careful analysis of the birds of Eastern Massachusetts (Naturalist's Guide, Part II, pp. 162 – 164, 1870), gives only one hundred and fifteen as being known with certainty to breed in the eastern half of that State, one or two of which cannot be considered as breeding there regularly. While this somewhat exceeds the number generally given as breeding at localities more to the southward, it is far less than the number given by Dr. Richardson as breeding on the Saskatchewan, and much less than the number now well known to be found there in summer. Dr. Coues, in his "Synopsis of the Birds of South Carolina," indicates only about one hundred and thirty-five as being known to breed regularly in that State.

APPENDIX TO PART V.

LIST OF AUTHORITIES.

In the following list are given the titles of general works and special papers that may be profitably consulted in a study of the geographical distribution of the birds of North America. An attempt has been made to cite all the papers of much importance bearing upon this subject that have appeared prior to the beginning of the year 1870, those published in this country having been also brought down to the present date (April, 1871). Some of those published in the transactions of foreign societies during 1869 have been necessarily omitted, as also a large proportion of those published in 1870, since most of these publications are usually several months in reaching this country.

In compiling the present list I have been greatly aided by the "List of Authorities" published by Professor Baird in the Appendix of his Report on the Birds of North America in 1858; Agassiz's "Bibliographia Zoölogiæ"; Carus and Engleman's "Bibliotheca Zoölogica," ending with the year 1860; by Dr. G. Hartlaub's "Bericht über die Leistungen in der Naturgeschichte der Vögel," in Wiegmann's Archiv für Naturgeschichte, and by Professor Alfred Newton's admirable ornithological record in Dr. Günther's "Zoölogical Record."* I am also indebted to Dr. Elliott Coues for the addition of the titles of a considerable number of articles to the proof-sheets, which he has had the kindness to carefully examine. The few titles enclosed in brackets indicate those papers I have not myself consulted.

In aiming at brevity I may have excluded from the list a few papers that might well have been added. Usually papers mentioning less than half a dozen species have been excluded, including announcements of the capture of species at localities beyond their usual range. To cite all such notices would nearly double the length of the list, without materially adding to its value, at least for general purposes. Papers in which new species were described are frequently omitted where the geographical data given in them have been subsequently incorporated in other papers published by the same author.

* The volume for 1869 I regret to find has not yet appeared.

The geographical arrangement of the papers serves to show at a glance what portions of the continent are tolerably well known, so far as regards the birds occurring there, as well as to indicate the considerable areas that are still almost unknown, and the amount of information possessed respecting the regions partially known. In order to indicate to some extent the character of the papers mentioned, the number of species given in each is usually stated, as well as the number of pages the papers embrace.

Occasionally valuable notes on the distribution of our birds, and sometimes nearly complete local lists, are to be found in the various agricultural periodicals, in the transactions or reports of agricultural societies, and in the various State agricultural reports. Although a number of such have been entered in the following list, others may have escaped notice; and information of such omissions, or of the omission of any local list, would be thankfully received by the writer.

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BACHMAN, JOHN. On the Migration of the Birds of North America. Am. Journ. Sci. and Arts, 1st Ser., Vol. XXX, pp. 81–100, 1836.

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COUES, ELLIOTT. A Critical Review of the Sub-family *Lestridinæ*. Proc. Acad. Nat. Sci. Philad., 1863, pp. 121 – 138. (7 species.)

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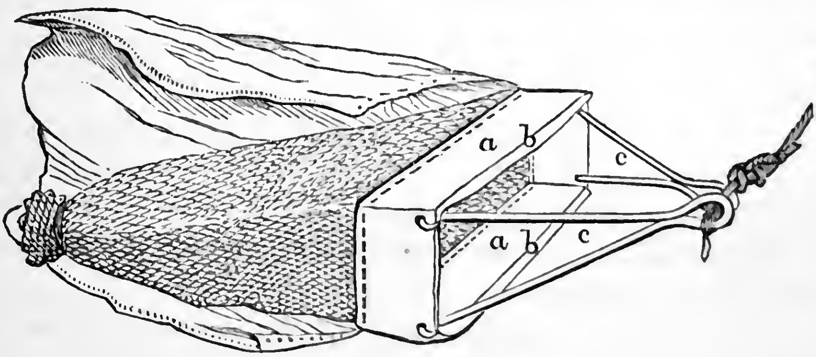
Cambridge, April, 1871.

N. B. — The Museum of Comparative Zoölogy would gladly accept books not yet upon the shelves of its library in exchange for its publications or zoölogical specimens.

No. 4. — *Directions for Dredging.* Drawn up by L. F. de Pourtales, Assist. U. S. Coast Survey.

The results obtained in late years by dredging in various depths have been such as to open a wide field to the naturalist. The laborers are few as yet, and these directions are issued in the hope of increasing their number by making them acquainted with the readiest modes of operation.

The dredge has as yet received but few improvements since the days of Forbes. His model has proved simple and sufficient, and would probably gain little by being made more complicated. Its construction will be best understood by referring to the figure below, in which *a a* represents an iron frame with the edges *b b* sharpened and slightly turned up, and forming the scrapers. The rear edge is pierced with a row of holes, through which the twine, or, better, brass wire, is passed by which the net is fastened. The arms *c c* are hooked to the short sides of the



frame, in such a way as to allow their being folded in, for easier transportation, and turned out in case they are caught among the rocks, as will be explained further on. The net is made of strong twine with small meshes, and may be three or four feet deep, according to the size of the dredge. It was found convenient to have it open at the bottom, and gathered and firmly tied only when in use. This gives greater convenience in emptying and washing out the bag after a haul. The net is protected against the rocks and corals by an outer covering of stout canvas or leather, open at the bottom. It is represented cut open and thrown back in the figure, so as to show the net. The English Deep-Sea Dredging Expedition used a double bag, the outer being a close net of sounding-line, the inner a piece of "bread-bag," a somewhat open canvas. To prevent the bag from being turned inside out in going down, a stout brass wire, bent in a semicircle and put inside the bag with the ends fastened to the frame, will be found very convenient.

The dredge used by the Swedish expeditions is a little different, the bag being simple and made of canvas with several square holes closed with wire-gauze. Light objects would seem liable to be washed out of this bag when hauling up, still it appears to have worked satisfactorily.

Mr. Bowerbank used a bag formed of two pieces of raw hide connected at the ends and bottom by a net made of cod-line.

The dimensions of a dredge vary according to the depth or bottom on which it is to be used. From two feet by six inches up to four feet by eight inches will be found the most useful dimensions. For deep-sea dredging, the dredge ought to be heavy, so as to sink rapidly, and be kept on the bottom by its own weight. A heavy lead was attached to it with advantage in the United States Coast Survey Expedition. The English dredgers consider it an impediment, and prefer to have the weight in the metal of the dredge. The rope used by the United States Coast Survey in deep-sea dredging was from one and a half to one and three fourths inches in circumference, made of best Italian hemp by Messrs. Sewall, Day, & Co., of Boston, and gave entire satisfaction. The Porcupine Expedition used hemp rope two and two and a half inches in circumference.

In dredging over rocky ground, the rope is fastened to the ring of one of the arms only, whilst the other is tied to it with spun-yarn. Should the dredge get foul of a rock, the stop will break and the dredge come up endwise, the whole pull acting then on one arm.

As a rule the length of line should be about twice the depth. On very soft bottom it is somewhat shortened, to keep the dredge from getting filled too soon. In very great depths it was found by the English Porcupine Expedition that the line could be kept much shorter by attaching to it weights of one hundred or two hundred pounds at about one fourth the depth from the dredge. The dredging is then carried on, as it were, from the weight, and not from the vessel. In this way three thousand fathoms were used for a depth of two thousand four hundred and thirty-five fathoms.

Dredging may be carried on from a boat, down to ten or twelve fathoms, with wind enough to propel it, or a good crew to pull it if calm. From a sailing yacht two hundred and fifty fathoms have been attained, though probably with some difficulty. For greater depths a steamer is almost indispensable, provided also with a donkey-engine to haul up the line. Without the latter the labor of the men is very heavy, and the time consumed a great drawback. To ascertain the strain on the rope, some kind of a dynamometer ought to be attached to it. A convenient form is the "accumulator" used in the Porcupine. It consists of a number of solid india-rubber springs, about two feet long, connected at each end with a disk of wood. One end of the accumulator is fastened below to the derrick and above to a rope, which, passing through a block at the top of the derrick, supports the snatch-block through which the dredge-line goes overboard. The motions of the accumulator show the variable strain on the line.

Many valuable specimens were obtained on board the Porcupine by means of hempen tangles or swabs, attached to the ends of a transverse bar made fast to the dredge. According to Mr. Jeffreys, it is, however, more advisable to use them separately, as they interfere with good work of the dredge itself.

In dredging it is preferable to have the dredge go over the bow, especially on rough bottom, as it is easier, in case of fouling, to steam ahead to release the dredge than to back up. Otherwise the stern is more convenient, as the working-table, alcohol jars, &c., are usually stowed on the quarter-deck.

After the dredge is brought up the contents may be emptied into a tub, the more delicate specimens picked out and transferred to clean sea-water if they are to be observed alive, and the residue washed in graduated sieves of copper wire. A rough list of the contents is noted in a book, with specification of the depth, temperature of the water, &c. Until they can be sorted, the contents of every dredgeful can be tied up in a bag of some loose stuff (old bunting from worn signal-flags was used in the Coast Survey), a label written with ink and folded up being enclosed, and the whole put in alcohol. Thus a large metallic vessel, filled with alcohol, can be used to contain the results of many dredgings; bottles being reserved for the more delicate objects. Economy of space can thus be gained to a considerable extent.

Surface specimens can be obtained during the dredging in tow-nets of bunting, stretched over a hoop; when under way very small towing-nets may occasionally be used also, if the speed is slow.

The naturalists of the Swedish Josephine Expedition used also an implement intermediate between the dredge and the tow-net, to obtain the small swimming crustacea, found near but not on the bottom. It was a sort of very light dredge, made of hoop-iron, with the end-pieces rounded off in such a way as to lift the edge of the net some distance above the ground, so as not to scrape. The net was made of some strong gauze-like stuff.

No. 5. — *Appendix to the Preliminary Report* (Bulletin No. 9, Vol. I.) *on the* ECHINI *collected by* L. F. DE POURTALÈS. *By* ALEXANDER AGASSIZ.

THE two species of sea-urchins here briefly noticed are interesting in a geographical point of view; the one being a second species of a genus thus far only known from the Indian Ocean; the other as additional evidence on an interesting question of geographical distribution in the Atlantic Ocean.

Among the Echini collected by Mr. Pourtalès in 1868 – 69, during his exploration of the Gulf Stream, were numerous fragments of spines of sea-urchins which I was unable, at the time of writing the preliminary report, to refer to any genus of Echini known to me. Having while in Paris had the opportunity — thanks to Professor Bayle — of examining Michelin's collection now in the École des Mines, containing among other types a remarkable sea-urchin of which only a single specimen exists, described by Michelin, in Annéxe A to Maillard's notes sur l'isle de Bourbon, in 1863.

This sea-urchin he named *Keraiaphorus Maillardi;* it was brought up from a depth of two hundred metres on a fishing-line, and was called Keraiaphorus on account of its long curved spines, resembling the antennæ of *Cerambycidæ.* The fragments of spines collected by Mr. Pourtalès off Tennessee Reef, at a depth of one hundred and sixty fathoms, belong to this genus, but differ sufficiently in appearance to show they do not belong to the same species. They are of a bright vermilion on the concave part of the spine, and a light pink on the opposite side; the extremity of the spine is white for a considerable distance; the spine is slightly curved from the base; a section of the spines shows them to be somewhat triangular, with rounded sides, the long convex side of the triangle being placed on the side of greatest diameter of curvature of the spine, and the short slightly concave or straight sides on the concave part of the spine. The spine is nearly solid, with the exception of a small annular space, nearer the centre than the periphery, made up of one row of large triangular limestone cells, such as are so characteristic of spines of Echini; the central part and the periphery of the spine consist of very minute circular cells closely packed together, presenting a homogeneous structure; in consequence the outside of the spine is not striated, either longitudinally or transversely, and shows simply a homogeneous close granulation, like very fine marble. The longest fragments are about two inches in length, and to judge from analogy with *Keraiaphorus Maillardi*, they must have attained a length of at least five or six inches. It is to be hoped that future explorations will bring to light this interesting sea-urchin, as the only specimen thus far found is not in such a state of preservation as to enable us to ascertain its affinities perfectly satisfactorily. As far as an examination would allow, Keraiaphorus is identical with Cœlopleurus, and is closely allied to Echinocidaris. There are some discrepancies between the description of Michelin and his figures, the tubercles are not perforated nor crenulated, the general structure of the genital and ocular plates is similar to those of Echinocidaris; unfortunately the anal plates are not preserved, and Michelin says nothing about them. The peculiar structure of the bare portion of the abactinal part of the interambulacra is not sufficiently brought out in Michelin's figures, in the specimen, ridges of small tubercles, running in S-shaped curves across this bare part of the interambulacra from the base of one plate to the angle of the opposite plate, are quite prominent and fully as marked as in the best figures of Cœlopleurus given by Cotteau in the Actes de la Société Linnéenne de Bordeaux, pl. xii, fig. 4, Vol. 27. The spines of Cœlopleurus are as yet not known, unless the spines cited under the name of Cidaris incerta *d'Arch*, found in the same beds as those containing Cœlopleurus, should turn out to be the spines of this genus. They greatly resemble the smaller, shorter, and straight spines of Keraiaphorus found round the actinostome, as was suggested to me by Mr. Vaillant of the École des Mines.*

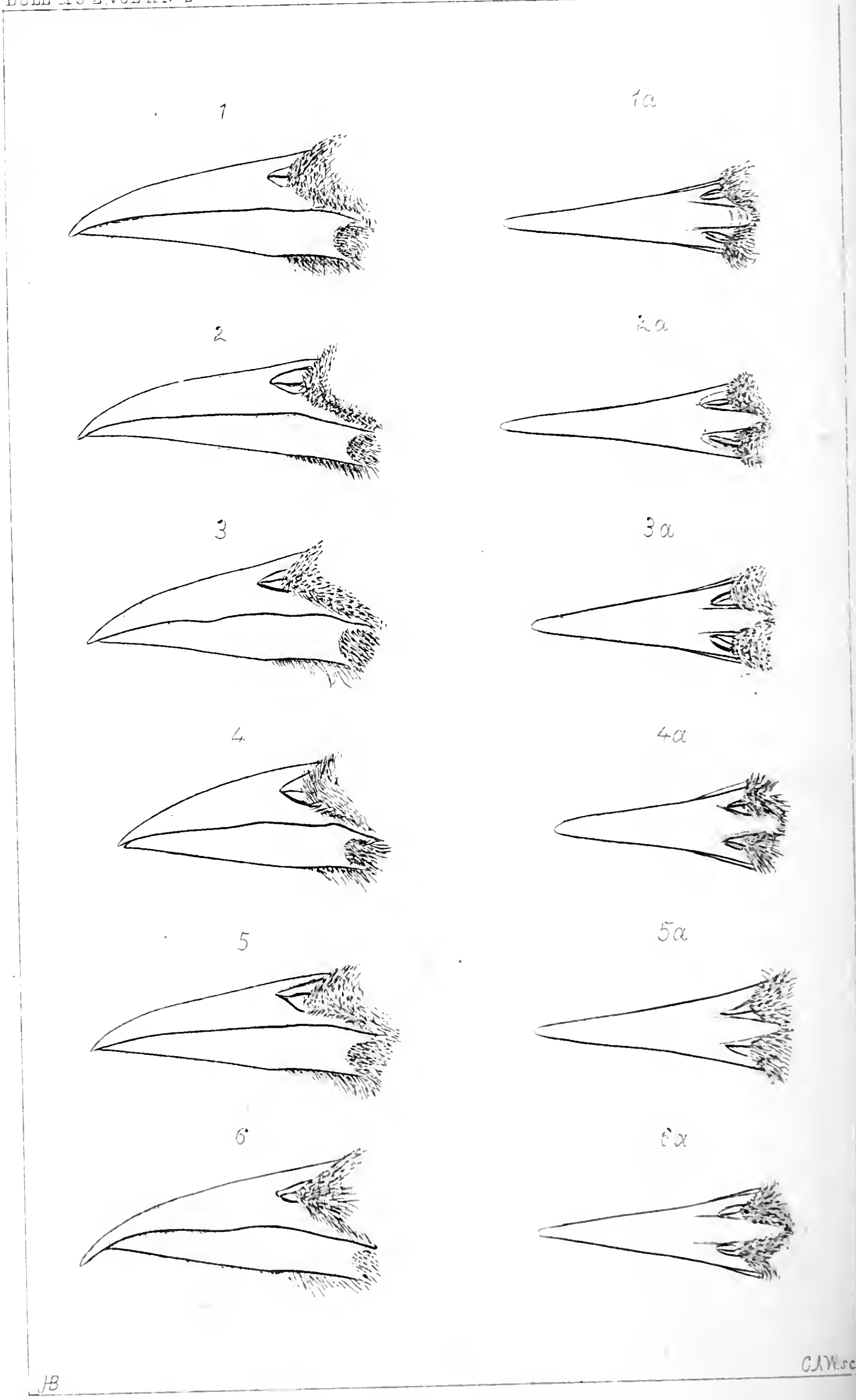
In addition to the foregoing species, there was a small sea-urchin, one eighth of an inch in diameter, which will most probably turn out to be the young of some species of the Diadematidæ allied to Asthenosoma Grube. It is already of a size when a young Diadema has its plates tolerably well defined, and when its spines far surpass the diameter of the test in length, besides being provided with a long anal proboscis, which at once characterizes young Diadematidæ. This specimen was nearly flat, the outline deeply cut at the ambulacra, the interambulacra pro-

* It is interesting to note that we find a species of Cœlopleurus in the tertiaries of Alabama, and in the Londen Crag.

jecting as large lobes beyond the general outline; the whole test was made up of small limestone cells, and evidently was quite movable, though tough, in its present condition; there were deep actinal cuts in the centre of the ambulacral field, the actinal membrane unfortunately was not well preserved. The spines were very short, and bore about the same ratio to the test which they have in Astropyga and Asthenosoma. The tubercles were not yet separated from the general limestone network of the test, and the spines were arranged in the interambulacral spaces in two irregular main rows, and in one row in the ambulacral spaces, both extending to the abactinal pole. A species of a genus closely allied to Asthenosoma GRUBE has been dredged by the Porcupine Expedition off Cape Wrath and south of Cape Finistère, off Vigo; I presume this will prove to be the young of it. Professor Wyville Thomson will soon describe this species as *Calveria hystrix*, and, like several of the species first dredged by Mr. Pourtalès, and subsequently found also by the Porcupine and by the Josephine Expeditions, will add another to the list of Echini common to both sides of the Atlantic. They are the following, exclusive of the circumpolar species: —

Cidaris annulata GRAY. ? *Diadema antillarum* PHIL. *Calveria hystrix* W. THOMS. *Genocidaris maculata* A. AG. *Trigonocidaris albida* A. AG. *Echinus norvegicus* D. ET K. ? *Echinometra Michelini* DES. *Echinocyamus angulosus* LESKE (not young of Stolonoclyp. Ravenelli). *Pourtalesia miranda* A. AG. ? *Brissus columbaris* AG. *Echinocardium cordatum* GRAY. *Echinocardium ovatum* GRAY. ? *Echinocardium lævigaster* A. AG. *Brissopsis lyrifera* AG. *Lissonotus fragilis* A. AG. *Schizaster fragilis* AG.

CAMBRIDGE, April, 1871.



Quiscalus purpureus

Plate VII

Fig. 1 – 1*a*. *Quiscalus purpureus*, specimen No. 4601, ♂, from Newtonville, Mass.

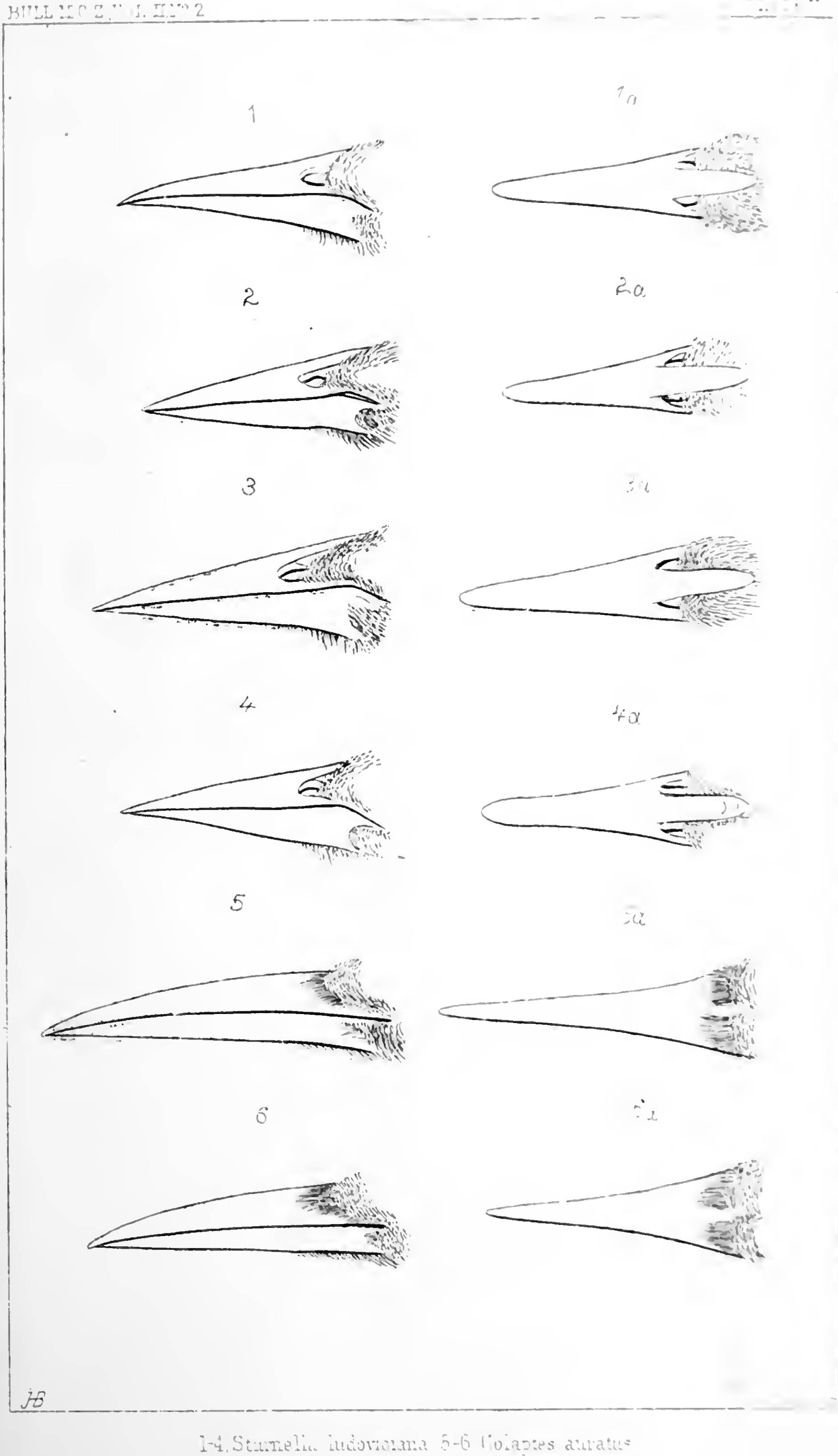
" 2 – 2*a*. *Quiscalus purpureus*, specimen No. 5201, ♂, from Welaka, St. John's River.

" 3 – 3*a*. *Quiscalus purpureus*, specimen No. 4603, ♂, from Newtonville, Mass.

" 4 – 4*a*. *Quiscalus purpureus*, specimen No. 8072, ♂, from Orleans, Mass.

" 5 – 5*a*. *Quiscalus purpureus*, specimen No. 6834, ♂, from Phillipsburg New Jersey,

" 6 – 6*a*. *Quiscalus purpureus*, specimen No. 6848, ♂, from Cape Florida.



1-4. Sturnella ludoviciana 5-6 Colaptes auratus

Plate VIII.

Fig. 1 – 1*a*. *Sturnella ludoviciana*, specimen No. 5370, ♀, from Hawkinsville, Fla.

" 2 – 2*a*. *Sturnella ludoviciana*, specimen No. 5372, ♀, from Hawkinsville, Fla.

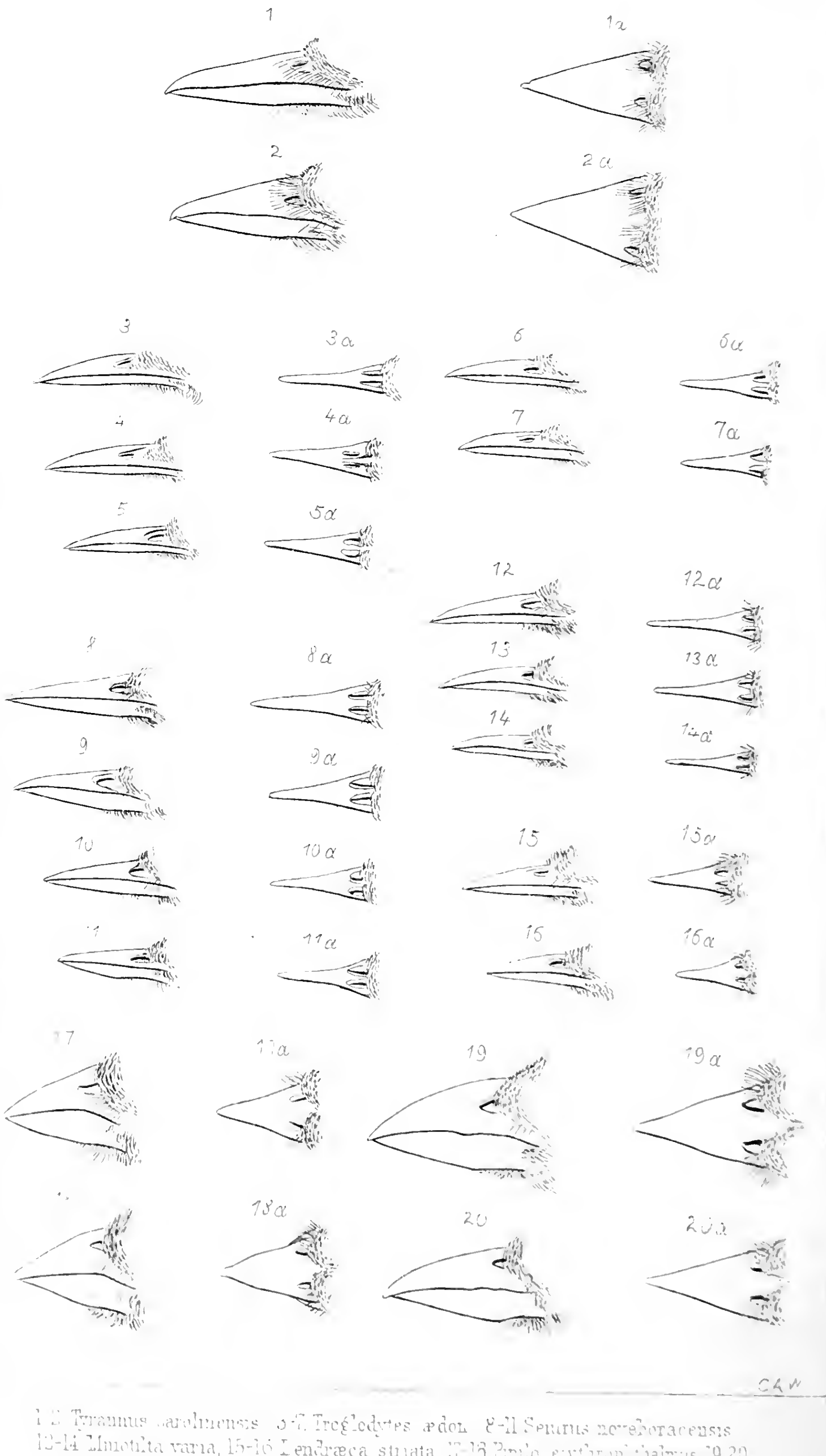
" 3 – 3*a*. *Sturnella ludoviciana*, specimen No. 5339, ♂, from Enterprise, Fla.

" 4 – 4*a*. *Sturnella ludoviciana*, specimen No. 5340, ♂, from Enterprise, Fla.

" 5 – 5*a*. *Colaptes auratus*, specimen No. 4881, ♀, from Newton, Mass.

" 6 – 6*a*. *Colaptes auratus*, specimen No. 5464, ♀, from Newton, Mass.

ERRATA. At the upper left-hand corner of all the plates, for " Bull. M. C. Z., Vol. II, No. 2," read " Bull. M. C. Z., Vol. II, No. 3."



1-2. Tyrannus carolinensis. 3-7. Troglodytes ædon. 8-11. Seiurus noveboracensis. 12-14. Mniotilta varia. 15-16. Dendræca striata. 17-18. Pipilo erythrophthalmus. 19-20. Pyranga rubra.

Plate IV.*

Fig. 1 – 1*a*. *Tyrannus carolinensis*, specimen No. 6942, from Eastern Massachusetts.

" 2 – 2*a*. *Tyrannus carolinensis*, specimen No. 6945, from Eastern Massachusetts.

" 3 – 3*a*. *Troglodytes aëdon*, specimen No. 10931, ♀, from Jacksonville, Fla.

" 4 – 4*a*. *Troglodytes aëdon*, specimen No. 10684, ♀, from Dummitt's, Fla.

" 5 – 5*a*. *Troglodytes aëdon*, specimen No. 10683, from Dummitt's, Fla.

" 6 – 6*a*. *Troglodytes aëdon*, specimen No. 5212, from Welaka, St. John's River, Fla.

" 7 – 7*a*. *Troglodytes aëdon*, specimen No. 10930, from Jacksonville, Fla.

" 8 – 8*a*. *Seiurus noveboracensis*, specimen No. 5447, from Mount Tom, Mass.

" 9 – 9*a*. *Seiurus noveboracensis*, specimen No. 1442, from Weston, Mass.

" 10 – 10*a*. *Seiurus noveboracensis*, specimen No. 6794, from Brookline, Mass.

" 11 – 11*a*. *Seiurus noveboracensis*, specimen No. 4246, from Waterville, Maine.

" 12 – 12*a*. *Mniotilla varia*, specimen No. 5148, ♂, from Jacksonville, Fla.

" 13 – 13*a*. *Mniotilla varia*, specimen No. 6806, ♂, from Brookline, Mass.

" 14 – 14*a*. *Mniotilla varia*, specimen No. 8216, ♂, from Hudson, Mass.

" 15 – 15*a*. *Dendrœca striata*, specimen No. 5052, ♂, from Watertown, Mass.

" 16 – 16*a*. *Dendrœca striata*, specimen No. 4367, ♂, from Newtonville, Mass.

" 17 – 17*a*. *Pipilo erythrophthalmus*, specimen No. 4727, ♂, from Weston, Mass.

" 18 – 18*a*. *Pipilo erythrophthalmus*, specimen No. 10721, ♂, from Dummitt's, Fla.

" 19 – 19*a*. *Pyranga æstiva*, specimen No. 10629, ♂, from Jacksonville, Fla.

" 20 – 20*a*. *Pyranga æstiva*, specimen No. 5431, ♂, from Jacksonville, Fla.

* At bottom of Plate IV, last line, for " Pyranga *rubra* " read " Pyranga *æstiva*."

Plate V.

Fig. 1 – 1*a*. *Ægiothus linaria*, specimen No. 10859, ♂, from Newton, Mass.

" – 2*a*. *Ægiothus linaria*, specimen No. 10860, ♂, from Newton, Mass.

" 3 – 3*a*. *Ægiothus linaria*, specimen No. 6392, ♂, from Fort Anderson, British America. (An original specimen of *Æ. fuscescens* Coues. — Smith. Inst., No. 43386.)

" 4 – 4*a*. *Ægiothus linaria*, specimen No. 4943, from Newton, Mass.

" 5 – 5*a*. *Ægiothus linaria*, specimen No. 3229, from Southern Maine.

" 6 – 6*a*. *Ægiothus linaria*, specimen No. 6489, ♀, from Fort Simpson, British America. (An original specimen of *Æ. exilipes* Coues. — Smith. Inst., No. 27431.)

" 7 – 7*a*. *Chrysomitris tristis*, specimen No. 6453, ♂, from Rocky Mountains, west of Denver, Colorado.

" 8 – 8*a*. *Chrysomitris tristis*, specimen No. 8125, ♂, from Springfield, Mass.

" 9 – 9*a*. *Chrysomitris tristis*, specimen No. 4925, from Newtonville, Mass.

" 10 – 10*a*. *Chrysomitris tristis*, specimen No. 4631, from Newtonville, Mass.

" 11 – 11*a*. *Chrysomitris pinus*, specimen No. 9556, from Waterville, Maine.

" 12 – 12*a*. *Chrysomitris pinus*, specimen No. 10875, from Gorham, New Hampshire.

" 13 – 13*a*. *Curvirostra americana*, specimen No. 4639, ♂, from Newton, Mass.

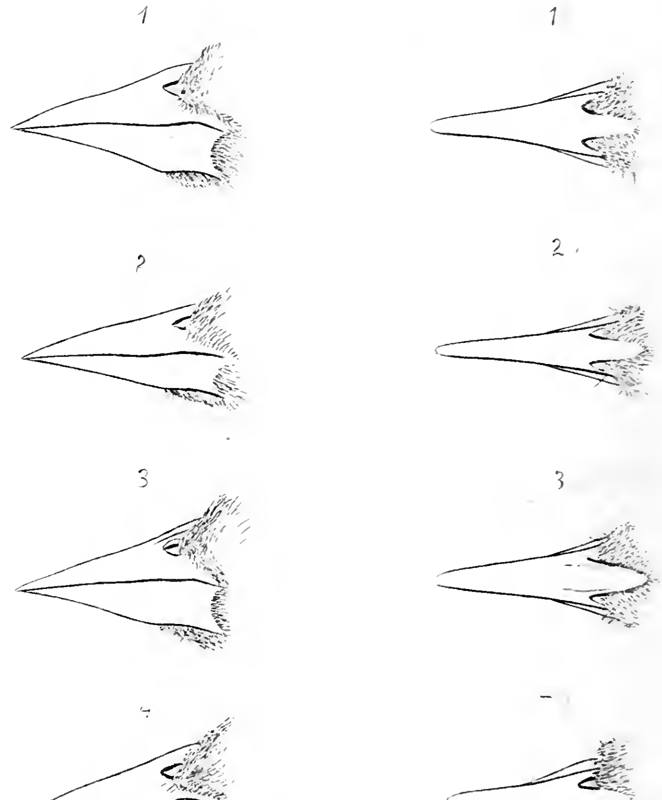
" 14 – 14*a*. *Curvirostra americana*, specimen No. 4638, ♂, from Newton, Mass.

" 15 – 15*a*. *Curvirostra americana*, specimen No. 4637, ♂, from Newton, Mass.

" 16 – 16*a*. *Passerculus savanna*, specimen No. 5084, ♂, from Ipswich, Mass.

" 17 – 17*a*. *Passerculus savanna*, specimen No. 5175, ♂, from Hibernia, St. John's River, Florida.

" 18 – 18*a*. *Passerculus savanna*, specimen No. 7119, ♂, from Henley Harbor, Labrador.



J.B. G. J. lith.

Agelaius phoeniceus

Plate VI.

Fig. 1 – 1*a*. *Agelæus phœniceus*, specimen No. 8071, ♂, from Orleans, Mass.

" 2 – 2*a*. *Agelæus phœniceus*, specimen No. 10572, ♂, from Dummitt's, Fla.

" 3 – 3*a*. *Agelæus phœniceus*, specimen No. 4589, ♂, from Newtonville, Mass.

" 4 – 4*a*. *Agelæus phœniceus*, specimen No. 8068, ♂, from Orleans, Mass.

" 5 – 5*a*. *Agelæus phœniceus*, specimen No. 10569, ♂, from Dummitt's, Fla.

" 6 – 6*a*. *Agelæus phœniceus*, specimen No. 10576, ♂, from Dummitt's, Fla.